THE ABORIGINAL MIDDENS AT BIRUBI

An account of surface collections (1964-1977) on the Aboriginal site at Birubi, near Port Stephens, New South Wales, and its subsequent excavation in 1978 and 1979.

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CHAPTER 1: INTRODUCTION

Preamble

The Aboriginal occupation site at the locality of Birubi Point is close to the ocean beach. Map 1 shows the location of the Birubi midden on the east coast of Australia, and Map 2 shows its proximity to the sheltered waters of Port Stephens quite close to the north (only 6 km to Cromarty's Bay, or 7 km to Salamander Bay). The Hunter River estuary at Newcastle is 32 km to the southwest along an open ocean beach.

At Birubi, the long sweep of the beach and tall Outer Barrier sand dunes of the Newcastle Bight terminate at two headlands of porphyritic rock. Between these two headlands there is a small sandy beach, about 120 metres long, which is known locally as Little Beach. Birubi is officially part of the township of Anna Bay and in recent years the two settlements have become contiguous, but at the time of our fieldwork Birubi was regarded as a separate locality.

Birubi is within the region traditionally owned by the Worimi people (Elkin 1932; Enright 1932). Today, the Worimi Land Council pursues an active program of recording Koori sites within their area, and I am indebted to the Land Council secretary, Lennie Anderson, for a stimulating and informative discussion about their work. The tribal way of life of the Worimi ceased within a decade or two of the settlement at Port Stephens by the Australian Agricultural Company in 1826, but we are fortunate to have accounts of their lifestyle observed by Dawson (1830) between 1826 and 1828 and by William Scott in the 1850's (Bennett 1929). These and numerous other records from the time of European exploration and settlement have been gathered together by B. Sokoloff (1973) in a B. Litt. thesis. The early records are unusually rich (see Chapter 7).

Site location

Morna Point 1:25000 map (Second Edition), grid reference 136721.

Site description

I first visited this site in 1963, when the modern-day township was still small and had not yet encroached much upon the shell middens. Map 3 shows the details of the Birubi site as I sketched it in April 1977. At the time of my first visits, I estimated the shell middens to cover 4 to 5 hectares. Since 1977, more streets and parking areas, and a caravan park, have been constructed over the main area (D in Map 3) of the middens. The middens also continued to be steadily reduced by damage from gales. By the end of 1979, the main shell middens had all been scattered, and only the areas labelled AB and C remained. These last two areas were utterly destroyed by violent windstorms during 2002.

In 1963, the most extensive shell heaps stretched across the top of low sand hills about 150 metres back from the high waterline of Little Beach. The shell layer, which was generally 10 to 30 cm thick, had long been subjected to the undercutting action of southerly storms, so that shell, flaked stone, and lumps of porphyry were strewn down the seaward face of the ridgeline. A continuous layer of undisturbed shell extended for about 150 metres parallel to the beach. Windblown sand covered the top of the shell layer, which possibly extended 30 metres back inland from the exposed face. The sand ridges terminated in low swampy ground.

In some places, in front of the intact areas of shell, there were low conical sand heaps bearing a thin scatter of shell. These heaps represented collapses of the shell midden through wind action. These collapsed, or "deflated", areas were remarked upon as long ago as 1928 by Hall (1928), and no doubt such damage by violent southerly storms has been occurring ever since the Aborigines first occupied the site. The deflated midden, on the area extending towards the beach from the existing shell layers, was 20 to 40 metres wide, and occupied a gentle slope that terminated at the edge of a shallow swale immediately behind the low sand ridge at the back of the beach. In wet weather, this swale held fresh water.

In Map 3, the part of this shell midden still intact in 1977 is labelled "Area D", the letter being chosen to coincide with the designation of the trench we subsequently dug there.

Immediately to the southwest of this Area D, on the slopes of the narrow headland, scattered shell and flaked stone were exposed amongst the rocks. Most of this area (labelled F on Map 3) was covered with drift sand and lantana scrub in the 1960's, and the considerable extent of it was not revealed until the Port Stephens Shire Council cleared the area during the early 1970's to provide road access to a beachside parking area.

Area G extended up the slopes of a massive sand dune immediately west of the narrow headland. This dune is part of the Outer Barrier system, which is a major geographical feature between Newcastle and Birubi. Although there is some loose sand on the seaward face of this dune, most of its face is made up of iron-cemented layers, and the presence of peaty layers and rotten tree-stumps indicates that there was a vegetative cover here at a not-too-distant date. These peaty layers formed sills, usually about 6 metres above the level of the freshwater ponds in the swale behind the beach dune. Flaked stone was commonplace in Area G, and in her 1928 paper Hall referred to "ovens" made up of rings of stones on this part of the site. This dune slope was for many years the terminus of the RAAF strafing and rocketing range and I have been told by Wing Commander Paul Johnson that pilots used the shell middens as targets. Following a serious accident to some boys who handled a live bomb, the lower slopes of this dune system were dug up and screened in 1972-73 to remove unexploded ammunition.

The area behind Area D consisted of low sand dunes through which off-road vehicles gained access to the beach. This sandy track has now been paved and is called James Paterson Street. On this part of "Area F" there was merely a scatter of broken pipi shell, but stone artefacts - generally microlithic - were common. Further inland from Areas D and F there were swampy areas of black soil covered with tea-tree scrub. There is no permanent stream at Birubi but water supply would have been no problem since there were extensive swamplands within a few hundred metres of the shell middens. After wet weather, surface water was available in the swale between Little Beach and the main midden (D), and probably could be obtained by digging in all seasons.

Deflated midden also extended east and southeast of Area D, up to the European cemetery, and this area (E on the map) carried a considerable scatter of burned cobbles as well as flaked stone. This midden was destroyed sometime prior to 1964, probably when Ocean Avenue was constructed to provide access to Little Beach. Further east, behind the rocky shore which forms part of Morna Point, shell could often be seen exposed on vacant house-lots and in gardens along Ocean Street. It was noticeable that these shells were species (such as tritons, turbans, and cartruts) typical of rocky shores whereas other middens mentioned here were made up predominantly of pipi shell.

The appearance of recreational beach trikes at Birubi, in 1973, led to deep tracks being cut along the southern edge of the main headland. One such track exposed a small midden (designated AB) which differed from all the others in that it contained large quantities of fish bone amongst the shell. (In my 1977 report on Birubi to NPWS, I called this the “Headland Midden”). Another midden, on the tiny tide island close to AB (see Map 4), has similar faunal remains. Behind the AB-midden, the side of the headland was blanketed by a ridge of sand, which according to local residents (in 1978) had built up in the previous 30 years. Some of the sand moved in 1977 to reveal that the main headland at Birubi was capped with a pipi shell midden, some of it apparently intact. We designated this shell capping Area C and have now partly excavated it. Scattered shell extended out to the end of this porphyritic headland.

In August 1975 I reported to NPWS an Aboriginal burial exposed in an off-road vehicle track at the base of this headland (see Map 3).

The botany of the area

The Report (dated April 1978) from Kevin McDonald, botanist, is attached (Appendix 1).

In his opinion, the excavation area at Trench D was a badly eroded frontal dune system, which formerly had been vegetated. Remnants of the original vegetation remained, and allowed him to reconstruct the former appearance, as follows.

The area was once extensively covered by associated stands of Coastal Banksia (*Banksia integrifolia*) and Coastal Tea Tree (*Leptospermum laevigatum*). This plant association may have been interrupted in the more protected swales (where the water table is closer to the surface) by small communities of the sedge *Scirpus nodosa* and small bushes of the indigenous Whitebeard (*Lencopogon* sp.).

On the seaward side, the banksia-tea tree cover would have graded into an association of Sand Spinifex (*Spinifex hirsutus*) and small plants (see Appendix 1).

Further landward from the Trench D excavation site, dune vegetation still remained in 1978, and divided into two distinct communities. In the depressions, where water is at or just below the water table, there remained a forest of Broad-leafed Paperbark (*Melaleuca quinquenervia*). The sand dunes supported an association of Rusty Gum (*Angophera costata*) and Old Man Banksia (*Banksia serrata*).

Further inland from these two communities, there was in 1978 a low open forest of Blackbutt (*Eucalyptus pilularis*) growing on the tall dunes of the Outer Barrier system.

The overall impression one gains from this botanical report is that the Birubi archaeological site was formerly well shaded, and had enough shrub and tree cover to give protection from the wind. Moreover, there was ready access to a good range of scrub and forest environments for collecting and hunting terrestial food.

The work of Lesley D. Hall

The major published work on the Birubi site is that of Hall (1928), who collected flaked stone items and gave a detailed illustrated account of them. The implements were chiefly scrapers, large backed knives (elouera in modern terminology), and the heavy choppers which are commonly known as worimi cleavers. Her main collection area was apparently D on my Map 3. Faunal remains were not part of her brief. The flake-and-blade stone implements were made of chert, nearly always grey-coloured, which she believed was traded from the Newcastle natives. Chert of this kind does occur in the sea cliffs at Newcastle (Nashar 1964: 50). Hall noted that the worimi cleavers were often made of basalt. These worimi have also been mentioned by Thorpe (1928a), and by McCarthy (1947) who analysed a sample of 24 worimi from Morna Point (as Birubi was then called).

Hall states that human burials at Birubi were said to be numerous, and she records that an extensive digging program in 1926 yielded three. I presume she is referring here to the work of the Curator of Ethnology from The Australian Museum, W. W. Thorpe (1928b). In 1984 I contacted an elderly Birubi resident, Ernie Blanch, who said he helped Thorpe "in about 1927" to excavate burials near the southern headland. (The approximate spot is marked with an asterisk on Map 3). Mr. Blanch was not able identify the exact spot, or to recall how large an area was turned over in the search for skeletons.

My own surface collections

I included the Birubi site within the framework of a general program of collecting Aboriginal stone artefacts along the Newcastle coastline. My Birubi collections, made between 1965 and 1977, have been lodged with The Australian Museum. It was clear to me from the beginning that some of the implement types at Birubi had not been discovered by Hall, perhaps because the areas in which they occur were grassed over in her time. The most notable "missing element" in her collection was that of microlithic backed blades (bondi points and geometrics). These implements were actually quite numerous in Areas F and G. Also I discovered that not all the flake-and-blade implements were made of chert: there was a small level of occurrence of other materials such as silcrete, quartzite, quartz, shale, basalt, and acid volcanics. Only the last two of these materials are found in the immediate vicinity.

With a view of establishing the range of implement types, and the proportions of each type of rock used, I changed from random collecting to total collections off limited areas of the midden. In view of Hall's assertion (Hall 1928) that even poor flakes of chert were used at Birubi because the cores had to be obtained by trading, it seemed worthwhile to compare the tool-to-waste ratios of Birubi with those at sites closer to the chert source at Newcastle.

The tool-to-waste ratios, and the total quantities of material collected, varied so widely from one visit to another, that I suspected other collectors to be active. Enquiries revealed that my suspicions were correct. Some of these other people were collecting both frequently and on a grand scale. Mrs. D.N. Carroll told me on 17/11/1978 she had collected here “after each blow” for 39 years, and I was told by one of his friends that Bob Skilton used to collect artefacts “by the sugarbagful” during the 1960’s. At least one other frequent collector, and several occasional ones, have been mentioned to me by local residents. My collecting objectives were obviously not realizable, and I gave up serious collecting in 1977. At the same time I abandoned my lithological analyses as unsatisfactory. Not being a trained geologist myself, I had relied on the help of an enthusiastic amateur. In due course I discovered many of his identifications of rock types to be in error.

Nevertheless, the surface collections had revealed some important features of the Birubi site. The AB area was very rich in fish bone but very poor in stone flakes. At the main shell middens (Area D), weathering exposed substantial amounts of waste stone flakes and stone tools, modest amounts of mammalian bone, and a little fish bone.While the stone tools at D were chiefly simple scrapers, there were a good number of elouera, and edge-ground axes turned up from time to time. Area C must have been buried in drift sand during the period of my collections, but when it showed up in 1978 (apparently after a heavy gale in October that year) its surface revealed moderate amounts of both fish bone and stone flakes.

Bondaian tools were extremely rare in Area D (only one example), and likewise only four examples were found on the deflated midden E. Not one was found on the AB or C midden areas. But these microlithic chipped-back tools were common on the deflated midden areas F and G. A local resident, Dan Carroll, told me that he found over 300 bondi points on a single visit to the dune slopes of area G. This distribution of bondaian material indicates either that such tool-making was restricted by custom to certain parts of the Birubi campsite, or that it represents the older parts of the camp. These locations F and G are both on sand dunes piled against rock outcrops, and may represent older, less mobile land surfaces. The lower dunes in area D, which are bordered by a wet swale on the seaward side and a marsh on the landward side, have probably developed quite recently.

Rapid degeneration of the site

During the 1970's the Birubi archaeological site suffered massive degeneration. Houses were built onto the eastern edge of Area D, along Ocean Avenue, Fitzroy Street, and

Robinson Avenue. There was further encroachment on the middens when the Port Stephens Shire Council provided a large parking area at the back of Little Beach, and the slopes of Area F were scraped clean in connection with landscaping. The access road to the new car park obliterated the inland end of Area F, which in any event was already severely degraded. In 1974, Cyclone Donna struck and the windstorm damage to the face of the main midden (D) was so severe that most of the shell capping collapsed and parts of the underlying ridge of sand blew away. The overall changes to the site have been so extensive that I can no longer identify some of the areas on which I made surface collections.

In 1973, recreational beach trikes cut two tracks some 0.5 metres deep across the AB-midden. While it was these tracks that first brought this midden deposit into view, they also made it vulnerable to collapse by the next heavy southerly storm. Shire Council rangers put a stop to the trike traffic but the damage was already done.

The predicted storm damage to this midden did occur. On October 2, 1978, I was invited by two local residents (Dr. Chris Brown and his wife Marie) to view the great damage which had occurred to the AB midden alongside Shelly Beach. (See Map 4). The storm damage had been exacerbated by vehicles, and it looked likely that this midden would all be dispersed within a year. I was persuaded to embark on a rescue dig as a matter of urgency. Officers of the National Parks and Wildlife Service of New South Wales agreed that this rescue dig must be started immediately, and issued Permit A3570 to me. Obtaining permission from the owners of the land was more complicated. It transpired that the AB and C areas were on land reserved to the Commonwealth Government for air traffic control, but the Port Stephens Shire Council acted as trustee and had permissive occupancy for the purposes of a public reserve. Area D was on Crown Land. Once it had been worked out who should issue permission for us to proceed, both the Lands Department at Maitland, and the Port Stephens Shire Council, were quick to grant permits.

The excavation

Excavation of the AB-midden was carried out in November-December 1978, together with a small trench in the C-midden. In January 1979 a severe gale destroyed most of the main shell midden (Area D). Only a small part of it remained for us to sample by excavation, which we did in April 1979. At the same time we extended our excavation of Area C.

Anxiety about the future of these shell middens was well founded. The small remnants of Area D collapsed within months of our excavation. The AB- and C-middens survived reasonably intact for two decades, until subjected to a violent storm in 2002. When I visited Birubi in September that year, neither of these shell middens was to be seen. I could not even find the survey pegs we had hammered in to mark our datum lines for excavation. The archaeological field work described in the following Chapters is the last that can ever be carried out at Birubi.

Studies of the artefacts and faunal remains have been taken as far as can be done with the available resources, but are far from complete. The project did not have a geologist to look at all the stone material – in fact only a few per cent of the stone items have been examined by a professional geologist, and further studies in this area would be useful. The bones of birds and mammals have not been identified, because I do not have a collection of skeletons for comparative purposes. Only the fish bone and the shellfish have been studied in detail.

All the excavated stone, bone, and charcoal material has been lodged with The Australian Museum, together with some samples of the shellfish. Thus, it is possible for others to study this material in more detail, and to obtain more radiocarbon dates. I hope that such studies will be made.

I have published a preliminary account of the excavations (Dyall 1982). There are also two reports I have made to the National Parks and Wildlife Service of New South Wales, one on the surface collections (dated April 1977) and another ("Excavations at Birubi, NSW" dated September 1979) which was a short preliminary report of the excavations. The present account supersedes all these reports and does not always agree with the conclusions reached in them.

CHAPTER 2: SURFACE COLLECTIONS OF STONE MATERIAL

I collected stone artefacts from the surface of the collapsing shell middens on 33 occasions between 1964 and 1977. Initially I was encouraged to collect by David Moore, who was then Curator of Anthropology at The Australian Museum. Later I held Permit A3570 from the National Parks and Wildlife Service of New South Wales.

I hoped, by making thorough surface collections, to achieve some of the following aims.

1. To establish the range of stone tool types at Birubi.
2. To determine whether the toolmakers preferred a specific type of rock for certain tools.
3. To establish, from tool-to-waste ratios, whether certain kinds of rock were used more efficiently than others.

Methods

When collecting artefacts, I prefer to make "total collections" on small areas of a deflated midden. In this method, *all* rock is collected from the selected area, and the sorting and identifications are made at leisure afterwards. In this way, small tools, and unmodified flakes showing use wear, are more likely to be recognized. "Total collecting" is the only way to obtain meaningful samples of waste flakes.

It has to be borne in mind that the Birubi site is a very public place, alongside a popular swimming beach. I was not in a position to stake out gridlines for these collections (some of which were made on vehicle tracks) and therefore measurements of items per square metre were not attempted. Marking the exact collection sites with posts was not an option either. During the 14 years I collected at Birubi, the area of the middens shrank considerably, until now at the time of writing (2003) there are no middens left. It is therefore difficult to pinpoint the collection areas and it must not be assumed that Map 3 is accurate.

Not long after I began collecting, it became obvious that I was a small-scale collector compared with others who were visiting these shell middens. Thus it was not practicable to calculate tool-to-waste ratios, because I would have seen few of the tools that weathered out of the shell heaps. In any event, one must accept that many stone tools made at an Aboriginal campsite would end up being lost or discarded somewhere else. The third aim listed above, therefore, is not realizable (even if one had exclusive collecting rights on a site), and the second aim is problematical. Only the first aim – to establish the range of tool types by repeated surface collecting – is achievable. With that in mind, I collected tools on a random basis as well as through "total collections".

In 1977 I decided that I was not going to learn anything further about the Birubi site by surface collecting, and I wrote a final report for NPWS (Dyall 1977). I was not to know that I would be asked to conduct salvage excavations only a year later!

Classification of stone tools

Because no straightforward and universally accepted classification of stone tools has evolved in Australia, I have fallen back on a very simple classification. Certain stone tools have been given names simply because they are easily recognized; thus we have elouera, backed blades (which include the well-known bondi point), and the edge-ground axe. For other tools I have used names based either on appearance or probable function (McCarthy 1976). The classification is largely subjective and it is best that I now provide a list. Some of these tools are illustrated in **Sketches 2-1**, **2-2**, **2-3**, and **2-4**.

Flakes and blades have been struck off a *flaking core*. I have defined blades as being more than three times as long as they are broad, while flakes have a smaller ratio of length to breadth.

Used flakes. Most had quite clearly been used for scraping, but others may have been used for cutting. These flakes have not been examined microscopically for use wear and (like the simple blades listed below) many of them might fail the criteria since set forth for a "used flake" (Flenniken and White 1985).

Blades. These are simple blades (that is, no secondary chipping) showing use wear or edge damage.

Backed blades have had one of their long edges blunted by deliberate chipping. This category is largely made up of the thin blades commonly called bondi points, but also includes some larger, heavier backed blades.

Cleavers and slices are heavy tools, sometimes called "choppers" in the literature. Often they are in the form of a massive slice hammered off a boulder, but other examples are a "core tool" shaped by knocking flakes off a cobble. I have put these two types together, because it can be difficult to distinguish them. These cleavers are commonly called "worimi" (see **Sketch 2-2**).

Elouera are sturdy flakes, trimmed on one edge until the shape is like a segment from an orange (see **Sketch 2-1**). The cutting edge, which is on the chord, is often polished by use, and sometimes has been sharpened by delicate chipping.

Geometrics are blades that have been trimmed into such shapes as crescents, triangles, and trapezoids. Like bondi points, the "backs" have been blunted by chipping, but they differ in being shorter, and almost always the "bulb of percussion" has been trimmed away. There is some overlap of "geometrics" and "backed blades", and a large geometric looks like a small elouera, but the categories are sufficiently distinct for our purposes.

Hammerstones are large waterworn pebbles, or small cobbles, with percussive damage on the ends.

Microliths are items less than 3 cm in their longest dimension.

Mortars are slabs of rock whose use for grinding and/or pounding has produced an obvious hollow in one or both of the faces. **Sketch 2-3** illustrates a well-defined example that was found at Williamtown. The Birubi examples were not well defined and have been listed later in this Chapter under "slabs, anvils, and blocks".

Mullers are smooth rounded stones bearing polish from some sort of rubbing use.

Slabs, anvils, and blocks. These heavy items are invariably made of locally-available igneous rocks, and have at least one flat surface bearing scratches and/or percussive pits. Heavy use might cause these items to be classed as mortars.

A flaking core is the remnant left after flakes have been struck from a suitable block of stone. At Birubi, most of the cores were irregular polyhedra, but three other kinds also occurred: microblade cores (see Mulvaney and Kamminga 1999: 235), scalar cores (White 1968; Flenniken and White 1985), and bipolar cores (Mulvaney and Kamminga 1999: 215). Scalar cores, which are stout flakes with heavy battering on one or more edges, are probably under-represented in my collections since these items were not generally recognized at the time most of my collecting took place. The bipolar cores are listed below as "utilized pebbles".

Utilized pebbles are flat in shape, and have been heavily battered, pitted, and chipped around the edges. The damage is too severe to have been done by use as a hammerstone. They probably represent unsuccessful attempts at bipolar flaking. In this flaking technique, the pebble is placed on a hard surface (such as a stone anvil) and then struck with a hammer (Mulvaney and Kamminga 1999: 215) (See **Sketch 2-4**). However, not all these utilized pebbles are bipolar cores: see item 3 in the list of "special items" on page 17.

Sketch 2-1. Some typical flake-and-blade tools from Birubi surface collections
All shown at actual size

Bondi points


silcrete


silcrete


chert

Geometrics

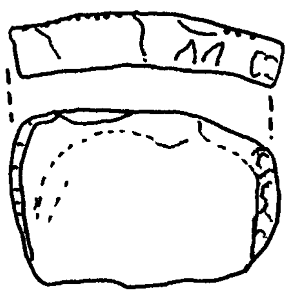

chert

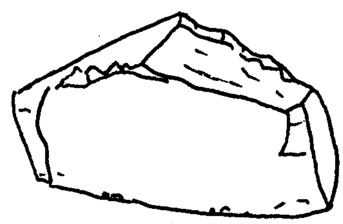

chert


silcrete


chert

Elouera

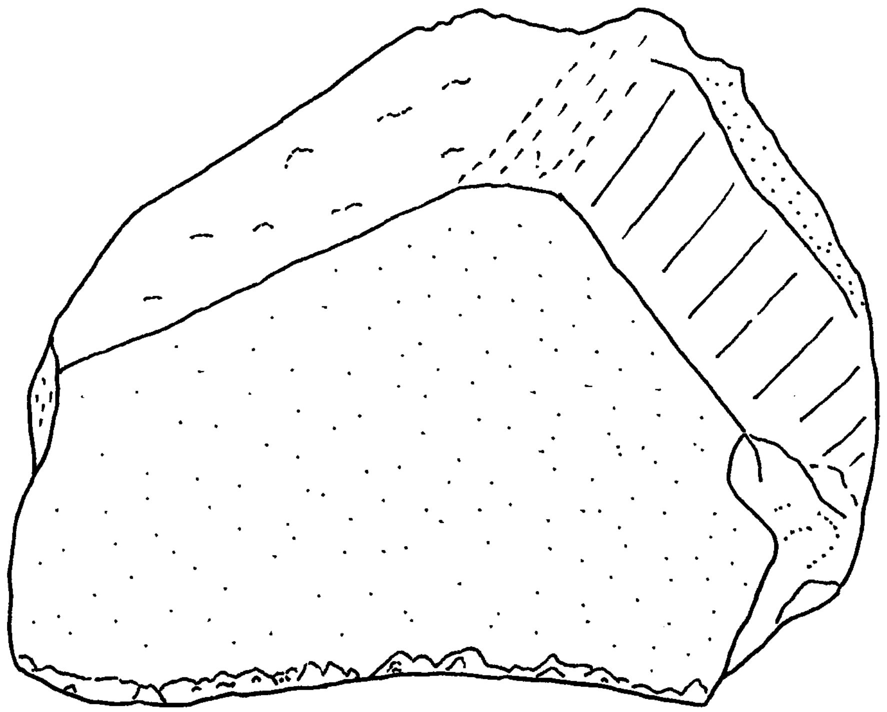

chert

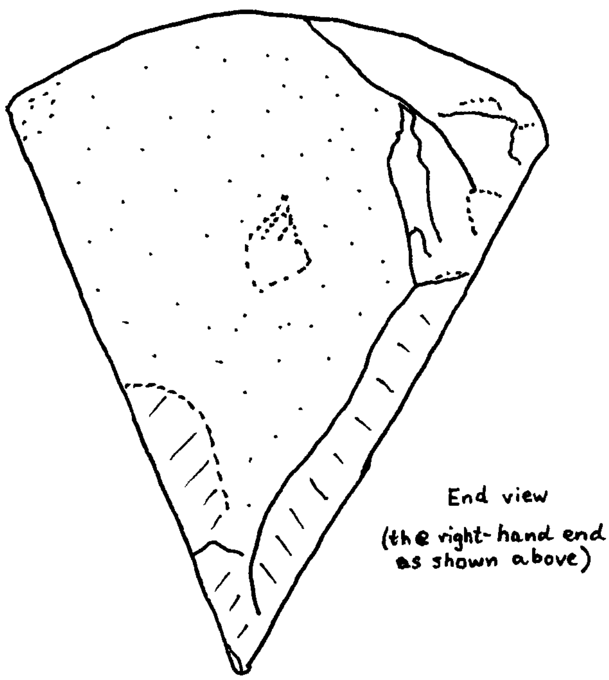

chert
The chord on the reverse
side is heavily battered.

Sketch 2-2. A worimi from Birubi

This implement was found by C. Whitehead on Area AB of the Birubi site. The material is quartz-feldspar porphyry. The chord bears a row of tiny flake scars on the face shown, but none on the reverse side. Both sides of the chord are polished by use. The broad "back" of the tool is heavily weathered.

This worimi measures 118x79x77 mm, and weighs 710 g.





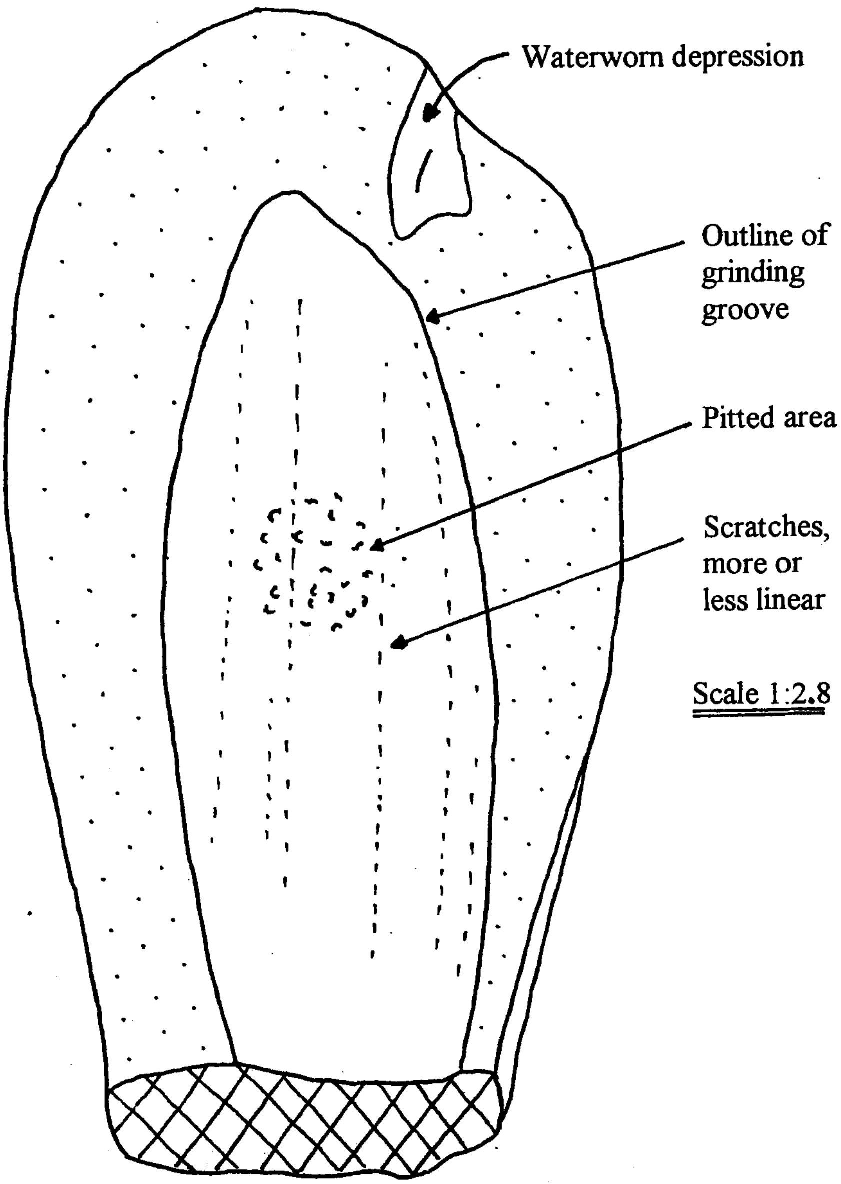
Sketch 2-3. A grinding slab from Williamtown.

Col Whitehead borrowed this item briefly from the farmer who ploughed it up, so that I could make a sketch on 23/9/1983. The farmer has since died and this implement has been lost.

This smooth, flat boulder has maximum dimensions 400x230x40 mm, and weighs 10.0 kg. The end shown with hatching had been shaped by chipping, and in addition was damaged when the slab was ploughed up.

The oval area on the face is the grinding groove. This groove has maximum dimensions 330x125 mm, and reaches as far as the chipped end. The groove is highly polished, but there is a small pitted area, and there are longitudinal scratches, though these were too faint to show up on the photograph we took.

On the reverse face, the groove is deeper, less polished, and shorter (maximum dimensions 265x110 mm), with much pitting.



The surface collection areas

The various collection areas have been described in Chapter 1, and are shown in Map 3. In my 1977 report to NPWS (Dyall 1977) the AB-midden was called "the headland midden". Midden C does not feature in any of the collections, which means it must have been covered in drift sand at those times.

The Area D collections include those I made when housing lots were prepared by bulldozing at the western end of Ocean Avenue in 1970. I have however not included some test pits I dug in December 1978 to the north of the cul-de-sac at the western end of Ocean Avenue; the location is on the border between Areas D and E in Map 3. The report on these test pits is attached as Appendix 2.

RESULTS OF THE COLLECTIONS

The numbers and types of stone tools are listed in **Table 2.1**, which is followed by a list of miscellaneous items, and another of special items.

Table 2.1. List of stone tools collected in Areas AB to G at Birubi

Item	AB	E	D	(D+F)[A]	F	G	Totals
Elouera	1	-	12	53	9	-	**75**
Used flakes[B]	-	2	67	203	68	2	**342**
Simple blades	-	4	25	98	39	2	**168**
Backed blades	-	4	1	95	104	5	**209**
Geometrics	-	-	-	24	31	-	**55**
Cleavers/slices	-[C]	-	12	33	9	1	**55**
Ground-edge axes	-	-	3	-	-	-	**3**
Hammerstones	-	-	2	7	1	-	**10**
Slabs/anvils	-	-	4	2	2	-	**8**
Miscellaneous[D]	1	-	8	3	-	-	**12**
Broken[E]	-	1	19	91	93	2	**206**
Totals	**2**	**11**	**153**	**609**	**356**	**12**	**1143**
Pebbles	16[F]	23	64	82	73	-	202
Ochres	-	-	2	1	22	1	23
Flaking cores	2	1	17[G]	70	39	9	138
Scalar cores	-	-	6	8	3	-	17
Utilized pebbles[H]	-	1	6	2	4	1	14

A My first collections at Birubi covered both these areas. It became clear that backed blades and geometrics were concentrated in Area F, and thereafter the collections from Areas D and F were kept separate.

B One-third of the used flakes are microlithic.

C Another collector has shown me a worimi cleaver that came from the AB midden (see **Sketch 2-2**).

D There is a separate listing of these miscellaneous items.

E Of these 206 items, 76 were broken backed blades, one from Area G and all the rest from the F and (D+F) areas. Three of the remaining items were broken slabs; the rest were broken flakes bearing evidence of use.

F These pebbles from the AB area included 7 of coal.

G There was also a large battered lump of basalt, which may have been either a pounding stone or a flaking core. It is not included in the numbers of either.

H Nearly all of these utilized pebbles appear to be bipolar flaking cores.

<u>Listing of miscellaneous items</u>

The following items are listed as "Miscellaneous" in **Table 2.1**.

1. Mullers/rubbing stones. The eight examples (seven from Area D, one from Area (D+F)) were all large pebbles or small cobbles bearing use-polish. The lengths ranged from 57 to 85 mm.
2. Pebble chopper. This item (?quartzite), from Area (D+F), is a flat oval pebble flaked on both ends.
3. Pick (from Area (D+F)). A heavy pointed cobble of porphyry.
4. Fish hook files. There are three of these items, as follows.
    1) From Area D: a smooth pointed pebble 53 mm long, and possibly broken at its wider end.
    2) From Area F: a short fragment of red sandstone, lying together with bondi points on a heap of broken pipi shell.
    3) From Area AB: a finger-shaped tool, broken at both ends and having a rough texture. Dr. S. Warne is reasonably sure the material is ignimbrite.

    Note that Hall (1928) recorded from Birubi a finger-shaped tool (her Plate 38, Item Z1) which is assuredly a fishhook file.

    The fishhook file shown in **Sketch 2-4** was loaned to me by a private collector. Another collector showed me a spatulate sandstone file with pronounced bevels from use; it measured 79x20x8 mm.

<u>Listing of special items</u>

These items are already included in **Table 2.1**, under flakes, axes, pebbles, or anvils.

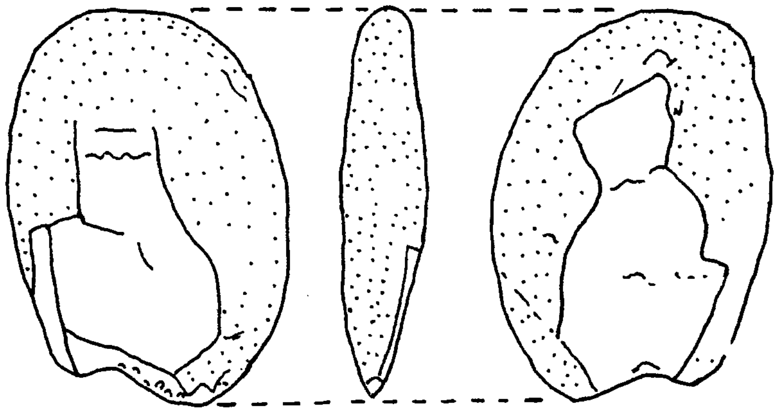
1. Edge-ground axes. These are discussed below under "Comments on the implement types". Note that I have followed common usage in calling these items "axes", though most of them are properly called "hatchets".
2. Anvils. The dimensions of two of them are as follows: 195x158x52 mm; 98x92x21 mm. These two were both of local porphyritic rock, the first coming from Area F and the second from (D+F).
3. Grooved pebble (Area D). This small flat pebble is grooved up the long axis, on both faces.
4. Drills. There are two of these triangular flake items, both from the (D+F) area. One measures 25x11 mm, and is blunted on the point and both edges. The other measures 23x10 mm and has been retouched on all three edges.
5. Adze flakes. These three flakes (two from the (D+F) area, the other from the D area) have heavy battering on their cutting edges.
6. Chisel (Area F). This blade has a chisel end, apparently used.
7. Thumbnail scrapers. Six examples of microlithic thumbnail-shaped flakes, with retouch on their curved edges, were found in Area (D+F).

Distribution of stone implement types

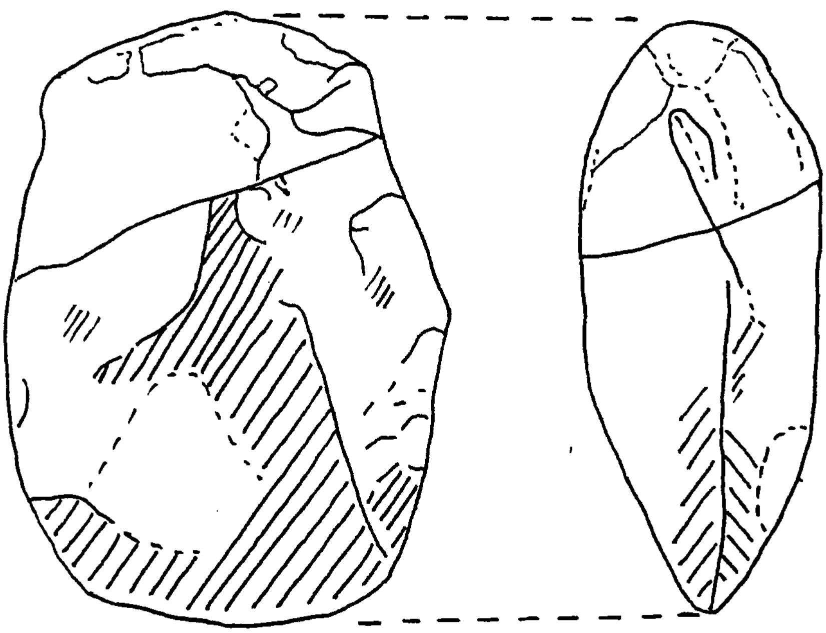
Classification of the stone tools recovered in these collections revealed some striking differences in distribution. Along a sandy vehicle track (now paved and called James Paterson Street) I found numerous microlithic backed blades, of the types commonly called "bondi points" and "geometrics". During the early years of my collecting, I found no backed blades anywhere else, though eventually one example was found on the main shell midden (Area D on Map 3), and others on Areas E and G.

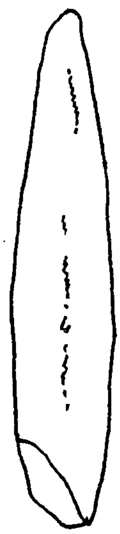
The area where backed blades were very common was segregated for collection purposes (it is Area F in **Table 2.1**) from the main shell midden (Area D). The backed blades extended from Area F on to the adjacent sand dunes at the eastern end of the Newcastle Bight (Area G), and a few were found on Area E near the modern European cemetery. These occurrences (Areas E, F, and G) are all on the slopes of low sand dunes piled against small

Sketch 2-4. Miscellaneous stone tools from Birubi



Utilized pebble of chert, probably a bipolar flaking core. The stippled area is the coroid surface of the pebble.





Edge-ground axe. The shaded areas are polished. The thin transverse line is a flaw in the rock. The reverse face is hammer-dressed as well as edge-ground.

Fishhook file
(70 x 13 x 12 mm)
Fine-grained sandstone

rocky headlands. These land surfaces are probably the first to have formed when the coastline prograded in Holocene times, and could thus be older than the rather lower sand ridges which now partly fill the swale behind Little Beach (Area D). Therefore it is possible that the backed blades represent the oldest human occupation at Birubi. These occupation zones (E, F, and G) are, unfortunately, completely deflated and there is no method currently available for dating them.

The above explanation for concentration of backed blades assumes that these artefacts predate those implement types found on Area D. For the Sydney area, Bowdler (1970) has argued that these backed microlithic blades "faded out" of the Aboriginal tool kit around 1000 years BP. However, Moore (1969) and Hiscock (1986) have argued that these microliths were manufactured to a later date in the Hunter Valley, probably up until the arrival of Europeans. I myself have collected three bondi points made of bottle glass at the Williamtown Road site. An alternative explanation for the concentration of backed blades in certain areas at Birubi is that these areas happened to be preferred by those who made such artefacts during the fairly recent occupation of this site. The preference might have been determined by some landscape feature no longer evident, such as a group of shady trees.

The AB area (which we later excavated) yielded large amounts of fish bone and shell through progressive collapse of its windward edge, but scarcely any stone material.

The proportions of the various tools listed in **Table 2.1** must not be taken to represent their relative occurrences in the Aboriginal tool kit, because we do not know the extent to which other collectors have biased the sample.

Comments on the implement types

The collections reported by Hall (1928) are generally typical of the site. I confirm her conclusion that flakes of a wide range of shapes were used for cutting and scraping purposes, and these flakes are accompanied by a strong component of elouera. The frequent occurrence of the worimi cleaver, usually made of local igneous rock, has been commented on by Hall (above), McCarthy (1947), and Thorpe (1928a), and there are 55 examples in my own collections.

I can now add some important elements to the previously-reported collections. These new elements fall into three categories. Firstly there are the microlithic backed blades, which as noted above are very common on some parts of the Birubi site. One can only assume that at the time of Hall's visit in 1928 these areas were covered with grass, scrub, or drift sand. (However, Kinsella found three bondi points at Birubi in 1935 (Swan 1970)). Secondly, there are unmodified pebbles or cobbles, which found use as hammerstones, mullers, mortars, and anvils. The third group are edge-ground axes.

Two of the axes I collected were made from quarried blanks. Both were extensively ground on the cutting edge, and the butts were heavily battered. One axe was quite small (81x 60x29 mm, and weighed only 255 g); the other was somewhat larger but its measurements are unknown because it disappeared when loaned for a school exhibition. The small axe (see **Sketch 2-4**) was examined by Dr. S. Warne, who believes it is made of acid ignimbrite, though a thin section would have to be cut and microscopically examined to be totally sure. Both Ralph Basden and I thought the other axe was made of the same material. Dr. Warne reports that the third axe was made on a cobble of dolerite, probably of local origin. I have been shown a fourth axe (held in a private collection) that was thin and broadly spatulate (155mm long, 145 mm across). This axe was grooved on both faces for the handle, and had a deep anvil pit on one face near the butt. The pale-coloured rock was so heavily weathered that I could not even guess its identity.

Worimi (see **Sketch 2-2**) were a common item at Birubi. These large items were usually triangular in cross-section, and the chord was often extensively polished by use. Some worimi had a retouched cutting edge. For the ten worimi whose measurements I have recorded, the length ranged from 69 to 122 mm, the blade-to-back dimension from 52 to 110 mm, and the thickness (across the back) from 18 to 51 mm. Weights ranged from 230 to 625g. Most of the materials were igneous, often being made of the local porphyritic rock. The worimi illustrated in **Sketch 2-2** was loaned by a private collector.

The slabs, or anvils, were invariably waterworn cobbles or boulders of the local porphyritic rock, and had presumably been selected from the cobble beaches along Morna Point. One such anvil, from Area F, measured 195x158x52 mm. Its flat top bore several marks from battering, as well as some irregular deep scratches.

Grindstones and mortars have not previously been reported from the Newcastle coastline. However, Col Whitehead has kindly arranged for me to see two unmistakable examples, which are held in private collections. The very large one illustrated in **Sketch 2-3** was ploughed up by the late Mr. Chesworth on his farm at Williamtown, between the Nelson Bay Road and the inner face of the Outer Barrier sand dunes. (The approximate location is GR 962691 on the Williamtown 1:25000 map sheet (9232-II-N), first edition). The other example, from the Williamtown-Fullerton Cove area, is a flat cobble of sandstone weighing 8.1 kg. One face has a deep, circular depression with grinding scratches around its circumference. The other face has a large, shallow, oval depression, which is polished around its outer edges but bears shallow pits in the centre. A sketch is attached (see Appendix 14).

In the light of these Williamtown mortars, one would expect similar items to be found at Birubi. I am reasonably certain that two smooth waterworn slabs of the local porphyritic rock are indeed mortars, but they have not had enough use to develop convincing usewear. Both have a shallow indentation, apparently waterworn, in one face. These slabs were presumably chosen because they already had the desired hollow face. One measured 140x104x56 mm, the other 148x92x41 mm. Both came from Area D.

The range of lithologies

Most of the flaked rock at the Birubi site is either acid volcanic (quartz-felspar porphyry or rhyolite) or chert. Ten other lithologies have also been identified (see later).

It must be emphasized that the project did not have a participating geologist. Certain rock samples were shown to various members of the Geology Department at The University of Newcastle (Associate Professors R. Offler, A. S. Ritchie, and S. St. J. Warne), whose identifications are combined into the list given at the bottom of page 20. Dr. Slade Warne has been especially helpful in recent years, but by this time nearly all the material had passed from my hands.

Chert is the commonest rock amongst the flaked material at Birubi, closely followed by acid volcanic materials such as quartz-feldspar porphyry and ignimbrite. While an amateur like myself should not make significant errors in identifying chert and quartz, the range of igneous materials, and some of the other lithologies listed above, were beyond my competence. It was suggested to me in 1964 that I have my rock samples identified by Ralph Basden, who was at that time in retirement and working as an Honorary Research Fellow in Chemistry at The University of Newcastle. Ralph put in many hours examining my stone debitage and implements, and his efforts are greatly appreciated. Only after his death in 1976 did I realize that his modest qualifications as a geologist had not always been up to the tasks I set him. In particular, "silcrete" was not in the vocabulary of a man of his advanced years, being a comparatively recent classification. It appears that he classed the silcrete samples I showed him either as "tuffs", "quartzites", or "rhyolites". Probably some of the silcrete samples had been heat-treated (Dean-Jones 1990), which would have added to the difficulties in making accurate classification.

By the time I realized that identifications of silcrete, rhyolite, quartzite, and tuff were hopelessly muddled together, the stone tools in my collections had already been lodged with The Australian Museum. The museum staff declined to accept the many thousands of waste flakes that I offered to them, which was understandable since their storage space is limited. I had no storage space either, and all these waste flakes ended up as fill in rubble drains at my former residence (10 Montrose Avenue, Adamstown Heights). It is too late now to revise the geological classifications of my surface collections of debitage, but the tools and flaking cores are in The Australian Museum and their study by a competent geologist would add a valuable new dimension to our studies of the archaeological site.

To summarize: the vast majority (>99%) of the stone artefacts have not been examined by a professional geologist. I have classified them myself in very general terms ("chert", "quartz", "igneous" and "other"). These broad classifications are used in the treatment that follows, and seem to be adequate for drawing some general conclusions.

Lithology distribution in the waste flakes and flaking cores

It was highly unlikely that other collectors were gathering waste flakes, and I therefore expected that I would be able to apply statistical methods to the overall collection of them. However, there was considerable variation in the proportions of chert in the various collections of waste flakes (see **Table 2.2**). These variations are doubtless due to individual flaking events having dominated the sample. I had hoped that pooling the total collections made on several small areas would "even out" the effects of these localized concentrations of a single rock type, but I was mistaken. Thus, statistical treatments of the data cannot be realized, and only general remarks can be made.

Table 2.2. Percentages of chert in the waste flakes from "total collections" made on the midden surface

Collection Area	Number of Items[A]	% Chert	Variations (%)[B]
D	804	39	25,51
F	3959	60	52, 59, 66, 66, 82
(D+F)	1786	71	65, 82, 95
Overall	**6549**	**60**	-

A The numbers in this column refer to items of *all* lithologies.

B These figures in this column are the percentages of chert in the total collections made on separate dates. On each date, more than one small area (5 to 10 m^2) was collected upon, and the lithic items were pooled.

In nine of the ten total collections I made, over half the waste flakes were of chert (see **Table 2.2**). (In the other collection, consisting of only 368 flakes, I deliberately chose a collection area which was seen to have a lot of non-chert debitage). Pooling all the data for total collections, we find that chert made up 60% of all the waste flakes. Thus the Aboriginal toolmakers were more likely to choose chert for flaking than any other rock type. The lithology of the flaking cores found on the site (**Table 2.3**) supports this conclusion.

The rest of the waste flakes, and flaking cores, were mostly rhyolite and porphyry, with small amounts of quartz, quartzite, ignimbrite, dolerite, silcrete, shale, and fossilized wood. It has already been noted that the identifications of these materials are incomplete, and percentages therefore cannot be calculated. Quartz made up 1.9% of the waste flakes and 1.4% of the flaking cores listed in **Tables 2.2** and **2.3**.

The 13 bipolar cores amongst the 14 "utilized pebbles" listed in **Table 2.1** deserve separate comment. Not one of them is chert. Apparently the bipolar flaking technique was reserved for other materials, which were quartz, quartzite, silcrete, shale, and acid volcanic.

Table 2.3. Percentages of chert for the flaking cores and flake-and-blade tools

Collection Area	Flaking Cores *Number of Items*[B]	Flaking Cores *% Chert*	Flake/Blade Tools *Number of Items*[B]	Flake/Blade Tools *% Chert*
AB	2	(100)	1	(100)
D	23	70	124	81
F	42	67	341	89
(D+F)	78	76	564	88
E	1	(100)	11	100
F	9	56	11	82
Totals	**155**	**74**	**1052**	**87**

A These data include casual collections as well as total collections.

B These numbers refer to items of *all* lithologies. Polyhedral cores, blade cores, and scalar cores are included in these figures. Of the 17 scalar cores, 15 were chert. The bipolar cores are discussed in the text at the foot of page 20.

Lithology distribution in the flake-and-blade tools

We have just seen that, when data for all parts of the Birubi site are combined, 60% of the waste flakes and 70% of the flaking cores are chert. The proportion of chert flake-and-blade tools is much higher than this (87%), ranging from 81 to100% for the various collection areas (see **Table 2.3**).

This is a most striking overall picture. The midden material suggests that chert was more often converted into recognizable flake-and-blade tools than the next most abundant class of raw material, the acid volcanics. Put another way, the acid volcanic materials were widely flaked, but not often found on the middens as flake-and-blade tools.

Why is this? One possibility is that local collectors preferred to pick up non-chert tools. I think this is unlikely: I have seen the major local collection and it did not have this bias. Another reason could be that the flakes of acid volcanic material found on the midden were actually struck off while shaping core tools. There is some weight to this suggestion, because more than half of the worimi are made of acid volcanic rock. However, worimi show little secondary trimming and could not explain the vast amount of acid volcanic debitage scattered across the Birubi site. It seems more likely that these locally-available acid volcanic materials were convenient sources of flakes to be used briefly in some way that left no signs of use (eg. cutting soft tissue). Alternatively, or perhaps in addition, these flakes of igneous material were used and discarded elsewhere. These possibilities will be discussed again when the excavated lithic material has been analysed (see Chapter 8).

In **Table 2.4**, the proportions of the various lithologies are shown for the 1052 flake-and-blade tools. The data in this Table make it clear that chert was strongly preferred for making all classes of the flake-and-blade tools discarded on the site. There may have been less preference for chert when making geometrics (which were sometimes made of silcrete), but one cannot be sure because the numbers are small and other collectors may have skewed the sample.

It is noticeable that chert was restricted to the manufacture of comparatively small tools. I collected only one example of a large tool (a worimi) made of chert.

Table 2.4. Use of various lithologies for different types of flake-and-blade tools

Implement Type	Chert	Igneous	Other	Total	% Chert
Elouera	69	1	5	75	92
Used flakes	290	15	37	342	85
Simple blades	158	-	10	168	94
Backed blades	175	1	33	209	84
Geometrics	41	-	14	55	75
Broken	184	-	19	203[A]	91
Totals	**917**	**17 (1.6%)**	**118 (11.2%)**	**1052**	**87**

A This total is three less than that shown for broken tools in Table 2.1, because three items there were broken slabs.

Quartz tools were rare on the site. There was one used microlithic flake from the (D+F) area, and five broken flakes from Area D probably had been used. Flake-and-blade tools made of igneous rock were uncommon (only 17 examples), and generally appeared to be made of basalt. There was a significant level of silcrete tools but, as already mentioned, there are only a few reliable identifications to hand. It is possible that silcrete was used for upwards of 10 per cent of the tools.

Items from the European Contact Period

1. Glass tools. Three shards of brown glass bearing heavy edge-use were found in the Area F, and another two in Area (D+F). Also, back in 1967, Mr. Jon Drabble showed me a rectangular piece of curved brown glass with one edge ground to form a cutting edge. It was found in my presence on Area E. Broken glass was very common on the middens, but it was impossible to establish whether it arrived there by the agency of Aborigines or Europeans. The six items mentioned here are, however, almost certainly made by Aborigines.
2. Copper nails. Nails with a square cross-section, and bent over near the pointed end, were common on the shell middens. Most of these nails had a round washer near the point, and would properly be called a rivet. These nails had probably been used in boat-building, and may have been embedded in driftwood brought to the site as firewood. No firm connection with Aboriginal people can be made.
3. Pipestems. Four pieces of clay pipestems were found in the D and (D+F) areas, and another at the AB-midden. There is no certainty of an Aboriginal connection.

CHAPTER 3: SURFACE COLLECTION OF FAUNAL REMAINS

This Chapter is based on the report entitled "Birubi" that I made to NPWS in April 1977. In that Report, the Area AB was called "The Headland Midden", and Area D was "The Mainland Midden". (See Sketch Maps 3 and 4). For the purposes of this present Chapter, the presentation of the data has been altered considerably.

I did not collect faunal material at Birubi until 1975, and discontinued in 1977. The intention of these collections was to assemble data on fish and shellfish so that the two relatively intact areas of the middens (AB and D) might be compared, and to make comparisons with the excavated material from the Swansea Channel site.

All the faunal material described here has been lodged with The Australian Museum.

Methods of identification

Shellfish. The identifications were made by comparison with illustrations in a handbook by Child (1963). I am indebted to Col Whitehead for convincing me that the items I initially identified as coneshells are actually volutes, and for updating the scientific names (Wilson 1993, 1994; Jansen 2000). Appendix 3 lists both the common and the scientific names of the shellfish found at the midden.

The data have been reduced to minimum numbers of individuals (MNI). Thus, the numbers of pipi shells (and other bivalves) have been divided by two. Many of the shells were broken, in which case any bivalve fragment with the hinge present was counted, and other fragments were ignored. In the case of chitons, the number of segments was divided by eight. Calculations of MNI of fragmentary gastropods called for a more subjective estimate of how many shellfish could account for the items collected. With turban shells, the MNI often equated to the number of operculi. For cartruts and tritons, each spire tip represented one individual and an estimate was made of how many extra individuals (if any) were needed to account for the other fragments. Limpets, if not intact, were counted whenever the fragment included the spire.

Fish. Identifications were made by direct comparison of midden material with skeletons of known fish. This method depends for its reliability on having an adequate collection of skeletons of fish known to occur in the local area. My reference collection is listed in Appendix 4, where both common and scientific names are given. While I caught some of the fish myself, I am indebted to my sons Trevor and Gavin, and to Col Whitehead, for many of them. The staff of Bollinger's Fish Shop at Garden City in Newcastle were also very helpful in providing me with heads of snapper of known weight. Dr. John Paxton at The Australian Museum gave a great deal of help and advice, and identified the less common species.

In general, fish have been identified from the toothed sections of their jaws. (Strictly these parts of the composite jaw are called dentaries for the lower jaw and pre-maxilla for the upper. I henceforth call them "jaws"). For certain species, the otoliths (a button of bone in the ear, which provides the fish with a sense of balance) were definitive. With bream and snapper, other cranial bones were also useful. The quantity of postcranial bone was very large and no attempt was made to sort it out by species, because nearly all of the individual fish that might have been so identified would already have been listed from their cranial material. Exceptions were leatherjackets and stingrays, both of which had poor survival of cranial material but did have some durable and highly characteristic spines.

For those not familiar with fish skeletons, I should remark that the characteristic tongue-shaped frontal bone of a snapper skull has a lengthwise join, and is often found split in half. The unmistakable thickened crest on top of the supra-occipital of well-grown snapper figures in many of the identifications. Like the frontal bone, it was often smashed, which suggests that the Aborigines liked to eat the large brain of these fish.

Unlike mammals, some species of fish have additional sets of teeth in the throat (pharyngeal plates) and on the palate (vomer teeth). The pharyngeal plates (one lower plate and two upper plates) of the labrid family (groper and wrasse) are often used to identify them.

Canine teeth of large fish were often found loose, and generally were not useful. However, the large canines of groper could be confidently identified. Tarwhine have one large flat molar in each jaw and I have used loose examples of these molars to identify the species when the jaws were not present.

The identifications have been reduced to MNI by figuring out how many individual fish would account for the identified bones. This procedure removes the advantage certain species (such as snapper) have by possessing quite a number of characteristic cranial bones, while others (such as mullet) have few. The sizes of individuals were taken into account when calculating MNI; thus a large left lower jaw and a small right one represented two fish, whereas a small lower left jaw and a small upper right jaw represented one fish. The details of these MNI counts will become clearer when I deal with very large numbers of fish in Chapters 5 and 11.

The fish bone was frequently fragmentary, sometimes so much so that definite identification of species could not be made.

The MNI is a useful concept in that it allows meaningful comparisons of numbers of each species. However, the MNI is certainly a lot less than the real number of individual fish represented in an archaeological sample. For many species of fish, a shoal is made up of individuals of very similar size. It follows that in the archaeological record of a catch of fish, a pair of jaws matching in size well might have come from two fish. In addition, one cannot assume that the midden contains all the bones of all fish eaten at the campsite, because both the human diners and subsequent scavengers (such as seabirds) will have dismembered the skeletons and removed parts of them, or sometimes even the entire skeleton. Allen and Guy (1984) have estimated that the number of individual fauna originally at a site may be 4 or 5 times higher than the MNI. Despite these problems, the MNI is the most useful count to use, because it allows *proportions* of various species to be measured, and these proportions are often more important than the absolute numbers.

<u>Mammals</u>. My reference collection was very limited, consisting only of one complete skeleton (ringtail possum, *Pseudochairus peregrinus*) and three skulls:a wombat (*Vombatus ursinus*), a macropod (thought to be grey kangaroo, *Macropus giganteus*), and a dog (*Canus* sp.). At the time I made these surface collections, I also had from our excavations at Swansea some mammal teeth that had been identified by an archaeological zoologist, Dr. Jeannette Hope. Overall, this reference material was not adequate for identifying much of the mammalian bone.

<u>Birds and reptiles</u>. My reference collections were extremely limited. The only bird skeleton was one of a shearwater (probably *Puffinus tenuirostris*, but possibly *P. griseus*), and there were three reptile skeletons derived from “road kills”: bluetongue lizard (*Tiliqua scincoids*), bearded dragon (*Pogono barbatus*), and an unidentified skink (*Scincidae* sp.). I also had the skeleton of a common tortoise (*Chelodina longicollis*).

THE AREA AB COLLECTIONS

The midden was on the shoreline edge of a sand dune piled against the porphyritic backbone of the headland. A vehicle track had cut into the sand to expose a 15-cm vertical bank of dark sand, from which bone and shell materials were collapsing onto the track from a face 10 metres long. The track was approximately three metres above the high-water line. The midden had been almost demolished on its southern edge by a beach-trike track, while loose dune sand had buried its northern end.

My collections were usually made from the damaged western edge of the midden, only several metres from the shoreline. The 15-cm seam of brown-black sand contained much charcoal and fish bone, but only modest amounts of shell. There were very few pieces of flaked stone. This material spilled down onto the vehicle track.

At the southern end of the exposed midden, in the angle between two vehicle tracks (see Map 4), the archaeological deposit had slumped. Wind erosion had removed the top surface to leave a layer of shell, small quantities of fire-shattered porphyry, and waterworn cobbles of black coal.

Collection of a shell sample

A total collection was made on 6 March 1977, on an area of one square metre of the shell crust left on top of the midden by wind erosion. I removed this crust of loose shell down to the underlying sand surface, which was met at depths between 2 and 5 cm. The transition from dense shell to the occasional shell of the sandy midden was very sharp. This collection would correspond reasonably well to the Level 0 in the subsequent excavations we made here (see Chapter 4). Fortunately, the collection was made several metres to the south of the trenches we dug in 1978. The shell counts are given in **Table 3.1**, together with a list of the additional species noted during other visits to this AB midden.

Table 3.1. Total shell count[A] on one square metre of the midden AB surface

Common Name	**Number of Items**	**Minimum Number of Edible Shellfish[B]**
Bonnet shell	2	-
Cartrut	28 fragments	11
Chiton	50 segments	7
Kelpshell (banded)	3	-
Limpet (keyhole)	1	1
Limpet (scaly)	5	5
Limpet (undifferentiated)	15	15
Mussel (edible)	1	1
Nerita	37	37
Pipi	298	149
Topshell (zebra)	1	1
Topshell (undifferentiated)	1	1
Triton (Spengler’s)	9 fragments	3
Triton (undifferentiated)	10 fragments	3
Turban (heavy)	1 shell, 7 operculi	7
Turban (green)	1 fragment	1
Turban (undifferentiated)	15 fragments	-
Unidentified	12[C]	1
Totals	**497**	**243**

A There were also 3 pieces of cemented tubules (*Galeolaria caespitosa*), as well as a barnacle incrustation. (Barnacles are actually crustaceans).

B “Edible shellfish” are arbitrarily taken to be over 1 cm in their greatest dimension.

C The unidentified items were 8 small operculi (one of them scorched), 3 tiny cockles, and 1 bivalve.

Additional species from other collections on the AB midden: abalone, brown mitre, cluster wink, eight-rayed limpet, Hercules club (mud whelk), and Sydney cockle.

The majority (61%) of the shellfish are seen to be pipi, which would have been collected from the ocean beach 500 metres west of Little Beach, or even 50 metres away at Little Beach itself. Nearly all the other shell species came from the intertidal zone of the rocky headlands and reefs, with neritas (15%) and limpets (9%) being quite numerous. In terms of actual meat, the large gastropods (cartrut, triton, and turban) made a significant contribution.

Some of the species are too small to have been eaten. They may have arrived on the midden attached to kelp, or to other shellfish. Such small shells may also have been blown there from the adjacent beach.

It is surprising to see Sydney cockles and mud whelks at this ocean shore. These shellfish grow in shallow estuaries. There is no estuary at Birubi today, and the only possible place for a prehistoric one would be where the D-midden is located. This D-midden has a basal date of 1445 ± 70 BP (see Chapter 6), so if there ever was an estuary, it had to be filled in before that date. The AB-midden is less than 500 years old, so these estuarine shellfish were brought here from some other locality, doubtless the tidal creeks of Port Stephens. These creeks are only 3 to 4 km distant from Birubi, to the northwest.

The species distribution in this surface-collected sample of shell (MNI 243) can be compared with the combined Level 0 samples from the subsequent excavation, where six square metres yielded an MNI of 2542. The excavated pipis averaged 67% of the shell sample (range 56-77 for the six excavated Squares), the neritas 8.5% (range 5-10), and the limpets 9% (range 3-14). The surface collection has thus given a quite fair picture of the shell content of the midden surface, though perhaps fortuitously since the excavated shell samples show such wide variations.

Bone samples

One sample came from the total collection made across one square metre on top of the midden (as described above, on 6 March 1977). Other total collections were made along the vehicle track below the west face of the midden, on five occasions between 2 October 1976 and 13 February 1977. All six collections are pooled in the listings given below.

<u>Fish bone</u>

The MNI figures are shown in **Table 3.2**. Note that these calculations of MNI for fish did not use the careful size matching of items that featured in analyses of excavated material (Chapters 5 and 11). One should not therefore try to compare data for surface-collected and excavated fish bone too closely.

<u>Bird bone</u>

The collections yielded 45 items, nearly all deeply stained. The items include one beak (matching *Puffinus*) and one pelvic girdle. The rest are various long bones, generally of *Puffinus* size though two are appreciably larger.

<u>Mammal bone</u>

Jaws: 3 items (one small jaw fragment with two tiny molars; one tiny jaw fragment with a curved canine; one tiny jaw fragment with a tooth in the end).

Other material: 60 items made up of one rather large femur head; one piece of pelvis; two large vertebrae; one long bone possibly the end of a collarbone and bearing hack marks; one large sesamoid; two ends of long bone one large and one small; three large ribs; two carpals; 18 fragments of long bones (two of them charred); and 29 slivers of long bones.

<u>Reptile bone</u>

There is one small jaw fragment with blunt rounded teeth, possibly lizard. Another small fragment of bone has a serrated edge which *may* be part of a reptile jaw but could belong to a fish.

Bone implement

There was one broken sliver of bone (20 mm long) with 12 mm of its length ground to a point.

Shell fishhook

In October 1978, while examining the AB-midden with a view to excavation, I found a shell fishhook on the surface. This large J-shaped hook was made from a heavy turban shell (*Turbo torquatus*). Both ends of the hook were broken, sufficiently long ago for the broken edges to be organically stained. The hook measured 35 mm from the broken end of the shank to the bottom of the curve, and 27 mm across the outer edges of the gape. In the bottom of the curve, the hook was 6 mm across and 2.5 mm thick. Both the inner and the outer edges had been filed.

THE ISLET MIDDEN

Across the top of these low rocks there is a ridge of tightly-compacted shell, charcoal, and ash, covering upwards of 20 square metres. The depth was uncertain, until an especially violent storm during 2002 damaged this midden and showed it to be 20 cm deep.

I examined this midden on 26 December 1976 and 9 January 1977, at which times it was compacted so firmly there was little loose material to collect. I found 109 fish bones, from which I identified one kelpfish, one leatherjacket, one snapper, and one wirrah cod. Birds were represented by three long bones, mammals by four items (two fragments of vertebrae, one charred fragment, and one bone sliver), and reptiles by one lizard jaw.

In May 1979 I noticed many fishhook “blanks” made of heavy turban shell, and in 2002 I was present when a companion found a C-shaped shell hook on the wave-damaged part of the midden.

AREA D COLLECTIONS

Total collections of the bone material were made along the collapsed face of the shell midden. The layer of shell was generally about 20 cm thick along the crest of the dunes. Wind erosion caused this shell layer to spill down the dune face, whose angle was about 45 degrees. Beach buggy traffic hastened this collapse.

Collections of bone were made on eight occasions between 1 June 1975 and 9 January 1977. These collections ranged across some 50 metres of the midden face. The glaring white slope of shell was a difficult place on which to collect in bright sunshine, and I suspect that the collections are biased in favour of larger material.

Shellfish counts

No attempt was made to do a count on these masses of shell, but pipi easily dominated. Numbers of oysters, Sydney cockles, mud whelks, black neritas, turbans, tritons, cartruts, abalone, limpets, elephant snails, volutes, and mussels were noted. These species were also seen on Area F.

Bone material

Fish bone

The collection yielded 616 bones (225 g), representing 9 species and MNI 35. Details are listed in **Table 3.2**.

Bird bone

22 long bones (15 g).

Mammal bone

239 items (295 g).

Jaws: 4 jaw fragments (three lower, one upper) of large wallaby size; 2 fragments of lower jaws of small marsupials, one probably bandicoot (*Isoodon* sp.); 1 canine of a medium-sized marsupial; 5 loose teeth, one from a large macropod; 2 dog canines, one small and one very large; 1 fragment of a small lower jaw, probably possum.
Other bones: 87 broad, curved fragments of long bones (one of them burned); 11 shafts of long bones; 13 flat chunks of bone (three of them charred); 5 ribs; 1 small vertebra; 1 small heel bone; 23 long bones with end joints, all of them snapped.
In addition there were 82 slivers of long bones, between 10 and 40 mm long, as well as the bone implement mentioned below.
Reptile bone
None

Bone implement

There was one sliver of mammalian bone, 60 mm long. Both ends were pointed and one of these ends had been ground.

Table 3.2. Fish identifications from surface collections
Numbers are given as minimum number of individuals (MNI)

Fish Species	**Area AB**	**Area D**
Black bream	6	7
Flathead	-	1
Groper	5	1
Jewfish	-	1
Kelpfish	12	-
Leatherjacket	3	3
Luderick	1	-
Morwong	1	-
Port Jackson shark	-	1
Red rock cod	5	-
Salmon trout	1	-
Snapper	40	19
Sweep	1	-
Tailor	1	-
Tarwhine	2	-
Wirrah	7	1
Wrasse	7	1
Total MNI	**92**	**34**
Number of species	14	9

COMMENTS ON THE BONE COLLECTIONS

The chief family of fish taken at Birubi were the sparids (bream and snapper), at both the AB and the D areas of the site. Several of the snapper were quite large (4 to 5 kg). The notable difference between these two parts of the site is provided by the kelpfish, which were common in Area AB but not represented at D. (See **Table 3.2**). These small rock cod feed in broken water around rocky shores, and would be difficult to spear. Kelpfish are easy to catch with hook and line, and one must tentatively conclude that angling was practised by the people who ate fish on the AB-midden. More than a year after these bone collections were completed and reported, my discovery of a shell fishhook at the AB midden made this conclusion more certain. (However, this particular hook was far too large for catching a mere kelpfish).

The two examples of well-made bone points, and large numbers of bone slivers, at both Areas of the midden, indicate that making bone points was a local industry. Scarcely any mammalian long bones were left intact. In Chapter 9 it will be argued that these bone points are in most cases the points of fish spears.

There is a wider range of fish species from the AB-midden, but that may simply be the result of having a much larger sample of fish bone. The question of range of species will be taken up in Chapter 11 when the very large samples of excavated fish bone are analysed.

The amount of mammal bone is considerable, especially on Area D, and species of a wide range of sizes are represented. There is also a modest amount of bird bone, and possibly an occasional reptile bone. The overall conclusion is that the Aborigines at Birubi had a mixed hunter-gatherer economy. While food procurement was mostly about catching fish and gathering shellfish, sources of protein from the bush were also widely exploited. It must be noted that no remains of vegetable foods survived to be collected from the midden.

The state of preservation of bone material was remarkably good, thanks to the alkaline state of the midden (see pH measurements below). Of course once the midden collapses, the bone exposed on the surface of the dune is exposed to wetting-and-drying cycles and will disintegrate. Large bones (such as those from the massive skulls of large snapper) will be more durable under these conditions, and the numbers of the various species of fish listed in **Table 3.2** may have a bias towards large fish.

pH Measurements

A sample from the midpoint of the face of the AB midden gave a pH of 8.2, which is the value expected for a midden containing wood-ash and shell. Another sample, taken from the top of the sand dune on the headland in an area free of Aboriginal material, also proved to be faintly alkaline (pH 7.6). Apparently the whole water table of this dune system is permeated with lime from the shell middens.

The pH measurements were made by adding a sample of soil (about 2 g) to distilled water (20 cm^3) and mixing with a magnetic stirrer. The pH was measured with a pH meter (calibrated with a standard buffer at pH 4.00) after 10 minutes' stirring. The reading crept slowly to higher values, doubtless due to adsorption of negatively-charged clay particles onto the electrode. The values quoted above are considered accurate to 0.2 units.

CHAPTER 4: THE EXCAVATION AT BIRUBI

The preliminaries

In Chapter 1 a brief outline was given of the events leading up to this rescue dig. The period between the decision that a rescue dig was necessary (taken on October 2, 1978) and the beginning of the fieldwork (on November 18) was distinctly hectic. I was busy enough already with The University of Newcastle's annual examinations! During those seven weeks I had been negotiating access to the land, obtaining an excavation permit, marshalling the necessary human and material resources, and arranging for Port Stephens Shire Council rangers to keep an eye on the site. Luckily I received prompt assistance from all the people involved. It helped that I had been through this exercise before, when we made a rescue dig on an important Aboriginal site at Swansea Channel in 1972.

I had also interviewed a number of Anna Bay residents in search of information about human burials at the middens. I had no wish to disturb the burials of either Aborigines or the Swedish sailors who were buried here after a shipwreck. So far as I could establish, the well-known Aboriginal burial ground at the western end of Little Beach (see Map 3) had been completely removed by W. W. Thorpe of The Australian Museum in 1926 and 1928. One informant (who chose to remain *incognito*) told B. Sokoloff in July 1977 that a storm some years earlier had eroded the sand dunes around the headland at the western end of Little Beach, and "dozens of coffins floated out to sea". I assumed that these coffins related to the shipwreck. The storm may have been the 1955 cyclone.

Human resources

The project was fortunate to enrol Boris and Sue Sokoloff, who acted as Assistant Directors throughout the excavation. Both of them had completed fieldwork training courses with The Victorian Archaeological Service. Sue Sokoloff took on the responsibility of keeping the records of what happened each day we were in the field, and it is thanks to her that we had no muddles. Boris was invaluable for training our volunteer workforce and helping me to control the excavation.

Our excavation assistants were volunteers, some of whom had worked with us at Swansea Channel in 1972. Few of the volunteers could spare the time to come to Birubi regularly, but it will be clear from the Diary of the Dig (see Attachment 1) that some came frequently. Much of the time we worked in hot and blustery conditions, and sometimes in sandstorms. Our volunteers worked cheerfully in these unpleasant conditions, and it is a pleasure to acknowledge the very high standard of the work they performed.

A project of this scale requires a number of consultants. We were fortunate to have Kevin McDonald as our botanist, and he was also a regular member of the excavation team. Barry Collier (Licensed Surveyor) took care of fixing the exact location of our trenches with respect to National Survey benchmarks.

Imants Kavalieris, the geologist who did such outstanding work for us at Swansea Channel, expected to be available but suddenly found himself working overseas. We were not able to find anyone to take his place. As explained in Chapter 8, I classified the stone material of the dig myself, sometimes with advice from colleagues in the Geology Department at The University of Newcastle. It will be related below how the arrangements for storage of the excavated material came to a sudden end in 1995, and all of it had to be shipped off to The Australian Museum before any competent geologist could devote time to it. However, while I was preparing this final Report, I received a great deal of assistance from Dr. Slade St. J. Warne, formerly Associate Professor in Geology at The University of Newcastle. While he has not viewed the excavated material, he has examined numerous stone artefacts held in private collections made at Birubi. His comments were of great value in preparation of Chapters 2 and 8.

The surface collections I had made at Birubi indicated that there would be vast quantities of faunal remains to identify. I had identified the shells and fish bone from the Swansea Heads project myself, and could do that again. We had no source of local expertise for identifying bone from mammals, birds, and reptiles; I could only hope that some means of dealing with that problem would turn up at a later date.

Finances

I made application to the Board of Environmental Studies, University of Newcastle, for a grant. The Board's Chairman, Professor F. M. Henderson, was very supportive and immediately gave me $400, which was the maximum grant the Board could award at that time. This sum was (optimistically!) supposed to cover the cost of two radiocarbon dates, the casual services of a typist, and supplies of plastic bags, heavy plastic covers, sieves, and fencing materials. I covered the other costs of the project myself, and in fact these were quite modest.

Storage

The University of Newcastle's Department of Chemistry (of which the author was then a senior member) provided storage in its basement for the excavated material from 1978 until it was all sorted in 1995. The amount of material was considerable, there being 92 large bags of it, as well as boxes of Special Finds, soil samples, and large cobbles. This storage arrangement caused some problems in December 1989, when the bags got in the way of emergency workers repairing water pipes broken in the Newcastle earthquake. Two of the bags burst when hauled out of the way, but fortunately the spillages did not overlap, no material appeared to be lost, and the bag labels survived.

In 1995 this storage arrangement came to an abrupt end. The officer responsible for enforcing Occupational Health and Safety regulations refused to accept that this archaeological material posed no threat to health, and demanded it be removed from the university premises. I would have preferred to maintain ready access to the sorted material while I wrote this Report, but I was about to take up residence overseas and had nowhere to store it privately. I am indebted to The Australian Museum's Aboriginal Collections Manager, Judith Graham, who accepted all my Birubi material into her collections. The Board of Trustees kindly waived the usual lodgement fees, which would have been appreciable.

Aims of the project

While the imminent collapse of the Birubi middens dictated an urgent "rescue dig", the excavation was partly in the nature of a research project. It was not merely a matter of rescuing whatever happened to be there. In fact I already knew with fair certainty what we would find at Birubi, thanks to the numerous surface collections I had made there (see Chapters 2 and 3).

In 1978 I was still working on the material from our Swansea Heads excavation. I would not have put that project aside for many years to excavate at Birubi unless I had thought the two projects could be usefully integrated. It was in the area of fishing technology that comparisons between the two sites looked most promising.

It is believed that shell fishhooks were introduced on the east coast of Australia about 700 years ago, or maybe 400 years earlier (Kamminga and Mulvaney 1999: 292). The material excavated from the Swansea Channel midden was all earlier than 2000 years BP, which means none of the fish represented there were caught with shell hooks. By contrast, the Birubi fish bone looked quite recent, and fishhook files had been found there: thus there was every chance that the fish catch would reflect a hook-and-line technology.

Other aims also emerged. Some are based on the picture of the site provided by the surface collections, and others derive from the intrinsic value of a rare site seen to be under threat.

1. To identify a large sample of fish bone, in terms of both species and size of individual fish, in order to establish the method(s) of fish capture.
2. To sample the copious amounts of fish bone, shell, and other faunal remains in the Birubi middens, with a view to working out the diet of the Aborigines who used this place.
3. To make comparisons of the material (especially of fish bone) from Birubi with that from Swansea Channel.
4. To place the recovered artefacts and faunal remains at Birubi in a chronological context, by means of radiocarbon dates. These dates should help to resolve whether the inhomogeneity of these middens is due to different time spans of occupation, or to selective positioning of contemporary activities.
5. To obtain samples of worked stone with which to characterize the stone industries practised on the site, and to try to identify the sources of this stone.
6. To compare the picture built up by surface collections with that yielded by excavation. (Not many sites have been studied by both methods).
7. Bearing in mind that no other undisturbed coastal midden was known to exist on the coast between Broken Bay and Port Stephens, to learn as much as possible about this Birubi site before it disappeared.

Choice of locations at which to excavate

The surface collections indicated that two quite distinct types of midden existed at Birubi. (See Map 3).

1. The AB area. This area was very rich in fish bone but not in stone material. The excellent state of preservation of the bone suggested this midden would be recent, and there was a good prospect for identifying even those fish species whose bones do not survive well in middens.
2. The D area. Here fish bone was not common, and the midden was a compacted mass of shell (chiefly pipi) containing significant levels of flaked stone.

In October 1978 I took the obvious decision to sample both these areas. I chose to excavate the AB area first, because there was little of it left and one more southerly gale might have finished it off.

Area C had at that date been exposed only recently, and I had not made any surface collections on it. The compacted pipi shell on its surface suggested similarities to Area D. Its relationship to Area AB, close below it on the headland, was not clear. The decision to excavate there developed gradually during the digging of the AB-trenches.

Site security

This matter caused anxiety at a site on such a popular beach, especially since none of our team could be there on weekdays. We could not afford fencing elaborate enough to be child-proof, and there was no telling what vandals might do. In the event we erected a notice telling people what we were doing, and strung a rope around our work area. At the end of each working day, the trenches were covered with planks, heavy plastic sheeting, and a large pile of sand. The excavation was arranged so that the deepest levels were completed and backfilled before we left at night. The Council Ranger (Mr. Maurice Clarke) and the local Honorary Ranger (Mr. Frank Skewes) undertook to keep an eye on the site. We deemed it advisable to complete the excavation before the school holidays began.

In the event, we had only minor problems with vandals. One night, children did break into the A-trench, but were apprehended by one of the rangers before much damage was done. Later, during the break between Phases 1 and 2 of our fieldwork, three of the four datum pegs we buried at the C-site were dug up.

Excavation methods

The midden material was removed by conventional methods: the soil was scraped with a small trowel, and the loosened material was sieved to recover shell, pieces of stone, fish bone, charcoal, and anything else larger than the 1/16-inch mesh of the sieve. While the sieve residues were frequently examined in the field, no attempt was made to sort them there. These residues were bagged directly off the sieves and then sorted at a later date. Details of the sorting are given in Chapter 5.

Field records of the dig

The field records of the dig are made available in this volume, but most readers would not want to read them end-to-end. I have therefore put them in the end-papers, as Attachment 1. The Diagrams and Field Sketches there are numbered as items belonging to this current Chapter 4.

Photographs exist – there are 34 of them – but these colour slides cannot conveniently be embodied here. I have of course consulted them while writing this report.

The AB-Squares

The layout of our L-shaped trench alongside Shelly Beach is shown in Attachment 1, Diagram **4-1**. Each of the excavation Squares had a side of one metre.

We first excavated Square A2. The irregular surface was removed to form a horizontal floor (maximum depth 5 cm below the surface), and then the excavation proceeded in arbitrary "spits" (that we called "Levels") of 10 cm each. The surface removal (0-5 cm depth) was called Level 0; Level 1 was from 5-15 cm depth, Level 2 from 15-25 cm, and so on. Near the top of the trench, there was a great deal of shell and the soil was quite black, but lower down the soil colours were much lighter (variously recorded as brown, grey, or yellow) and fish bone was more noticeable than shell. We found cultural material all the way down to a depth of 95 cm; a few traces were found as far down as 105 cm in this Square.

Assessment of excavation methods

Square A2 provided the "trial run" to determine what structure existed in this midden. Even before Square A2 was completed to full depth, I needed to decide how the rest of the excavation was to be done.

The profiles (see Field Sketches 6A, 6B, and 7) record lenses and strata of different colours. The lenses were sometimes quite small in area, and at other times, large enough to extend into neighbouring Squares. These lenses may have represented individual cooking events, or (in the case of the yellowish ones) the filling in of hollows in the midden surface by windblown sand and ash. The dark-coloured strata possibly represented longer phases of occupation, and the light-coloured ones might have accumulated by wind action at times when the site was unoccupied.

Ideally, such lenses and strata should be separately excavated, so that their contents can be compared and hypotheses such as the ones given above can be tested. It is best to excavate a rather large area, so that an overall picture can emerge of what took place on the living area each time the site was occupied.

In practice, I could not see how we could excavate over a large area. In the first place, there was not much of the midden left to excavate, so that we could not hope to get a picture of the whole living area. Nor could we handle the truckloads of material a large-area excavation would yield. Our grid of one-metre squares was the largest scale we could cope with.

Excavation by strata within our one-metre-wide Squares would have been achievable under ideal conditions. When first exposed, the lenses and strata were distinguishable, though the boundaries were usually quite blurred. (This blurring was probably caused by the footprints of the Aboriginal people, and by wind action, during the accumulation of the midden). In the hot and often windy conditions of November and December 1978, the freshly exposed soil quickly dried out, and the various shades of grey and brown in the soil faded until it was difficult to distinguish them. (The profiles plotted in the Field Sketches were sometimes enhanced with water sprayed from an atomizer, but even then the strata were not always well defined). At other times, heavy rain left the soil so wet that it took on a uniformly dark colour. I decided it would be impractical to satisfactorily distinguish the strata during the excavation. (Close inspection of the profiles drawn on different days, or even an hour or two apart, reveals that we were far from consistent in deciding where one stratum ended and the next one began. It is even possible that some of our "strata" reflect relative moisture levels in the soil rather than relative densities of human occupation).

We therefore excavated the midden in arbitrary Levels, exactly as described above for Square A2. The first Level (called 0) was taken down 5 cm with respect to the surface underneath the Front Datum Line, to a level bottom. Thereafter the Levels were each 10 cm deep. Occasionally one of the Levels was subdivided into two 5-cm sub-levels, in case we needed a narrower time span for a radiocarbon date. As with Square A2, all the depths refer to the surface of the midden along the Front Datum Line, and not to the Datum Level originally set along the tops of the pegs.

In these arbitrary Levels, the strata were usually mixed. Qualitatively, from my frequent examinations of sieve residues in the field, I concluded there was no invariant distinction between the contents of light and dark strata. Some of the yellow patches were indeed made up of sterile sand, but others contained more fish bone than the dark-coloured zones.

Because time was short, and the midden was straightforward to excavate by Levels, we were able to dig six of the AB-Squares in 10 field days during November and December 1978.

The cultural material

The quantities of fish bone in the midden were remarkably high, and there were large numbers of shellfish remains. Cobbles, pebbles, and stone rubble were present in appreciable amounts, but flaked stone material was scarce. The notable finds were fishhooks made of the shell of the heavy turban, *Turbo torquatus*, along with the shell "blanks" from which these hooks were made. We also uncovered four hearths, and one example of cobbles arranged to form a work-bench. These "finds" are discussed in detail in later chapters. Matters of stratigraphy, some dates, and geomorphology are presented in Chapter 6.

The C-Squares

When it became apparent that the AB-Squares would yield little information about flaked stone tools, we decided to excavate one square (Square C1) in the nearby shell midden on top of the headland (see Map 3). This midden proved to be comparatively shallow, about 30 cm deep. It contained less fish bone than the AB-midden, but rather more stone flakes.

In April 1979 we returned to Birubi for three days to excavate the D-area. Unfortunately, a recent windstorm had badly damaged that shell midden and there was little left to excavate. Therefore we extended our excavation at the C-area, and dug three more Squares (see **Diagram 4-10** in Attachment 1).

The most striking finds in the C-Squares were clusters of large cobbles, slabs, and small boulders (see Attachment 1 and Chapter 8). All the finds are discussed in later chapters.

The D-Squares

Selection of excavation site

Wind damage to the main shell middens (Area D) in October 1978 has already been mentioned. There had been another heavy gale in January 1979, and now these middens were reduced to just four small "promontories" projecting from a low ridge of sand. We could not find any undisturbed midden under this sand ridge, and its surface was scattered with remnants of a deflated midden.

The possibility of excavating on some vacant house lots near the cul-de-sac at the end of Ocean Street had already been considered (see Appendix 2). Test holes dug there showed that the Aboriginal midden had probably been cut through by wind action in the past, so that only incoherent remnants were left. Moreover, the presence of rusty iron mixed in with the Aboriginal material indicated that the midden had been disturbed. Most probably the shell layer had collapsed after being undercut by the wind. I rejected this house lot area as a site for excavation.

At the main shell midden, we selected one of the "promontories" for excavation. It consisted of a shell cap extending for 14 metres from its crumbling seaward (south) face to the loose sand dune behind. Diagram **4-11** shows the excavation grid. Initially we laid out four Squares (D1 to D4). North of D4, the shell had been disturbed by foot traffic, so that Squares D5, D6, D7 and D8 looked unpromising. We did excavate Squares D9, D10, and D11 but found their shell capping to be loosened and scattered. Our appraisal was that only Square D1, and part of D2, had escaped storm damage. This matter is further discussed in Chapter 6.

Our impression in the field was that the D-Squares contained only quite modest amounts of fish, bird, and mammal bone, but there were reasonable levels of flaked stone including some easily-recognized flake tools.

These D-trenches were 150 metres inland from Little Beach, and 280 metres from the AB-trench.

Extent of our excavations

The AB-midden. We excavated 60 % of the exposed (and still intact) midden. The inland limit of the midden is unknown, being buried under drift sand. An area equal to our excavation had already collapsed, beyond the line of Squares A5-B1-B2.

The C-midden. It is not known how far the shell midden extends under the sandhill. We excavated 40 % of the exposed midden.

The D-midden. Our trenches covered about 20 % of the midden remaining at April 1979.

The total volume of the middens at Birubi in 1965 can be very approximately estimated. Assuming the 4 hectares of midden were, on average, about 20 cm deep, the volume was 8000 m^3. Our three separate trenches sampled 8.85 m^3, which is approximately 0.1 per cent.

CHAPTER 5: SORTING AND IDENTIFICATION OF EXCAVATED MATERIAL

Sorting

The sieve residues from the excavation were made up of shells, bones, stone material, charcoal, plant roots, sand, and various minor items. Charcoal dust blackened most items and made them difficult to recognize.

Each bag of sieve residues was emptied onto a plastic sheet to dry thoroughly, and most of the charcoal dust and the sand then came free. The contents of large shells were emptied out, and yielded significant amounts of fish bone and charcoal. The upper Levels yielded a great deal of plant roots, which were picked out and then shaken to recover items caught up in them.

Large items, such as cobbles, pebbles, and most shells, were now taken out so that they would not damage other material during re-sieving. The residue was screened through a sieve with 1/16-inch mesh to remove an appreciable amount of sand. All the material caught on the sieve was now spread out on a table to be hand-sorted into the categories of stone, bone, charcoal, shell, and “special finds” (such as shell fishhooks). The categories were then further subdivided (fish bone, mammal bone, and so on).

In the early days of this sorting, the fine material that passed through the sieve was immersed in water and stirred, so that finely-divided charcoal would float to the surface. The masses of plant roots were also treated this way. I soon discovered that these flotation exercises were pointless: the weight of charcoal recovered this way was only a tiny fraction of that caught on the sieve, and it was doubtful if I could distinguish tiny fragments of charcoal from the tiny pieces of blackened pumice that floated up with them. Minute shells also floated, but were so fragile that nothing could be done with them. Only the materials from Squares A2 and C1 were subjected to flotation.

Sorting through midden material that is very dirty and mostly broken or charred requires both experience and unflagging concentration if important items are not to be missed. I decided at the outset that I should do all the sorting myself. In this way, a consistent level of item recovery was achieved, and comparisons of material from different Levels or Squares could be made with confidence. This task of sorting was a very lengthy one, taking up most of my “spare time” between 1979 and 1995. I have not kept a detailed record but I estimate that the sorting and identification of items from Birubi took me about 700 days.

At the end of each session of sorting, I was left with a heap of shell fragments to be discarded. Prior to discard, the heap was carefully re-sorted, and almost always a few important items were found.

Invariably I restricted myself to sorting and identifying material from a single Level of one Square at a time. In this way there was no possibility of a mixup.

It is difficult to maintain a consistent classification over a 17-year period. Therefore, in 1995 all the identified items were reclassified and recounted, except for the shell material, which had already been discarded.

Identification

Faunal remains

The methods of identifying shellfish, fish, mammals, birds, and reptiles have been set out in Chapter 3.

Shell rubble that did not contribute to the count of MNI (minimum numbers of individuals) was invariably discarded. The volume of counted shell was so large that only small samples of it were lodged with The Australian Museum; the rest of it was not retained.

Small chips of heavy turban shells were commonly encountered in the AB-Squares, and seem to be connected with the making of shell fishhooks. These chips were itemized and most of them were retained.

Stone material

The stone items from Squares A2 and C1 were scrubbed clean in soapy water with a nylon brush. This cleaning made it much easier to identify the lithology. However, early in the 1980's it became clear that stone tools should be left dirty, in case specialists in detection of food residues should wish to study them. The stone material from all the other Squares was rinsed in clean water to get a better look at the rock type, but was not subjected to either detergent or to scrubbing.

Level of recorded detail

The discussion that follows in Chapters 8 to 12 depends heavily on the identification of cultural items, the level of detail recorded about them, and the way in which numbers were determined. In order to make it clear what this level of detail amounted to, I now attach the record for Level 6 of Square A2. A record of this type for each Level in every Square was lodged with The Australian Museum, Sydney, in 1995.

BIRUBI
SQUARE A-2
LEVEL 6 (55 - 65 cm)

Dug 25/11/78 Medium-brown sand   Sorted December 1978   Recounted August 1995

SHELLS Retained.

Species	Item and	Number	Minimum Number
Abalone	intact[A]	2	
	spires	5[B]	
	rim fragments	38	
	other fragments	58	8
Australian horn	spire	1	1
Barnacle	intact	6	
	fragments	23	12
Cartrut	intact (rather small)	1	
	spires[C]	54	
	other fragments	124	55
Chiton	segments	86	
	fragments (<½)	4	11
Cockle (Sydney)	shell	1	
	fragments[D]	2	3
Elephant snail	intact	1	
	middle fragments	2	
	rim fragment[D]	1	4
Flame dog cockle	intact[D]	2	
	fragment[D]	1	3
Limpets	intact	33	
	spires	4	
	rim fragments	8	37
Mussels	intact	5	
	hinge fragments	8	
	other fragments	12	9
Nerita	intact	33	
	domes	123	
	openings	23	
	other fragments	36	

	operculi	54	156
Oyster (rock)	operculi	2	2
Pipi	shells[E]	345	173
Ramshorn	fragment	1	1
Sand snail	spires	30	
	fragment	1	30
Scallop	fragments	5	4
Tapestry shell	intact	1	
	fragment	1	1
Topshells[F]	intact	4	
	spires	10	
	fragment	1	14
Triton	intact	7[G]	
	spires	22	
	openings	6	
	fragments	320	29
Turban - green	intact (small)	1	
	broken open	4	
	spires	22	
	inner whorls	7	
	other fragments	135	
	operculi(≤1 cm) intact	20	
	operculum fragment	1	27
Turban - heavy	broken open	43	
	fragments (>1 cm)	312	
	chips (<1 cm)	87	
	operculi (>1 cm) intact[H]	39	
	operculum fragments	6	43
Volute	shells	2	2
	Minimum number of edible shellfish		625

[A] One of medium size and one large.

[B] Two of these are from small abalone.

[C] Four are heavily encrusted with tubules.

[D] These items do not match into pairs.

[E] Two of these pipi have been bored by a shell predator. The number includes the four shells listed under "Special Finds".

[F] Most of the topshell items are recognizable as being from Zebra topshells.

[G] Five of these shells are very small, one is small, and one is of medium size.

[H] The operculi are, like the shells, generally very large.

<u>Other shell material</u> : 64 Tubule lumps; 599 tiny shells made up of 11 australwinks, 60 barnacles, 2 cartruts, 23 volutes or coneshells, 2 flame dog cockles, 16 frilled Venus, 3 hollow carditas, 98 kelpshells, 80 limpets, 2 mussels, 3 topshells, 17 tritons, 2 turbans, 1 wedge shell, 61 unidentified bivalves, and 218 unidentified univalves. There was also one tiny operculum.

One shell of a common garden snail was also present.

BONE 867.76g made up of 4.70g bird bone, 18.04g crustacea, 842.63g fish bone, 2.37g mammal bone, and 0.02g reptile bone.

<u>Bird bone</u>

15 Items (one intact longbone; two ends of longbones; five fragments of long-bones; one broken carpal; six other bone fragments).

<u>Crustacea</u>

187 Items (12 crayfish mandibles; one claw; 15 pieces of test; 159 sea urchin spines of which 88 are "ends").

<u>Fish bone</u>

Black bream Minimum number 8 (one fish of 600g, one fish of 450g, and one fish of 400g each represented by the right upper jaw; one fish of 350g represented by the left upper jaw; one fish of 200g represented by both upper jaws and the left lower jaw; two fish of 150g represented by two right lower jaws; one tiny fish of about 100g represented by the left upper jaw and the left lower jaw).

Black drummer Minimum number 3 (three left upper jaws, one fish being well over 2kg and the other two much smaller).

Estuary cod Minimum number 1 (one right upper jaw).

Flathead Minimum number 1 (one left lower jaw from a fish of several kg).

Groper Minimum number 7 (four left upper jaws and three right upper jaws ranging from very large to medium in size and representing at least five fish; six left lower jaws and two right lower jaws representing at least seven fish; four fragments of jaws broken in storage; one small upper pharyngeal plate; one small lower pharyngeal plate; 13 loose canines).

Kelpfish Minimum number 33 (57 upper jaws arranged in nine size categories from extremely large to very small, in which the left jaws had 1, 1, 3, 2, 3, 2, 5, 9, and 7 respectively and the right 0, 1, 2, 1, 2, 2, 5, 7, and 4 respectively; 27 lower jaws arranged in eight size categories from very large to very small in which the left jaws had 0, 1, 3, 3, 2, 2, 2, and 1 respectively and the right had 1, 0, 1, 3, 1, 3, 2, and 2). There were also 6 anterior fragments of upper jaws and 2 small damaged left lower jaws.

Leatherjacket Minimum number 2 (one spine butt; three fragments of spines of which one is charred).

Mullet Minimum number 1 (one otolith).

Red rock cod Minimum number 13 (6 left upper jaws and two right upper jaws ranging in size from large to small and representing at least five fish; 8 left lower jaws and 9 right lower jaws ranging from large to small and representing at least 13 fish).

Salmon trout Minimum number 1 (one lower right jaw fragment).

Snapper Minimum number 12 (one fish of 2kg represented by the supra-occipital crest, fragments from both sides of the occipital, the right upper jaw, both lower jaws, and one otolith; one fish of 1kg represented by a right-side fragment of occipital, the right upper jaw, the right lower jaw, and one otolith; one fish of 750g represented by fragments of both sides of the occipital, the left upper jaw, and the right lower jaw; two fish of 600g represented by two right-side fragments of occipital and one right upper jaw; three fish of 450g represented by one right-side fragment of occipital, one right side of the frontal, three right upper jaws, two left lower jaws, and one right lower jaw; one fish of 375g represented by the supra-occipital crest, a right-side fragment of the occipital, the right side of the frontal, both upper jaws, and the right lower jaw; two fish of 300g represented by one supra-occipital crest, one right side of the frontal, one right upper jaw, two left lower jaws, and one right lower jaw; one fish of

	170g represented by a right-side fragment of occipital, the left upper jaw, and the right lower jaw). There were also one fragment of upper jaw, three fragments of indeterminate jaw, one fragment of occipital, one fragment of small supra-occipital crest, and two medium-sized otoliths.
Sweep	Minimum number 1 (one left upper jaw).
Tarwhine	Minimum number 1 (one right lower jaw).
Tereglin	Minimum number 1 (one otolith).
Trevally	Minimum number 1 (one small lower left jaw).
Whiting	Minimum number 1 (one large right lower jaw; one otolith).
Wirrah cod	Minimum number 8 (two left upper jaws and five right upper jaws ranging in size from large to tiny and representing at least six fish; four left lower jaws and five right lower jaws ranging from very large to small and representing at least seven fish).
Wrasse	Minimum number 16 (three left upper jaws and six right upper jaws ranging from large to tiny and representing at least six fish; ten left lower jaws and ten right lower jaws representing at least 12 fish; 18 upper pharyngeal plates of which two are charred; 15 intact lower pharyngeal plates ranging in size from very large to quite tiny and one charred fragment of another; four anterior fragments of upper jaw; one small fragment of an upper jaw; 11 fragments of indeterminate jaws two of which are charred; one charred fragment of a pharyngeal plate; two loose canines).
Unidentified	One extra number (one left upper jaw possibly from a flounder; two small crania; 11 pharyngeal plates; 32 non-sparid jaw fragments one of which is probably the left lower jaw of a salmon trout; 30 loose sparid teeth).

	Total number of identifiable fish	112

<u>Mammal bone</u>	
	4 Items (one large phalange; two fragments probably of vertebrae; one charred fragment).
<u>Reptile bone</u>	
	2 Items (two fragments of lizard jaw).
CHARCOAL	83.46g.
STONE	
Implement	1 (an elongated flat waterworn pebble, possibly of dolerite, with edge use) (29.78g).
Waste flakes	13 (one chert, wt. 13.39g; one andesite, wt. 3.41g; 11 rhyolite, wt. 37.53g).
Rubble	81 (all acid volcanics) (352.37g).
Cobbles	2 (both acid volcanics) (175.10 and 153.48g).
Pebbles	4 (two acid volcanics, wts. 10.37 and 0.29g; two siliceous, wts. 1.54 and 0.58g).
Coal	3 (all waterworn pebbles, total wt. 6.52g).
Pumice	33 (13.50 g).
SPECIAL FINDS	
Shell hooks	3 Items (one broken J-hook; one broken shaft of a J-hook; one broken tip).
Shell hook blanks	7 (all intact; one is quite small).
Utilized pipi shell	6 Items (four intact shells and two fragments).

CHAPTER 6: STRATIGRAPHY, DATES, AND GEOMORPHOLOGY

Stratigraphy and dates

The AB-Squares

When we came to excavate this shoreline midden in November 1978, only the central part was free of drift sand. The northern end of our trench line was covered with this sand to a depth of 30 cm, and the southern end by as much as 50 cm. In some places, bitou bush had taken hold. (See Field Sketch 1). We removed this drift sand to reveal the dark soil and broken shell of the midden surface. The minor bumps, hollows, and slopes of this surface were described in Chapter 4.

Excavation revealed compacted shell in the topmost Level of most Squares (A5 and B1 being the exceptions). At greater depth, the midden became very sandy, and contained varying amounts of shell, fish bone, ash, and stone rubble. This occupation material extended to depths ranging from 75 cm (Square A5) to 95 cm (Squares A2 and A4). Very small amounts of material were found up to 10 cm deeper still, but these are considered to have been trodden down into the sand dune surface by the first Aboriginal occupants.

Some degree of stratification of the occupation debris could be discerned in the wall profiles of our trenches, but we had the utmost difficulty in picking the boundaries. The colours of the strata depended on the dampness of the sandy soil, being much darker when the soil was wet. Thus we recorded different colours on different occasions, and sometimes identified more strata than at another time. (Compare Field Sketches 7 and 12). It has already been noted (see Chapter 4) that I decided not to attempt stratigraphic excavation: instead we used arbitrary "spits" that we have called "Levels".

The Field Sketches include numerous wall profiles for the AB-trenches, but for the reasons given above they do not give a consistent picture of the strata. Nevertheless there were some strata common to all six excavated Squares, even if the boundaries between these strata were vague and additional lenses confused the picture. A list of these common strata follows. The reader is cautioned not to match this list against the (arbitrary) excavation Levels, because in practice the strata varied in thickness from Square to Square and even within any one Square.

1. Between 0 and 15 cm depth (from the midden surface) there was a very dark grey, or black, layer. Except in Squares A5 and B1, there was compacted shell.
2. In most profiles, the very dark-coloured, shell-rich stratum was underlaid by a grey layer, about 10 cm thick, containing some ill-defined yellow lenses. This second stratum contained much less shell. The grey layer may be due to finely-divided charcoal that had diffused down from above, rather than to a discrete phase of human occupation.
3. Below 25 cm the soil was patchy in colour: we have variously recorded it as light brown, yellow, or pale grey. At times, we were able to pick out subdivisions in this stratum. Towards the top of this stratum, the soil was often yellowish (the colour of the beach sand). Towards the bottom the colour was brownish, and sometimes we discerned a brown layer. (See Diagram **6-2** for Square A2).
4. Below 75 cm we encountered yellow sand, about 35 cm thick. Cultural material was scarce in this layer, and nowhere extended to the bottom of it.

Soils below the levels of occupation

The yellow sand layer (number 4 above) lay on a deposit of dark brown soil, about 25 cm thick, which covered the bedrock. This dark brown soil was culturally sterile. There is a layer of similar soil right around Morna Point, and adjacent rocky coastlines, where this soil layer can be seen at the boundary between the bare shoreline rocks and the vegetation on the slopes above them.

The bedrock under our trench was composed of the red acid-volcanic rock of the headland. Under Square A2 the unbroken bedrock was 143 cm below the surface along the Front Datum Line, and 130 cm below the Rear Datum. The bedrock also formed an unbroken surface under Square B2, though here it was at shallower depth (103-110 cm). Under Square A4 there were cobbles as well as some massive rock, and there was a little broken shell. This broken, waterworn shell formed a layer beneath Square A5; there was more of it under Square B1 and under Peg 36 of Square B2. Cobbles and boulders formed a layer under Squares A4, B1, and B2.

A sample of this shell and cobble layer (108-115 cm depth) was taken from a small area under the floor of Square B1. We could not reach massive bedrock there at 115 cm depth, and in the confined space it was not practicable to dig deeper. A test hole, about 40 cm square, yielded a mass of stone rubble, pebbles, shellgrit, pumice, and large sand grains, as well as 147 shellfish of edible size, small amounts of fish and bird bone, and a tiny amount of charcoal. (See Appendix 13). Many of the shells were waterworn. This material matches that exposed at the back of the shoreline immediately south of the AB-midden, at the same level as the bedrock in our trenches. (This level is 3.4 m above HWL). The massive storm in 2002 uncovered much more of this material, some of it immediately alongside our trenches. We interpreted this material as debris tossed up by the powerful surge of prehistoric storm waves. The rock of the headland typically weathers into fissures that fill up with shellgrit, shells (many of them waterworn), cobbles, and pebbles. Such a fissure apparently lay under Squares A5, B1, and B2. There is however another possibility (see "Geomorphology" below), namely that a tsunami carried this material in and dumped it.

Whichever of these two explanations is correct, my interpretation of this stratigraphy-at-depth is that a drift of sand subsequently covered the bedrock and its thin cover of dark soil. This sand formed a convenient level area alongside the shoreline; thus the Aborigines occupied it and a midden developed.

Vertical distribution of cultural material in the midden

In the absence of well-defined stratigraphic units that could be separately excavated, we have to use other approaches to discover what changes in distribution of cultural material may have occurred during the time the midden site was occupied.

There are a number of items whose vertical distribution in the midden can be looked at: these include shellfish, bones, charcoal, flaked stone, fishhooks made of shell, numbers of identifiable fish, and stone rubble. For each of the six Squares we excavated, the occurrence (expressed as number, or weight) of the chosen item in each Level can be expressed as a percentage of the total quantity of that item found in the whole Square. The percentages found at each Level were then averaged across the six Squares to give the figures listed in **Table 6.1**, the mean deviations referring to the six percentages that were averaged for each Level. Note that Level 0, being a disturbed surface of variable thickness, has been omitted. In practice, Level 0 was very similar to Level 1.

Plotting these numbers **(Diagram 6-1)** shows some useful trends. Shellfish, bones, and charcoal are all abundant in Level 1, but their amounts fall very sharply in Levels 2 and 3. (Stone rubble is a little different, its amount falling from Level 1 to Level 2, but rising again in Level 3). At lower Levels, these "occupation markers" all increase again, reaching a maximum in Level 5 and then falling away again to virtually zero occurrence in Level 9.

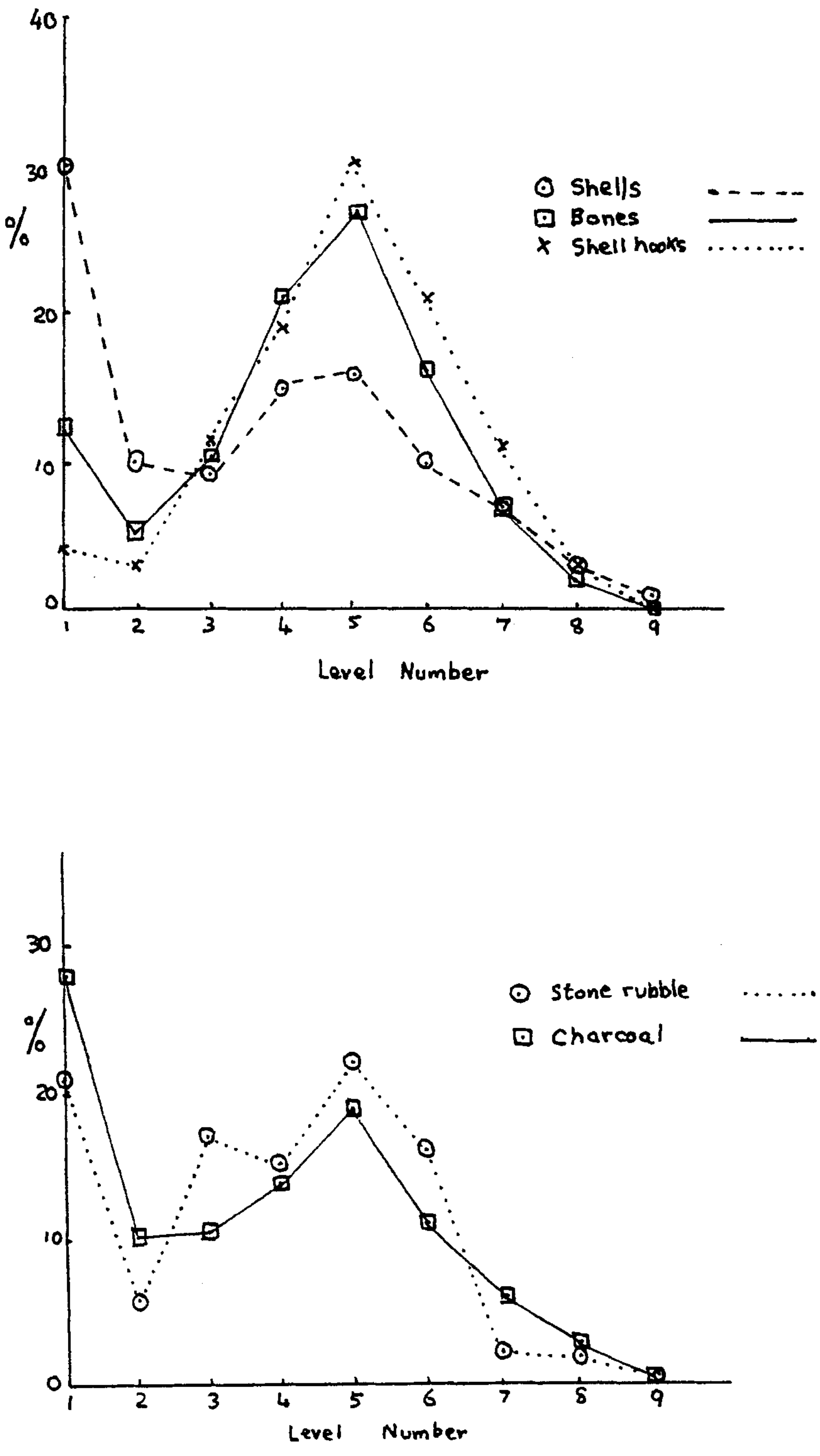


Diagram 6-1. Vertical distribution of some indices of occupation

Table 6.1. Occurrences (expressed as percentages) of occupation indices for the AB-Squares (Mean deviations are shown)

Level	Shells	Bones	Rubble	Charcoal	Shell Hooks
1	30 ± 9	12 ± 4	21 ± 7	28 ± 5	4 ± 2
2	10 ± 3	5 ± 2	6 ± 4	10 ± 3	3 ± 2
3	9 ± 5	10 ± 6	17 ± 9	11 ± 6	11 ± 8
4	15 ± 5	21 ± 8	15 ± 4	14 ± 4	19 ± 8
5	16 ± 6	27 ± 6	22 ± 11	19 ± 6	30 ± 10
6	10 ± 3	16 ± 5	16 ± 7	11 ± 2	21 ± 7
7	7 ± 2	7 ± 5	2 ± 2	6 ± 3	11 ± 13
8	3 ± 2	2 ± 2	2 ± 3	3 ± 3	3 ± 5
9	1 ± 1	-	0.1 ± 0.1	0.2 ± 0.1	-
Total items	n=28205	21.8 kg	15.8 kg	2.96 kg	n=181

Two of the items mentioned earlier are not tabulated or plotted. Fish numbers exactly parallel bone weight figures – not surprising since nearly all the bones belong to fish – while percentage numbers for the stone flakes behave erratically. The stone flake outcome is probably because the great majority of these items occur in Level 1, so that numbers in lower Levels are very small (see Chapter 8).

I do not wish to draw too many conclusions from **Diagram 6-1** – there is in fact some variation from Square to Square in the position of the maximum. (In Square A2 it is Level 6, while in Square B2 it is between Levels 3 and 4). The magnitudes of the mean variations given in **Table 6.1** also warn us to be cautious. Nevertheless, there is an overall picture to be recognized.

From the time of first occupation (Level 8), there was a steady build-up in items per 10-cm Level. Later, after reaching a maximum, the density of items declined steadily to a minimum in Level 2, after which all items (except shell fishhooks) increased sharply.

Our excavation notes remark on the patches and lenses of drift sand in Levels 2 and 3, and the minimum in artefact density in **Diagram 6-1** is readily understood. It is not necessary to postulate that the site fell into a low level of use at these Levels, merely that the midden material was greatly diluted with drift sand. Actually we cannot comment on whether there was any change in level of occupation of the site, because we do not have a series of radiocarbon dates with which to construct a depth versus age calibration curve.

The other feature of **Diagram 6-1** is that the relative levels of bone (mainly fish bone) and shell changed between Levels 5 and 1. A possible explanation is that an extended period of sand accumulation, starting around Level 4, spoiled the fishing around the reefs, and forced the Aborigines to depend more heavily on shellfish. One cannot however prove such a supposition; the levels of shell in the midden may reflect upswings and downswings in the available populations of shellfish. People who collect pipis have told me that the populations of these shellfish varied considerably during the last 50 years.

Nevertheless, this possible sanding-up of inshore reefs arises again when the fish bone is analysed in detail (see Chapter 11). Shortly we shall see that geomorphologists have actually postulated such sand movements.

There is considerable variation in amounts of shell in Level 1: as already remarked, Squares A5 and B1 have much less shell than do other Squares. It is as if these two Squares lost much of their surface layer, perhaps to stormwater runoff or to the slop of a wave breaking on the shoreline 4 m below in a particularly violent storm.

The possibility of serious storm damage to the midden

Because the AB-midden is only 12 m in horizontal distance from the present high-water line, and its lowest levels of occupation are only 3.6 m above this HWL, the possibility of damage and re-working of the deposit by storm waves must be seriously considered. The existence of swash-zone material only 0.5 m below the lowest occupation levels is indicative of this possibility.

Some criteria have been set forth by Hughes and Sullivan (1974) for deciding whether damage to shell middens has occurred. They suggest that middens less than 6 or 7 metres above the upper limit of normal wave swash are prone to re-working by storm waves, and there may be a mixture of "re-worked" and "undisturbed" material in the same midden. Their list of indicators of wave damage is made up of waterworn shell, corals, worm tubes, appreciable levels of shells either inedible or too small to eat, rounded gravels, and pieces of pumice greater than 1 cm across. In their opinion, any one of these items is sufficient to indicate that a midden-like deposit is in fact re-worked by storm waves.

In my opinion, the AB-midden is not a cultural deposit that has been re-worked by storm waves. In the Levels with occupation material, we saw no examples of waterworn shell, which is surely the most important indicator of wave surge. We found numerous examples of small shells, especially the banded kelp shell (*Bankivia fasciata*), limpets, barnacles, and australwinks (*Melarapha unifasciata*) (see Chapter 10), but one would predict such species to arrive at the midden attached to the larger shells that were brought here to eat. Kelpshells would not arrive here this way, but there are reported to be millions of them in the shallow offshore waters (Thom *et al* 1992:28) and they are a common item on the beach; thus it is not surprising that modest numbers of them have found their way onto the midden. We found no corals in the midden, but worm tubes (*Galeolaria* sp.) were reasonably common and in many cases were still attached to large edible shellfish, especially the heavy turban (*Turbo torquatus*) and the cartrut (*Thais orbita*).

Hughes and Sullivan state that rounded pebbles less than 5 cm (presumably in diameter) are rarely found in undisturbed middens, but this is not the case at Birubi. Small numbers of them occur in all three midden areas. We suggest (see Chapter 8) that some were children's playthings.

Pumice is common in the AB-midden. Hughes and Sullivan believe that small pieces (<0.5 cm) are readily moved by the wind, but that pieces larger than 1 cm arrive at midden sites by wave action. While I think they under-estimate the ability of gale-force winds to move objects, it so happens that the pieces of pumice we found were all small. (See Chapter 8).

Taking an overall view of the criteria of Hughes and Sullivan, it has to be said that one is forced to take a subjective view about which levels of small pebbles, tiny shells, and pumice indicate that waves have surged across the midden. Only the presence of waterworn shell strikes me as definitive. In our case the most compelling evidence against wave surge at the AB-midden is that waterworn shell is absent. The other items are present, but one must note they also occur in middens C and D where the arrival of storm waves is impossible. (D is 180 m from the beach and 7 metres above HWL; C is 38 m from the present HWL and 8 m above it). Geomorphologists consider that the shoreline was further seawards a few centuries ago (see later in this Chapter).

It is perhaps surprising that the AB-midden avoided wave damage for a period of 500 years. However, the common storms here come from the south-east (Thom 1992:14), and there are two rocky outcrops close inshore to break the force of waves driving in from that direction. In addition, the shoreline is thought to have been further seawards for most of the lifetime of this midden. Nevertheless, as mentioned earlier, it is possible that wave slop (or maybe rainwater runoff) removed the shell capping from Squares A5 and B1. In 2002, luck ran out for the small remnant of the AB-midden: it was destroyed in a violent windstorm by what appears to be a combination of wind and rainwater. The same storm did a great deal of damage to the compacted shell midden on the nearby islet (see Map 4).

The possibility that the AB-midden was formed by slippage and stormwater wash from the sloping sandhill behind it must be considered. Such a mechanism of formation would considerably mix up the original midden deposit. We found four examples of cobbles arranged to form a hearth, and another of cobbles arranged to form a workbench (see Chapter 8), and these arrangements of stones are not consistent with re-deposition. Moreover, when there was a distinctive fish (such as a very large snapper or groper, or one of the uncommon species), we often found a number of its bones in the same Square and Level.

I am satisfied that the AB-midden has accumulated through continued deposition of cultural material, without major disturbance by weather factors, and can therefore yield meaningful dates. Later in this Chapter, I raise the possibility of tsunamis at Birubi, but it appears that this AB-midden post-dates such events.

Radiocarbon date

I decided to date the lowest level of significant occupation in Square A2. **Table 6.2** shows the vertical distribution of shells, bones, charcoal, shell fishhooks, and shell hook blanks.

Table 6.2. Vertical distribution of some occupation indices in Square A2

Level	Shells (MNI)	Bone (g)	Charcoal (g)	Shell hooks (number)	Hook blanks (number)
1	3073	571	341	0	0
2	883	296	124	1	0
3	377	150	50	1	4
4	536	392	56	2	6
5	459	658	90	8	6
6	625	868	83	3	7
7	474	881	63	16	10
8	470	319	91	6	9
9	77	10	4	0	0
10	3	0.4	0.2	0	0

These data show that there was no substantial occupation before Level 8; indeed the small amount of cultural material in Levels 9 and 10 has probably been trodden down from above. Level 8 also marks the earliest date at which shell fishhooks (and the shell "blanks" from which they were made) appeared on the AB-midden. Level 8 corresponds to the bottom of a poorly-defined brown layer, immediately above the yellow sand on which the midden began to accumulate. The profile accompanying submission of the dating sample (**Diagram 6-2**) corresponds with Field Sketch 7 for the Rear Datum wall.

The dating sample was pipi shell from Level 8 (75-85 cm below the surface). This Level yielded 481 pipi shells (*Donax deltoides*) with the bivalve hinge present. About half these were intact shells, and from them a random sample of 37 was selected. These shells were scrubbed in warm water (no detergent) with a soft nylon brush to remove dirt. After air-drying the sample (submitted as Birubi-1) weighed 178g. The Sydney University Radiocarbon Laboratory followed their usual procedure of dissolving 10-15% of the shell mass away with dilute hydrochloric acid, to remove surface contamination.

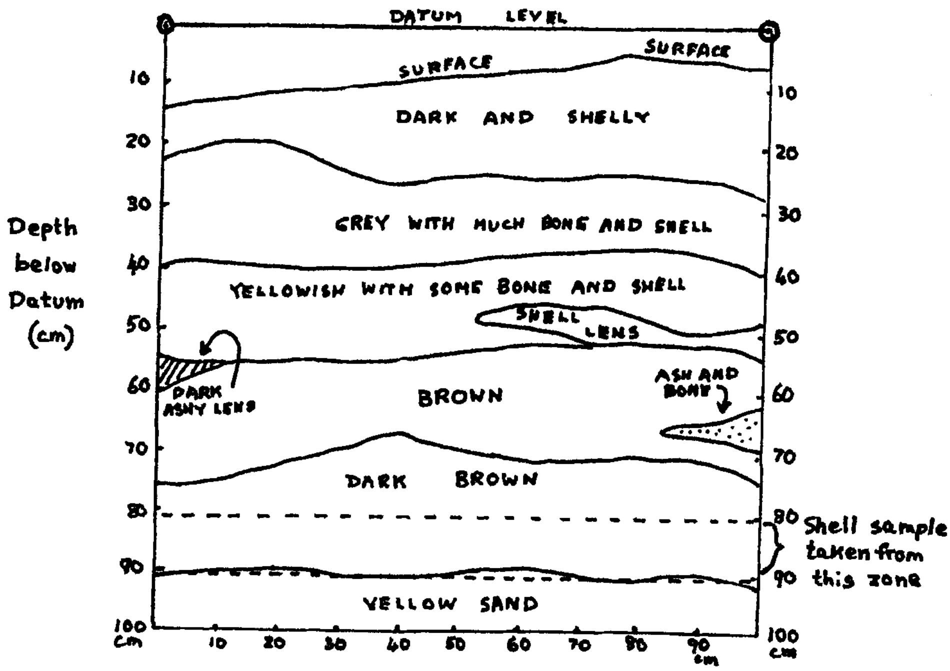


Diagram 6-2. Location of pipi shell sample used for dating (Birubi-1)

The date reported (SUA-1160) was 1240 ± 80 BP. Unfortunately this date (which is not corrected for the "reservoir effect") has passed into the literature. Several years later, the dating laboratory discovered a systematic error in some of their dates, apparently connected with the precise shape of the sample vial used in the radiation counting. The revised date for our sample is 940 ± 90 BP. When corrected for the "reservoir effect" which must be applied to shell samples (Gillespie and Temple 1977) this date becomes **490 ● 90 BP**.

The AB-midden is, then, very recent. Since "Present" is defined as 1950 AD, and the midden was probably not occupied after about 1850 AD (see Chapter 7), it has accumulated in a period of just 400 years.

The C-Squares

For the peg designations in the following discussion, refer to **Diagram 4-10**. The letters and numbers in parentheses refer to the 1978 excavation; the other designations are the 1979 version.

Stratigraphy

The amount of stratigraphic detail perceived was a function of the weather. On 15 December 1978, when we excavated Square C1, the soil was very damp. The northern wall profile (Pegs Z to 14, see Field Sketch 23) recorded only one occupation stratum ("dark (black) and shelly") overlying sterile yellow sand. When we excavated the adjoining Squares C3 and C4 on 22 April 1979, the soil was dry and we perceived that the black shell mass faded in colour to brown towards its bottom (Field Sketch 27, profile for Pegs 1→2→13). This lower band of brown was also seen in Square C2 (Field Sketch 26). The transition from black to brown was gradual, and probably reflected the amount of finely-divided carbon present. I do not think the "black" and "brown" zones represent separate occupation levels; in effect there is one continuous occupation layer. We saw none of the lenses that were a feature of the AB-trenches.

Along the profile a(Z) →1(14) →2→13 the midden surface was virtually level across Square C1, but sloped significantly down to the eastern end of Square C4; the total drop was 30 cm. The underlying, sterile, yellow sand had the same slope as the midden surface, and I assume that this yellow sand represents the sandhill on which the midden accumulated. The midden was fairly thin, about 25 cm. The black mass of shell and soil was particularly thin in the Peg 13 corner of Square C4 (Field Sketch 27), but the underlying brown layer was correspondingly thicker than usual.

On the southern side of this row of three Squares (profile b(Y) →4(15) →3→12, in Field Sketch 27) the surface sloped slightly uphill (by 5 cm) across Square C1; there was then a small drop (8 cm) across Square C3 and a much larger one (14 cm) across C4. The area around our Peg 4 had been disturbed by the vandals who dug out our Datum Peg, but in general this profile shows a shell mass with black soil, about 20 cm thick, which faded into a brown layer some 5 cm thick above sterile yellow sand. Again the slope of the surface matched that of the underlying sterile sand mass.

Careful comparison of Field Sketches 23 and 27 reveals a discrepancy of 5 cm in vertical levels. This discrepancy occurs because the Datum Peg placed in December 1978 was removed by vandals. The levels were reset in April 1979 using the one peg remaining in Square C1. It so happened that before we left the site in December 1978 this peg (called Y then, but re-named "a" in 1979) had been hammered down flush with the midden surface to hide it, and the midden surface was 5 cm lower than the Datum Level.

The vertical distributions of some indicators of occupation are shown in **Table 6.3**. Amounts are expressed as MNI (minimum numbers of individuals), or numbers, or weights, as convenient. It is seen that there is little cultural material below Level 2. Probably the small quantities in Level 3 (and Level 4 in one instance) were trodden down from higher levels during the early history of the midden. As Hughes and Lampert (1977) have pointed out, this "treadage" ceases once there is enough shell and other debris to form a firm cap on the midden. The profile plots generally have the dark-coloured stratum ending near the bottom of Level 2.

Table 6-3. Vertical distribution of some indicators of occupation.

Square/Level	Shells (MNI)	Bone (g)	Waste Flakes (number)	Stone Rubble (g)	Charcoal (g)
C1/0	1742	300	19	243	52
C1/1	3176	171	75	1363	26
C1/2	1477	35	103	405	10
C1/3	136	5.8	10	23	1.6
C2/0	1129	198	15	312	29
C2/1	2735	153	27	1112	21
C2/2	1311	38	23	893	10
C2/3	76	4.1	4	42	1.6
C2/4	9	-	-	-	-
C3/0	1203	257	8	119	23
C3/1	1484	184	45	1088	23
C3/2	914	51	41	1876	8
C3/3	105	7.3	17	162	1.8
C4/0	1148	116	44	363	6.3
C4/1	1449	150	39	926	18
C4/2	482	27	29	519	7.7
C4/3	69	5.7	14	60	1.4

In this Table, Level 0 (the surface clean-off) has been included. In thickness, this Level was only 5 cm (the other Levels being 10). When allowance is made for this reduced thickness, the density of occupation debris in Level 0 appears to match or even exceed that in Level 1. However, I do not think it wise to make much use of the data for Level 0. Even though this shell midden had been exposed to view only in 1978 when gale-force winds moved its cover of drift sand, the surface was strewn with rust flakes and glass. There was also a brass tack and a rifle bullet of .22-inch calibre. Clearly this was not the first occasion on which this midden had been exposed during recent historical times. In view of the presence of such modern items, it was not possible to identify any material from the Aboriginal-European contact period. Moreover, this surface Level may include pipi shell and fish bone from European occupation during the Great Depression.

Special features

There was a notable cluster of cobbles and small boulders in Level 2 of Squares C3 and C4 (see Field Sketch 25), and another in one corner of Square C1 (**Diagram 4-9**). Some of these clusters were thought to be work-benches. (See Chapter 8). There were no clusters of cobbles we thought to be hearths.

Dating of the earliest occupation

The dating sample was taken from Square C1 (15-25 cm depth). **Diagram 6-3** shows the relevant stratigraphy, which is the Peg Z-Peg 14 profile in Field Sketch 23. Level 2 has the earliest evidence for occupation at this C-midden, the material in Level 3 being considered "treadage".

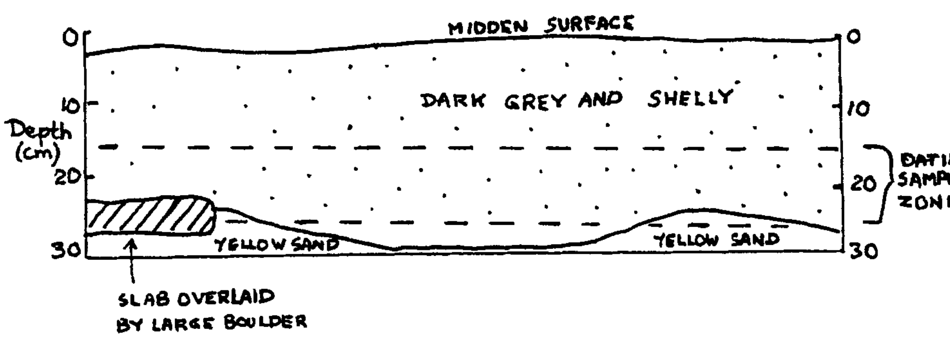


Diagram 6-3. Location of the dating sample Birubi-3 in Square C1.

The 996 pipi shells from Level 2 were selected, and the 129 intact shells were taken. These shells were arranged in 11 rows (12 to each, with the last row incomplete) and the third shell in each row was picked out. It was noted that 8 of the pipi shells amongst the 129 retained colour, and 4 of these ended up in the final sample.

The selected shells were washed in warm water (no detergent) with a soft nylon toothbrush, to remove dirt. The washing was twice repeated, each time with fresh water. The shells were then air-dried. This shell sample (211.5 g) was submitted for radiocarbon dating as Birubi-3.

The reported date (SUA-1806) was 1790 ± 80 BP, which after reservoir correction becomes **1340 ± 80 BP.** Because the sample was taken from a fairly broad range of depth (10 cm), the date of first occupation will be slightly older.

There are shell fishhook "blanks" (some of them with trimmed edges) in Level 2, but no examples of shell hooks were found in any of the C-Squares. If we accept these hook blanks as certain precursors to shell hooks, and rule out any possibility of stratigraphic disturbance, then this is a very early date for shell fishhooks. I am not convinced on either point. "Trimmed edges" on a shell fragment could arise from scraper use, and with just one date from the Square, we do not have a depth-with-age profile. Stratigraphic disturbance cannot therefore be ruled out. It is also to be noted that the tiny shell chips associated in large numbers with the shell hooks in the AB-Squares were rare in the C-Squares, and only one was found in C1 Level 2. These few chips could be accidentally formed when opening heavy turban shells.

The D-Squares

Square D1 was covered with a continuous layer of compacted shell (mixed with brown soil), varying in thickness from 2 to 14 cm (see Field Sketch 29). Over most of the Square, this seam of shell formed the surface, but in the Peg "g" corner it was covered with 10 cm of loose brown sand. This seam of shell merged into the underlying light-brown sand, in which there was very little shell. Below the light-brown sand, by the time 25 cm depth was reached, we encountered the sterile yellow sand of the dune on which this Aboriginal midden had accumulated. The underside of this layer of brown soil was irregular, probably reflecting the bumps and hollows of the original sandhill.

The boundary between shell mass and brown soil was poorly defined, which is why I elected to excavate this midden in arbitrary Levels.

The vertical distribution of "occupation indicators" for Square D1 is shown in **Table 6.4.** The occupation material was quite scarce once we excavated to the bottom of the shell layer, whose deepest portion extended into the top of Level 2.

Table 6.4. Vertical distribution of occupation indicators in Square D1

Level no.	Shells (MNI)	Bone (g)	Waste flakes (number)	Stone rubble (g)	Charcoal (g)
0[A]	1369	23	59	358	7.5
1	2942	62	126	628	37
2	430	21	47	61	10
3[B]	37	1.1	4	0.8	2.6

A Level 0 was dug to a depth of 5 cm, the others to 10 cm each.

B In the field, we found occupation material only around Peg "a", and then only around the top of this Level. The rest of this Level was sterile.

One can put forward two explanations for this scarce material being present at all in Levels 2 and 3.

1. Nearly all the shell has been dissolved away by groundwater at these deeper levels, leaving only bone, stone, and charcoal to represent the earliest occupation of the site.
2. The bottom of the shell layer represents the oldest occupation. However, some of the earliest occupation material to be discarded on the soft sandhill would get trodden down into the sand. This "treadage" would continue until there was enough discarded shell and other material to form a hard surface (Hughes and Lampert 1977).

I believe the evidence falls in favour of the second explanation. The shells at the bottom of the seam, and in the sandy layer beneath, looked quite fresh – not at all like the survivors of chemical leaching that had destroyed their fellows. The sharp diminution in quantities of *all* types of discarded material below Level 1 is perfectly consistent with the "treadage model".

The set of data in **Table 6.4** for Square D1 is supported by the corresponding set for Square D2 (**Table 6.5**).

Table 6.5. Vertical distribution of occupation indicators in Square D2

Level no.	Shells (MNI)	Bone (g)	Waste Flakes (number)	Stone Rubble (g)	Charcoal (g)
0	1707	44	136	891	13
1	3365	102	142	528	29
2	392	11	11	24	8.2
3	29	0.7	2	0.04	0.4

The compacted shell extended out from the common edge with Square D1 to a distance of 60 cm across D2, but some of it was covered with loose drift sand. Further north of this compacted shell layer, across Squares D3 and D4, the midden surface was broken up and loose. This deflation was much more serious in Squares D5 to D8, which we judged not worth excavating. In **Table 6.6**, data for Square D4 is presented for comparison with D1 and D2. Within Level 0, the shell count is seen to be greatly reduced in D4, and most of the sand mixed with the shells was yellow, whereas in D1 and D2 it was brown. There can be no doubt that the midden in Square D4 has been broken up and scattered.

Table 6.6. Vertical distribution of occupation indicators in Square D4

Level no.	Shells (MNI)	Bone (g)	Waste Flakes (number)	Stone Rubble (g)	Charcoal (g)
0	292	13	146	777	6.4
1	43	4.9	35	391	4.1
2	7	0.9	4	0.4	1.3

We excavated Squares D9, D10, and D11, but again there was evidence of deflation of the midden. In all these deflated Squares, the excavated material contained masses of grassroots, showing that the shell layer had been stable and coherent until quite recently.

Radiocarbon date

Of all the D-Squares, D1 was the only one whose shell layer was undisturbed across the whole Square. We chose to date a sample of pipi shell, which we excavated from 15-17 cm depth (see the Peg "g" – Peg "h" profile in Field Sketch 29). This shell came from close to Peg "g", that being the only part of the Square where compacted shell reached down to this depth. The intact shells were sorted out and built into a conical pile, and then 30 shells were taken out of one quadrant. These 30 shells (total weight 135 g) were scrubbed in warm water (no detergent) with a soft nylon brush to remove dirt.

This sample (our Birubi-2) gave an uncorrected radiocarbon date (SUA 1161) of 1895 ± 70 BP. After reservoir correction, the date becomes **1445 ± 70 BP**. Assuming it is correct that material deeper in the midden got there by treadage, this date indicates when substantial occupation at this part of the Birubi site first occurred. The date is not significantly different to the one obtained for early occupation in Square C1.

Single dates like this one cannot be regarded as very reliable estimates of "first occupation". As Coutts (1966) has pointed out, middens on open sites grow outwards horizontally with time. I have no way of telling whether our Square D1 was located in the middle of the original occupation site (that is, on its earliest part) or on its outer fringe. There were, in 1979, no other undisturbed parts of the Area D that we could excavate and date. Of course a similar uncertainty applies to our dates for Squares C1 and A2.

Structures

There were no stone-built hearths or work-benches in the D-Squares. In Square D4, Level 1, a roughly circular patch of charcoal and grey ash (see Field Sketch 30) is assumed to have been a small fireplace.

In D11 there was an "ashpit", containing a large amount of charcoal, often in large lumps. This pit extended below Level 2. It was probably a cooking pit though I could not rule out the possibility that the stump of a small tree had burned out here.

The midden surface

The loosened surface of nearly all these D-Squares meant that recent European rubbish was mixed into the Aboriginal midden. There was a great deal of this rubbish, mostly rusty iron and broken glass. Occasional shotgun pellets and small-calibre (.22-inch) rifle bullets and cartridge cases indicated that the area had been used as a shooting gallery. Moreover, a local informant (Mrs. D. Carroll) told me that during the Great Depression of the 1930's, numerous out-of-work people built shanties in this D-area and eked out an existence as best they could. Undoubtedly they collected and ate pipis. It would therefore be unwise to date pipi shell from the surface of this midden. Certainly the "squatters" left a great deal of rubbish behind them, and that created immense difficulties when we looked for evidence of the Aboriginal-European contact period. We excavated no items that could be reliably assigned to this contact period.

How intact was the D-midden?

The question must be asked whether the "intact" Squares (D1 and most of D2) were in fact undisturbed. My "test pits" on the housing lots (see Appendix 2) provided evidence that the midden there had collapsed and then reconsolidated, so that some of the European rubbish lay at the *bottom* of the shell layer. The housing lot midden had been exposed to the wind by adjacent road building.

A shell midden perched on a sand dune undergoes wind destruction by a process of undercutting. When enough sand has been blown away, the overhanging shell layer collapses. The shell may later reconsolidate and, if the dune on which it originally lay should be blown away, the shell may form a capping on another (but necessarily lower) dune. This shell capping would look "original".

By 1979 I had observed progressive wind demolition of the Birubi middens over a period of 15 years. The collapses had begun on the seaward side (from which the most violent windstorms blow), and progressed steadily inland, over a distance of about 40 metres. Square D1 was close to the landward edge of the midden, and I judge it had not yet been undercut. The vertical distribution of material (see **Table 6.4**) also looks normal, which might not be the case for a reconsolidated midden. There can however be no absolute certainty that Square D1 is an undisturbed midden. It is unfortunate that there were no other remnants of the once extensive D-midden that we might have dated.

Later in this Chapter, additional concern about the stratigraphic integrity of the D-midden is raised under the heading "Effects of tsunamis".

Soil pH measurements

The pH of 21 soil samples was measured (see Appendix 12). The variations in pH which attended the stirrer being on or off, and with changes in the time of measurement, indicate that one should not attempt to interpret small differences in the measured values. The variations probably arise from colloidal particles attaching to the electrode of the meter.

The general picture is that the midden soil is weakly alkaline, which is to be expected with so much shell and ash present. Movement of groundwater in the sand dunes has resulted in all the soil samples being weakly alkaline, even two (the first and last entries) that were not directly associated with the Aboriginal midden.

Geomorphology

The sand dune system along Newcastle Bight has been extensively studied by geomorphologists during the last 30 years. During that time, the size of the database has steadily increased and the overall picture of geomorphic events has been refined. A summary of data and conclusions was published by Thom and other authors in 1992 (Thom 1992), and a version specifically relating to archaeology has been written by Dean-Jones (1990).

It is generally agreed that the postglacial marine transgression of the sea ceased about 6500 years ago, and that sand began to prograde the shoreline from about 6000 years ago. These beach dunes encroached onto the southern edge of the bedrock at Morna Point (Thom 1981:347) – that is, at Birubi Point. The top of this sand deposit (now buried) has been located in boreholes near Anna Bay village, and two dates are available (5380±105 BP and 6070±130 BP) (Thom 1992:128 and 130).

Along Newcastle Bight, this sand deposit was buried by three successive transgressive dune ridges, which today form the Outer Barrier system. The earliest of these sand movements is older than 4000 BP. Later (from about 3000 until 1500 BP), a surge in wind activity built a second longwalled ridge. A third phase of beach dune instability began 800 – 400 years ago, with retreat of the beachfront and erosion of the foredune (Roy, Thom and Bowman 1981). This last date was later refined to "less than 500 years ago" (Thom 1992:365), largely on the basis of a date of 300±70 BP from the stump of a tree which died as a result of these recent sand movements. The two older dune ridges are now stabilized by vegetation, but the erosion of the beach dunes is an ongoing process and the present foredunes may be less than 100 years old (Thom 1992:121).

Dean-Jones (1990) provides a very clear framework for the phases of dune ridge development. She analyses the Newcastle Bight landscape in terms of three dune transgressions dated from approximately 4500 BP, from 2300-1200 BP, and from 300 BP. The geomorphologists quoted above, who actually developed the time framework, were less specific about the dates, pointing out that the second period could not be dated for the Newcastle Bight (Thom 1992:142). (The dates 2300-1200 BP actually come from further north, at Seal Rocks). In subsequent discussions I shall use Thom's broad estimates of 3000-1500 BP for the second of the three most recent major sand movements.

The ever-changing nature of their sandy homeland must have had profound effects on the resident Aborigines. During periods of active sand movement ("blowouts") some of the landscape would have been covered with bare sand, and the new land surfaces would have needed many years to revegetate. Shoreline erosion, thought to accompany these phases of active sand movement (Roy and Crawford 1980), would have had serious effects on the availability of marine food. During the most recent phase of sand movement (say from 500 BP) the shoreline is believed to be retreating at 1 to 2 metres a year (Roy and Crawford 1980). There can have been little continuity, from generation to generation of the Aborigines, in the locations of some campsites, and in areas suitable for hunting, fishing, and gathering.

I can discover no detailed geomorphologic study of Little Beach and Birubi Point, and it would be difficult now to make one with the area so much altered by residential and recreational developments. In general terms, since Little Beach is wide open to the prevailing wind and ocean swell from the southeast, the major sand movements observed for the long open beach of the Newcastle Bight must have occurred here also. Exact conformity perhaps should not be expected, because the rocky headlands at either end of Little Beach would exert an "anchoring effect" on the local sand movements. Sandy land surfaces dating from before 3000 BP may have survived along these rocky margins and provided suitable campsites for the Aborigines. It is possible that the backed blades found alongside both headlands (see

Chapter 2) represent an occupation from about 3000 BP, but we have no method of dating this scattered material. It is equally likely that these backed blades are contemporary with the middens C and D that we excavated, and occur only in specific locations because the artisans had preferred workshop areas.

Away from the bedrock, where our D-trench was located, it is unlikely that the terrain behind Little Beach was stable enough for regular occupation during the long span of dune transgressions beginning around 3000 BP. Even if middens had developed, processes of wind erosion would have scattered and buried them.

The sand transgression lasting until about 1500 BP probably built the low dunes in the D-area (180 m from HWL at Little Beach) and established the sand cap on top of the headland where midden C later developed. The approximate base dates from middens D and C (1445 ● 70 BP and 1340 ± 80 BP respectively) are consistent with the Aborigines proceeding to camp here as soon as the new landscape had settled down and developed vegetation.

Some of the sand incorporated into the dunes would have come from the shallow water close inshore, and probably the sea floor did not develop a rich marine flora and fauna until major sand movements slowed down. These factors too would have determined when intensive human occupation could begin at Birubi.

The appreciable retreat of the beachfront along Newcastle Bight during recent centuries has been remarked upon above. The small rocky headlands, and shoals close inshore, may have slowed the general retreat in the specific locality of Little Beach, but one must assume the beach was further seawards when Aboriginal occupation started here 1400 years ago.

The AB-midden was small in area and the sand dune on which it developed 490 ± 90 BP may not have been created in one of the major sand movements mentioned above. The frequent south-easterly gales move a lot of sand to this end of Little Beach, and major sand movements have occurred within living memory. The drift sand seen in Levels 2 and 3 of our excavation doubtless reflects similar events.

It is to be noted that the sand dune under the AB-midden was perched on top of the rocks of a former shoreline, indicating that prior to about 500 BP there had been some movement back and forth of this shore. Possibly the AB-midden, and the small islet midden (see Map 4) are remnants of a beach dune midden, once extending along Little Beach but now mostly destroyed as a consequence of beach retreat. This beach retreat has implications for fishing methods, which will be taken up in Chapter 11.

Effects of tsunamis

The geomorphologic changes postulated by Thom and his colleagues were seen as gradual developments, triggered by some change of climate such as increased windiness. In sharp contrast to this view, Bryant, Young, and their colleagues have recently proposed that at least some of the changes were caused by the catastrophic power of tsunamis (Bryant *et al* 1992; Bryant 2001).

Bryant and coworkers report evidence of a number of very large prehistoric tsunamis on the coast of New South Wales. Most of the evidence comes from the South Coast, which is not surprising since this research group is based at the University of Wollongong. However, some of the cited evidence does come from areas close to Birubi. There are shell-rich sand layers in dunes at Fingal Bay; and at Boat Harbour (near Port Stephens) there are blocks of rock 4x3x3 m in size that have been moved inland from the shore more than 100 m and lifted 10 to 12 m above sea level (Bryant 2001: 75, 114). Not all geologists accept the evidence for these tsunamis at the time of my writing (2004), and the debate will doubtless continue for many years. For the present, we must take the tsunami hypothesis very seriously and examine its archaeological implications.

Really large tsunamis would have had a devastating effect on the coastal Aborigines. As well as the heavy loss of human life, there would be massive damage to the inshore ecosystems. The huge hydraulic lift, the vortices, and the cavitation effects of a tremendous wave surge would be expected to strip shellfish and other biota from the rock platforms and reefs (Bryant 2001: 84, 258). Recovery of the populations of fish, crustaceans, and shellfish might have taken decades. These tsunami events would surely show up as breaks in the occupation of coastal Aboriginal middens.

Dates of tsunamis on the New South Wales coast

The dating of these tsunami events is an ongoing study. The dates given below were determined from shell deposits by the usual radiocarbon method, and therefore involve appreciable experimental errors, perhaps as large as ± 100 years. Numerous data will have to be accumulated before each event can be dated within a narrow range of calendar years. Bryant (2001: 259) has recognized six separate tsunamis within the last 8000 years, and one of them has obviously not yet been pinpointed in time. In the following list, I have given archaeological dates in parentheses. (Before Present has a reference date of 1950 AD).

7500 BC	(9450 BP)	2000-500 BC	(3950-2450 BP)
5000 BC	(6950 BP)	500 AD	(1450 BP)
3300 BC	(5250 BP)	1500 AD	(450 BP)

Tsunamis and the chronology of the Birubi middens

The basal dates of the three middens we sampled are in good accord with the tsunami dates given above. The C- and D-middens both began to accumulate immediately after the 1450 BP wave. If there had been any earlier occupation at Birubi, this big wave must have swept its midden away, or at least scattered it. The deflated midden with backed blades (Areas F and G; see Chapter 2) possibly represents an Aboriginal occupation from before this 1450 BP date.

According to the list of tsunami dates, disaster struck the Birubi site again, around 450 BP. Bryant believes this tsunami was caused by a meteor strike in the Tasman Sea, and that it was the largest of the big waves in the geological record for the south coast of New South Wales. While the full extent of tsunami damage has not been identified in detail on the Newcastle coastline, and no dates have been established here, one has little doubt that this mega-tsunami devastated the Birubi area. The C- and D-middens would have been washed over, and any middens closer to the shoreline been obliterated. The AB-midden, then, represents a re-occupation of the Birubi site. The layer of waterworn debris underlying this midden could be material dumped there by the tsunami.

The "tsunami theory" raises problems with the dating of the C- and D-middens at Birubi. Although both of them look like undisturbed shell middens, it is possible they have been lifted and dumped by the powerful surge of the 450 BP wave passing across them. This surge could cause stratigraphic mixing, and possibly the upper layers of midden would be stripped off and swept away. We cannot, therefore, assume an orderly progression of dates throughout these C- and D-middens. Radiocarbon dating of more samples will be needed to demonstrate that stratigraphic integrity exists, and this dating might detect a stratigraphic break where the upper midden was stripped away.

A further possibility is that the C- and D-middens were abandoned after the 450 BP tsunami. If that is the case, we cannot assume that their upper Levels are contemporary with the AB-midden. The surface material on the C- and D-middens needs dating to find out whether it corresponds to modern times or to the 450 AD tsunami event.

This dating is not straightforward, because some of the pipi shell on the surface may have been discarded by Europeans who lived there during the Great Depression. It would be necessary to use shell species not likely to be eaten by Europeans. The heavy turban shell

(*Turbo torquatus*) meets this requirement, and has been found suitable for shell dating (Gillespie and Temple 1977). An adequate sample from Square C1 Level 0 has been retained. The only shell material retained from the surface of the D-Squares (actually from D2/0) happens to be pipi shell.

Post-tsunami geomorphology

If the 450 BP tsunami event actually happened, there have been five centuries since then for less dramatic geomorphologic processes to occur. The postulated sand movement of recent centuries (Thom 1992: 365) does not depend for its evidence on whether there was, or was not, a tsunami beforehand. This sand movement assumes considerable importance in the discussion of fish bone evidence (Chapter 11).

CHAPTER 7: NOTES FROM THE PERIOD OF EUROPEAN CONTACT

Early Aboriginal-European contact at Port Stephens and Newcastle

Port Stephens was sighted by Captain James Cook on 11 May 1770; he bestowed its name but did not go ashore. Contact of Europeans with the Worimi tribe at Port Stephens began in 1790 when convict escapees from Sydney were given refuge (see below). In 1791 the first recorded visits by whalers took place, and it was not long before contacts between the two races became hostile. Within a decade or two, European settlements were established, first at Newcastle and later around Port Stephens. The hunter-gatherer lifestyle of the Aborigines was then doomed, and the spiritual life of the tribes became very difficult to maintain.

The following list of dated events will convey a general impression of Aboriginal-European contacts between 1790 and the mid-1800's. The list is not intended to be exhaustive: its purpose is to show the progressive disruption of the Aboriginal culture.

In 1790 five convicts who had escaped by boat from Sydney were shipwrecked at Port Stephens. These men were fed by the Aborigines, adopted into the tribe, treated as objects of worship, and given wives. Apparently these Europeans were considered to have returned from the dead, and one was taken by his "son" to visit the spot where he had been cremated. In 1795, when Captain Broughton visited the Port in H.M.S. *Providence*, the four surviving convicts gave themselves up, and reported that the natives had been "gentle" (Collins 1798: 356).

In 1791, during their remarkable journey by boat from Sydney to Timor, a convict party of 11 people put in at Port Stephens. Twice they landed and were driven back to their boat by the natives, but then they were left unmolested on a sandy island for the two days needed to repair their boat (Martin 1973).

Later that same year the whaler *Salamander* (Captain J. Nichol) made the first officially recorded visit to Port Stephens (Collins 1798: 191), and was followed by two other whalers at the end of the year. One of these last ships landed a boat in a bay six miles south of the Port (Collins 1798: 190); probably this was at One Mile Beach.

These early contacts between whalers and Aborigines may have generated friction, for within a few years there were reports of Aboriginal attacks on boat parties. In one incident, Europeans collecting coal (one assumes at or near Newcastle) were attacked and two crewmen were severely wounded, one of them fatally (Collins 1798: 484). Deputy Surveyor Charles Grimes surveyed Port Stephens in the schooner *Francis* in 1795 and found the Aborigines "very unfriendly". The crew were invited ashore to dance hand-in-hand around a tree, and while this was going on, one native twice attempted to spear Grimes. The native was shot and severely wounded by one of the crew (Collins 1798: 408; Engel 2000: 8).

In 1797 Lieutenant John Shortland discovered the Hunter River, and small boats from Sydney began to visit there to collect coal. Two years later the natives attacked and captured one of these boats (though without harming the crew), and in retaliation the Sydney colonists sent an armed party who wounded several natives (*Newcastle Morning Herald* 1918).

Up till this time, the visits by Europeans to the Newcastle-Port Stephens area may have had little impact on the traditional way of Aboriginal life, but now this situation was dramatically changed. In 1801 there was a short-lived penal settlement at Newcastle, and when Lt. James Grant RN visited there that year he found that private individuals were collecting coal and cutting cedar. In 1804 a second, and successful, penal colony was established at Newcastle. A work camp of convicts was also set up six miles north of Newcastle, in the direction of Williamtown, to burn shells into lime. Another settlement was made at Port Macquarie. From time to time, convicts absconded from Port Macquarie and headed back to Sydney. A picket of six soldiers was stationed at Soldiers Point to prevent these escapees from crossing the narrow "gut" of Port Stephens (Dawson 1930: 11). From

1816 onwards, cedar cutters moved up the Hunter River and into the Port Stephens area, and they treated the Aborigines very badly (Dawson 1830: 18, 21, 80; Engel 2000: 11; Ebsworth 1826: 43).

In 1826, the Australian Agricultural Company sent Chief Agent Robert Dawson to establish a sizable farming settlement at Carrington, on the north shore of Port Stephens. Dawson did his best to protect the Aborigines from the violence of cedar cutters and convicts, but the very presence of his colonists had a considerable effect on Aboriginal culture. During his period of residence (1826-1828), Dawson noted that iron tomahawks were in use (Dawson 1830: 15), some of the Aborigines knew how to use firearms (Dawson 1830: 173, 199), and that they discarded fishhooks made of shell for the iron European hooks (Dawson 1830: 308). Ebsworth, who joined the AA Company's settlement in 1826, found that Aborigines were employed to work there and to shoot game; in return they were given European food and expected to wear European clothes when "in town". The work done by Aborigines included carrying water, collecting and chopping wood, catching fish, sawing planks, rowing boats, burning shells into lime, washing clothes, and caring for the settlers' children (Ebsworth 1826: 42, 57). Soon venereal diseases became widespread amongst the Aboriginal population, with a disastrous effect on their birth rate (Bairstow 2003: 91).

European settlement around the south side of Port Stephens became extensive during the second quarter of the nineteenth century. Captain Cromarty was allocated 300 acres at Salamander Bay in 1824, and Lt. William Caswell took up residence at Tanilba in 1830 to develop a vineyard and dairy. William Blackford occupied land at Lemon Tree Passage in 1830, and stayed till 1832. James Smith took up land at "Oakfield" (now called "Oakdale"), near Salt Ash, in 1837. John Blanch also settled at "Oakdale" in about 1850, but after two very wet years he left this waterlogged area and moved to Birubi Point, where he established a vineyard. (Information provided by the Port Stephens and the Tanilba Historical Societies).

Scott (Bennett 1929: 6) mentions various epidemics that caused heavy casualties amongst the Aborigines, and by the time he left Carrington in 1873 the tribe living in that neighbourhood numbered only 50 people. Emily Caswell, writing in 1841, also mentioned the sharp decline in Aboriginal numbers at Tanilba. Enright, who began his extensive studies of the social organization and language of the Worimi people in 1896 (Enright 1932), found that the social structure had broken down. In 1899, not enough initiated Aborigines could be found to stage the Keepara ceremony of male initiation.

I can find no firm evidence on when the Aboriginal middens at Birubi were last occupied. One resident of Anna Bay, Monty Bull, told me in November 1978 that his great-grandfather Eagleton remembered "as a young feller" seeing Aborigines eating up on the shell middens at Birubi. The great-grandfather died around 1953 at the age of 90; thus his recollection may have dated from some time between 1875 and 1885. No other of our informants at Birubi had any oral tradition of Aborigines at the locality, and it is not likely that the traditional campsite was used for long after John Blanch settled there in the early 1850's. There were however Aborigines still living on the south side of Port Stephens at least as late as 1876, for I have found tools made from lemonade bottles bearing the coat-of-arms of a Newcastle company, W. R. Moore. I am informed by The Newcastle Regional Museum (per David Wells, Curator) that this company started making these bottles in 1876.

There is virtually a blank on early information about Aborigines living on the south side of Port Stephens. Dawson (1830: 70) met some men on a beach immediately south of the Port Stephens entrance, but made no mention of seeing any Aboriginal encampments or people during his long walk from this beach to Newcastle along the coast. Leichhardt, in 1842, must also have walked past Birubi on his way from Point Stephens to Newcastle, but made no mention of an Aboriginal presence (Aurousseau 1968: 599).

Documentary sources on Aboriginal physical culture

Because the material we excavated at Birubi is comparatively recent, one expects the interpretation of it to be assisted by the observations of early European visitors and settlers. These first Europeans left a quite satisfactory legacy of such observations. In the chapters that follow, I have generally been able to draw upon records from the Lake Macquarie-Newcastle-Port Stephens area, rather than upon the sources provided by First Fleet diarists at Sydney.

Many of the sources are primarily concerned with language, initiation ceremonies, and tribal gatherings; none of these aspects can be expected to show up in the archaeological record at the Birubi middens. For our purposes, we need to focus on the reports about food-gathering and implements. It is also important to note the dates when European informants made their observations, for the Aboriginal lifestyle changed rapidly once European contact began.

The chief informants we have are as follows.

Grant Lt. James Grant visited Newcastle and Port Stephens in 1801 and 1802. He does not have overmuch to say about the Aborigines, but he does appear to be an accurate observer. Importantly, he observed an almost undisturbed phase of Aboriginal life.

Barrallier Ensign F. Barrallier visited the Hunter River in 1802.

Browne Richard Browne, a convict, spent time in Newcastle until his sentence expired in 1817, and left a number of sketches and paintings of Aboriginal activities. At this early date, Aboriginal practices and implements would have been only a little altered by European contacts, though one does note there is a steel axe amongst the implements illustrated by Browne in the unpublished Scottowe manuscript (see Gunson 1974: 81 and McCarthy 1945). The Scottowe manuscript is dated 1813.

Threlkeld The Reverend L. E. Threlkeld set up a mission station at Belmont, on Lake Macquarie, in 1824. He found the Aborigines already corrupted by contacts with the penal colony at Newcastle, and by the time he left in 1841 the tribal way of life had disintegrated. Although Threlkeld toiled unceasingly to protect the Awabakal people from European violence and evils, he firmly believed that the only way forward for them was to become "civilized" and Christian. Despite this negative attitude to Aboriginal culture, he was an outstanding observer of detail and has left us very important descriptions of implements and food-gathering methods. His mastery of the Awabakal language undoubtedly helped him to elicit information.

Dawson Robert Dawson was the Chief Agent for The Australian Agricultural Company, and established its settlement at Carrington on the north shore of Port Stephens. During his time there (1826-28), Dawson befriended the Worimi people and took a wide-ranging interest in their activities. I believe he was a first-class informant.

Ebsworth J. E. Ebsworth joined the A. A. Company at Carrington as a Deputy Commissioner in 1827, and later lived at Booral. Some of his observations overlap those of Dawson.

Caswell The Caswell family settled at Tanilba in 1830. Letters survive from both the mother (Susan) and a daughter (Emily), and make passing reference to Aborigines.

Leichhardt This noted explorer and naturalist spent some months in the Newcastle area in 1842.

Scott William Scott was born at Carrington in 1844 and grew up with Aboriginal playmates. Late in his life he recorded all he could remember about the Aborigines, up until he left Carrington in 1873. He states that his recollections drew upon notes made during his time at Carrington. Scott probably had more opportunity to learn details of Aboriginal life than any other European informant, but we have to remember that the Worimi people were becoming Europeanised by this late date.

Enright W. J. Enright, a Maitland solicitor, made contact with surviving Worimi people in 1896 and spent the next 40 years studying their language, tribal organization, and initiation ceremonies. At this very late date, cultural disorganization was far advanced. The wooden implements that he was given were probably traditional ones, and will be referred to later.

Other sources have been very capably summarized in unpublished theses (Brayshaw 1966; Sokoloff 1973). Some of these other sources will be quoted below.

Implements

Hunting spears

Threlkeld (Gunson 1974: 61) tells us that the spears are “nothing but grass tree stems pointed with hard wood of the iron-bark tree”, and could pierce a wooden shield. “The spears are from 6 to 7 feet long, generally made with three divisions – two of the grass tree and one of the hardwood. The joints are cemented together with gum resin which exudes from the grass-tree… The ends of the grass-tree are charred in the fire, fitted one into the other with the melted rosin infused, the joint is tied with a filament of bark, and a lump of the gum is wrapped around the joint …. It is roasted over the fire, and as it is softened by the heat it is put into shape by the wet fingers of the artisan. The hard wooden skewer-like end is sharpened to a very fine point, charred in the fire and covered whilst hot with melted gum, and in some instances a bone barb is fastened at the point, in the same manner as the joints were made to adhere together.”

“The battle spear is made of the same material, but often with the addition of pieces of sharp quartz stuck along the hard wood joint on one side so as to resemble the teeth of a saw.” The “barb” of the *wom-mur-rur* [throwing-stick] was inserted into a small hole in the end of the spear, which was “carefully tied around and gummed, to form a sort of ferrule, to prevent the weak reed-like substance of the grasstree stem from splitting.” (Gunson 1974: 67-68).

Enright (1900: 103) illustrates a similar hunting spear, from Port Stephens, and likewise designed to be thrown from a wommera. The spear “is composed of three pieces: a sharpened hardwood point 24 inches in length, thrust into the thin stem of grasstree about 34 inches in length, and this in turn is fastened into a shaft of like material about 6 feet 4 inches in length.”

Dawson (1830: 244) gives much less detail of making a spear. He says the spears were made of the smooth straight stalk of the grasstree, which grew to a height of 7 or 8 feet. On one occasion (1830: 16) he met an old man armed with a spear about 8 feet long. This man scraped its point with a broken shell and hardened it in a fire. He drew the spear repeatedly over the blaze of the fire, then placed it in his teeth and applied both his hands to straighten it. (It would seem that this was a composite spear with a hardwood point). Scott (1929: 29) reported that spear shafts were made of various hardwoods, preferably ironbark. The wood was soaked 3 to 4 weeks before scraping, and then hardened in a fire. A hole was made in the shaft with a piece of hardwood twirled between the hands. The tip was fitted into this slot, made firm with cords of animal sinew or fibre, and coated over with grasstree gum. Spears were pointed with fish or animal bone, and some were both pointed and barbed. Some spears were made of hardwood saplings. (This last sentence seems to indicate one-piece spears).

Browne illustrated three composite hunting spears in the unpublished Scottowe manuscript (Gunson 1974: 81). In all cases the shafts were made in three sections. One spear had a simple skewer-like point, one had a single barb, and the third one had three barbs.

McKiernan (1911) described a less complicated spear than did Threlkeld or Enright. He stated that a groove was cut in one end of a 6-foot length of grasstree to receive the tongue of the end of the spearhead, which was glued in with “native gum”. A notch was then cut into the other end of the spear shaft to fit the point of the woomera.

Contrary to popular present-day belief, Aboriginal spears seen in the Newcastle district at the time of European contact did not have a stone head. Although spears were a major item in the array of Aboriginal implements, one cannot expect to find signs of them in middens. The wood will decay without trace; only the bone points or barbs have a chance to survive.

Fish spears

Scott tells us that the main shaft was a stalk of gigantic lily (*Doryanthes excelsa*), into which a second portion (the dried flower stem of the grass tree) was fitted. The hardwood for the four prongs was first shaped in the rough and then put in seawater for a lengthy period till the sap had gone and the tissue toughened. This treatment also made it easier for the maker to scrape the billet down with a broken shell (though by Scott's time they preferred to use a piece of bottle glass). The prongs were barbed.

The heaviest spears were used for spearing the big sea mullet which swam into the harbour [Port Stephens] at certain seasons. The women watched from the headlands for the shoal. The men dashed into the water up to their middles and stood motionless, spears poised on wommeras, till the signal to hurl was given. (Bennett 1929: 18).

A very similar description of the manufacture of this important fishing device is provided by Threlkeld from Lake Macquarie. "The fish spear is made from the stem of the grass-tree, at the end there are four pieces of hard wood, about two feet long [which] are fastened with a bark-thread covered with grass-tree gum, heated in the fire until at a melting point, when it is worked around the thread fastening it, as we would use sealing wax for a similar purpose. The three or four shorter spears thus fastened to the long stem of the grass-tree, of about 6 feet length, becomes thus somewhat nigh 8 feet in total length. Small wooden wedges are inserted betwixt the attached short spears just at their base where they are tied, and likewise gummed over firmly. These serve to spread out the three or four attached short spears, so that if one miss the fish in striking, the fish may be caught between the expanded hard-wood skewers. The point of each skewer is hardened in the fire, by charring; and when hot, covering it with a coating of the grass-tree gum, fastening at the same time a barb of bone at the point." (Gunson 1974: 67).

Enright (1900) was given a fish spear by the Port Stephens Aborigines, and it says something for the effectiveness of this spear for securing fish that it was still being made at such a late date. The shaft was made from the stem of the grasstree, 7 feet 6 inches long, and four pieces of hardwood 25 inches in length lashed together, but with the points separated by pieces of wood thrust in between them, and fastened into the shaft by means of gum and twine. Enright was told this spear was used to catch the large fish. His illustration does not indicate barbs.

Gunson (1974: 81) provides a copy of convict artist R. Browne's sketch of Newcastle artefacts. The details of the fish spear are not very clear, but there are at least two sections to the shaft, and the four prongs each carry one barb.

The barb of bone mentioned by Threlkeld is the well-known *muduk*, whose use as a spear barb has been summarized by McCarthy (1940, 1976) and Lampert (1966). Megaw (1969) has described three slivers of bone, bound with vegetable fibre and mounted in gum, on the ends of two fish spears collected by Cook and Banks at Botany Bay in 1770. One of these spears is illustrated by Mulvaney and Kamminga (1999: 288).

Other wooden implements

As well as the spears described above, a number of other wooden implements have been documented. Gunson (1974: 81) has replicated a drawing made by R. T. Browne in 1813 that depicts shields, woomera, boomerang, fighting clubs, and a bark basket. Enright (1900) illustrated a similar range of wooden implements, plus a bullroarer, coolamon, and digging stick. Threlkeld (Gunson 1974: 67, 68) listed bowls, shields, woomera, boomerangs, and a wooden sword. Sometimes, shields were made of bark (Dawson 1930: 183). Scott (Bennett 1929: 14, 30, 31) lists clubs, throwing sticks, two kinds of boomerangs, woomera, nulla-nullas, waddies, shields, etc. Ebsworth (1826) tells us that the fighting club was made of ironwood.

In the early 1900's, workmen digging a drain through a swamp 5 miles from Raymond Terrace found a shield with incised decoration, a woomera, and two spearheads. These wooden items had been well preserved in the mud, and one could see that the wooden peg in the end of the woomera had been attached by "some kind of native gum" (McKiernan 1911). The spearheads, both 22 inches long and made of some sort of ironbark wood, were thought by McKiernan to be heads of two hunting spears. However, Moore (1981), who viewed these wooden points, thought them to be prongs from a fish spear. The age of these items is not known.

Clearly there was a wide range of wooden implements in use, but they would not last long in the soil of a midden. We can however expect to find the stone tools used to make these wooden artefacts. Both Dawson and Scott (above) mention woodworking with broken shell, and such shells ought to be recognizable.

Stone implements

The historical record has very little to say about stone tools, probably because by the time observers like Threlkeld and Dawson arrived (in 1824 and 1826 respectively) the Aborigines had discarded stone in favour of iron or bottle glass.

Stone axes were however still in use. Dawson (1830: 202) tells us that these "stone hatchets" were sharpened by other stones to a "pretty fine edge". The axes he described had a groove worked near the "head" (one assumes he means "butt"), around which the Aboriginal twisted a stick to serve as a handle. The handles were attached with a very adhesive gum, resembling pitch, taken from the grass-tree and refined before being used. These axes were used to cut notches for climbing trees. Enright (1900) describes the fixing of the handle in slightly different detail: a piece of vine was doubled around the head and the two portions were then fastened together with bark, and the head made more secure with wax or gum.

Both Enright (1900) and McKiernan (1911) mention the stone knife as a basic tool but neither describes it. I have already mentioned that the Lake Macquarie people armed the points of their battle spears with quartz flakes (Gunson 1974: 67) though at the time Threlkeld made this observation, fragments of bottle glass were preferred.

Bone tools

A bone awl, made by grinding a kangaroo shank bone to a point, was used to make holes through a bark canoe when mending it with paperbark (Gunson 1974: 54). Dawson (1830: 116) reported that a young man carried a small sharp pointed bone, from the leg of a kangaroo. This bone was used as a comb, or rather to unravel the hair. Dawson (1830: 319) also noticed that the men bored the cartilage of their nose and sometimes poked a stick or a small bone from a kangaroo through it. Enright (1900) assigns the Worimi word *kooyeroo* to a bone used for combing hair.

Bone slivers, ground to a point on one or both ends ("unipoint" or "bipoint") were a common artefact on the east coast of Australia, and have been mentioned above under "Fish spears".

Scott (Bennett 1929: 18) mentions that "some of the [fish] hooks were fashioned of bone after the primitive style".

Shell implements

There are several references to using shells for scraping purposes. Dawson (1830: 66) tells us that broken shells were used for scraping spears to a point, as also does Scott (1929: 18, 29). Scott also noted that shell scrapers were used to remove the outer layer of bark when preparing fishing lines from kurrajong bark (1929: 18). Both men and women scarred themselves with sharp edges of shells (Dawson 1830: 319).

The shell fishhook was a particularly important artefact, which will be discussed in detail in Chapter 9.

Canoes

Threlkeld (Gunson 1974: 54) has left us the most detailed account of how a bark canoe was made, at Lake Macquarie.

"Their canoes were made of the bark of a tree about 12 or 14 feet long, and from 3 to 4 feet in width. The blacks are always on the look out in their travelling through the bush, and when they find a strait trunk suitable for the purpose, they chop round the bark, at about a couple of feet from the root, a space of three or four inches. They procure the limb of a tree and set it up against the standing trunk, as a ladder, on which they ascend and cut around the whole circumference of the tree in the same manner as done at the bottom. They then chop down a perpendicular line, when they insert their throwing-stick, which is of a wedgelike make at one end, betwixt the bark and the tree… they proceed to separate the sheet of bark from the tree whilst it is most carefully allowed to slide down and then is laid flat on the ground the rough outside of the bark being upward. A fire is then made upon the bark and being heated the steam of the sap softens it so as they can crumble [sic] up each end like a folded fan, the which they tie securely with vines from the bush. Sticks are placed across one at the one end, another at the other, for both ends are alike, they having no head and stern to their vessels. A cord made of the vine, is tied across the middle, which, whilst the two cross sticks press out the sides of the canoe, confines the edges and prevents its spreading open. In the centre, a hearth is made of earth upon which a fire is always kindled when they go upon the water. When fishing it not only serves to warm their feet and hands, but is principally used to roast the bait, whether cockles, or the flesh of the star – or any other fish, besides which the fire is useful to cook the fish as soon as they are caught, the fisherwomen being generally hungry when they begin their employment. A few bits of bark, one upon the other form a seat for the dark-sex on their frail vessel, whilst gliding across the silvery stream, paddling with short battledor like paddles one in each hand…..The wild vines of the bush formed their cables and a heavy stone was the substitute for an anchor."

Scott (Bennett 1929: 31), writing of Port Stephens, says the canoes were made of a single sheet of bark from a stringybark tree. Lines were cut around and across the tree to get the bark of required size and shape, and then the bark was carefully removed. The sheet was passed back and forth over flames to turn up the ends, which were tied with vine and fibre. The outer bark went to the outside and was trimmed off. [Note the difference here from Threlkeld's version]. The ends were not only tied up, but were made watertight with plugs of clay. The canoes were fitted with stretchers and were generally 15 feet long, with "a fair beam". Paddles were shaped like a large spoon or butter bat, made of hardwood; they were never double-ended. Dawson (1830: 79) provides a picture of one of these paddles. According to Scott, one often saw a dozen or so of these canoes out on the waters of the Bay, each with a little fire built on a hearth of clay towards the stern. Scott considered the canoes to be "fragile" and to need skill in handling.

Collins (1798: 408) quotes a report that the (huts and) canoes at Port Stephens were larger than at Sydney.

One bark canoe from the Hunter district is preserved in the collections of The Australian Museum (M 177: AM-E 78217). Described as a coastal estuarine canoe, it is 3.50 metres long, 44 cm maximum width, and 14 cm in depth. Both ends may have been lashed with vines (now missing); these ends are folded and secured by a wooden peg. This canoe has the smooth side of the bark inside and the rough side to the outside. At the time of writing, this frail-looking craft was on loan to the Newcastle Regional Museum.

It was usual for the natives to build a fire in the bottom of the canoe (Grant 1803: 162; Dawson 1830: 314-315). According to Dawson, "They always put a flat stone or two in the centre of the canoe, and place upon it several firebrands, with which they warm themselves when the weather is cold, and they also cook their fish and roast oysters for their subsistence when in the canoe. They have a large utensil, which is procured from trees, up in the branches of which it is found as an excrescence, in which they carry several quarts of fresh water."

Canoes were part of the scenery on waterways in the Lake Macquarie – Hunter River – Port Stephens area, being remarked upon repeatedly by such people as Martin (1791), Oxley (1820), Grant, Dawson, Threlkeld, Scott, and Caswell. Scott (1929: 31 is the odd man out in believing the canoeists avoided rough water: Threlkeld (Gunson 1974: 54) mentions the women fishing in bleak winds on Lake Macquarie and Dawson (1830: 340) states that "The natives use canoes on the coast even in heavy seas." The Aboriginal presence on Broughton Island (Wright 1975), which is about 3 km off the coast north of Port Stephens, implies a willingness to put to sea in canoes. The artist J. Lycett, in about 1820, sketched a scene in which two bark canoes were drawn up on an ocean beach near Newcastle (Hoorn 1990: Plate 14). The only way these canoes could have been used would involve a trip through the surf. The painting is reproduced by Mulvaney and Kamminga (1999: Plate X). Ebsworth (1826: 82) thought the canoes "of the roughest workmanship, being nothing but a sheet of bark prepared and tied together at either end; yet they venture miles from land when fishing and manage them with great dexterity."

One can still see "canoe trees" around the south shore of Port Stephens. It must be remarked that the sheet of bark removed for making the canoe does not, with either of the two trees I have seen, extend all the way around the trunk as described above by Threlkeld.

Fishing gear

Fishing lines

Scott (Bennett 1929: 18) tells us "…the lines were cleverly made from the inner bark of young kurrajong trees … extraordinary strength and capable of handling the heaviest of edible fish. … selected women prepared the lines. The bark was soaked in water until the outer portions could be readily scraped off with a shell. This left a white, flax-like fibre, very tough and strong. The women twisted this fibre … by rolling it on the front side of the thigh with the hands." Barrallier (Gunson1974: 5) reported something similar for the Hunter River "…the Natives … making lines to fish, and sacks three feet in circumference and deeply netted, of a new species of Coregean, which they prepare by soaking the bark and afterwards beating it with a wooden mallet. They only employ the right hand to twist their line, pressing the thread very light against their thighs."

It is likely that some of the detail escaped both these observers. Lampert and Sanders (1973) were told by an Aboriginal informant that fishing lines at the Beecroft Peninsula (near Jervis Bay) came from the bolwarra tree (*Eupomatia laurina*), or sometimes from the kurrajong and certain wattles. The bark was soaked in "tan" (eg. from the geebung, *Persoonia laurina*); then two strands were twisted tightly together before being soaked in sap of the red bloodwood (*Eucalyptus gummifera*) to prevent fraying.

In the opinion of Ebsworth (1826: 79), the fishing lines made at Port Stephens by twisting bark fibre with the hand against the leg were "equally as good as can be purchased in England."

Fishhooks

Fishhooks were made of "oyster or pearl shell" (Dawson 1830: 66, 308). Ebsworth (1826: 79) reported that the women at Port Stephens made the hooks from oyster shell. Shell hooks are also mentioned by Enright (1900), and Threlkeld states that "… hooks made of a shell ground down on a stone until it became the shape they wished" (Gunson 1974: 54). Emily Caswell (1841) stated that the fishhooks at Tanilba were made of oyster shell. Dean-Jones (1990) found part of an oyster shell hook at a foreshore site on Lemon Tree Passage, Port Stephens, but in Chapter 9 I raise questions about its identity as a hook.

In view of the paucity of information about how these hooks were made, we shall have to rely on excavated material to discover details.

Fishhook files

Two types of abrading stones – one shaped like a leaf or a triangle with flat upper and lower surfaces, the other cylindrical – have been described by McCarthy (1976: 62). Enright (1900) lists the Worimi word *dipoonga* as a stone used for sharpening fishhooks.

These files are commonly found associated with fish bone and shell fishhooks on the east coast of Australia and there seems little doubt they were used to make shell hooks. However, there is some evidence that these files appeared earlier than shell hooks (Lampert and Hughes 1974) and some archaeologists (Attenbrow, Fullagar and Szpak 1998) have cautioned that the files may have had a more varied use than just making shell hooks.

Methods of hook-and-line fishing

The painting entitled "Killigrant" by R. Browne (Sotheby's 1987) shows a woman carrying a looped fishing line of stout cord, perhaps 6 metres long. One end is tied to the middle of a short handle, say 10 cm long, and the other end to a C-shaped hook. Some strands of a red bait (possibly conjevoi) are draped over this hook. There is no sinker. Gunson has reproduced an illustration made by Browne, in 1813, of Newcastle implements (Gunson 1974: 81); it shows a similar hook and stout line, and again there is no sinker. This absence of sinkers is also borne out by two sketches made at Sydney very early in the 1800's. Megaw (1993) has reproduced one of these, showing a woman in a canoe landing a fish on a line. The other sketch, by Louis-Claude Freycinet at Port Jackson in 1802, shows a woman carrying an unweighted stout line with two traces on the end, each trace bearing a hook appearing to be made of shell (Kohen and Lampert 1987: 347).

Whereas the men speared fish, the women used lines (Bennett 1929: 18). Threlkeld refers to the women fishing on Lake Macquarie in their canoes "…angling with hook and line thrown by hand as they are seated in the bark canoe." Dawson (1830: 314) describes two women occupying bark canoes way out in the water [of Port Stephens] for hours, hooking fish as they came and went on the tide.

I can find no reference to hook-and-line fishing off beaches, and only one from rocky shorelines. Govett (1837: 62) observed natives fishing from a rock platform on the coast between Port Jackson and Broken Bay. The lines were in this case used by men, while the women tended fires and the boys collected bait from rock pools. This bait was called "starfish" though from the statement that these creatures emit a black fluid to obscure the water, they were surely octopus. Govett's illustration makes it quite clear that the rather heavy line had no attached sinker, and when he himself tried out the tackle, he found it quite difficult to throw the baited hook out into the water. According to Govett, the men caught snapper, generally 5 to 15 pounds in weight, and even 20 pounds. (2.2 pounds equals 1 kg). The fish were hauled in with great rapidity and then killed by piercing the back of the head. Govett watched one man catch eight large snapper in less than half an hour. When he himself borrowed the line, he snagged it on the bottom, and the Aboriginal owner valued the line and hook highly enough to dive into the deep water and recover it all. Govett did not, unfortunately, record the nature of the hook.

Although there are statements from other coastal regions that shell hooks, thanks to their gleaming nacreous surface, acted as a lure and needed no bait (see Chapter 9), our local sources mention bait. Threlkeld (Gunson 1974: 54) says "[The fire in the canoe] is principally used to roast the bait, whether cockles, or the flesh of the star – or any other fish." Further south, in the Hawkesbury estuary, Grant (1803: 88) noted "they used the skin of the fish as bait for fishing." Govett's description of using "starfish" for catching snapper has been described above.

Spearing

Enright (1900) gives the most complete account of using the fish spear in our region of interest. "They use this [fish] spear in catching the large fish. Going into the water as far as he can to use the spear with effect, the native stands like a statue holding the spear obliquely in poised hands ready to strike his prey as it passes. Standing motionless, he is soon surrounded by fish, and the first that passes his feet is pierced by a certain powerful thrust. Sometimes they make use of a boat (the bark canoe is never used nowadays) from which they spear the fish." Threlkeld also mentioned spearing fish from canoes (Gunson 1974: 190).

Scott (Bennett 1929: 18) reported the heaviest fish spears were used for spearing the big sea mullet that swam into Port Stephens at certain seasons. Also, salmon were speared in the shallows (see above). Dawson (1830: 255) noticed natives on the beach near Sugarloaf Point looking for mullet to spear in the heavy surf. A native chased the receding waves to hurl his spear.

At Port Jackson, two European observers (White 1962: 153 and Collins 1798: 286) noted that users of the fish spear spat a chewed "lure" (nowadays, we would call it "burley") to attract the fish. In one case the lure was said to be cockle.

There is one account of spearing fish at Port Stephens by torchlight (Pierce 1971). A slight account of this procedure, from Port Jackson, is given by Gunson (1974:340). Banks (1998) commented on the number of moving lights out on the waters of Botany Bay at night when he was there in 1770, and thought it was connected with striking fish.

Nets

Enright (1900) mentions that the Port Stephens natives made fishing nets, as also does Dawson (1830: 65, 66). Threlkeld (Gunson 1974: 190) briefly mentions the Aborigines using hand nets, forming a circle in shallow waters and enclosing the fish. Grant (1803: 154) found part of a net, made of strong grass, on a creek in the Hunter estuary, and may have been wrong in concluding it was the handiwork of an escaped convict.

Traps

In the Hunter estuary, near Ash Island, Grant (1803: 154) "saw in the stream the remains of a weir, the work of the native inhabitants, this being one of their principal devices for taking fish."

Threlkeld mentions the natives "planting sprigs of bushes in a zig-zag form across the streams, leaving an interval at the point of every angle, where the men stand with their nets to catch what others frighten towards them in the water." (Gunson 1974: 190). A horseshoe-shaped stone fish-trap was reported from Broughton Island by Enright (1935a).

Foods

Mammals

According to Dawson (1830: 237) the Aborigines at Port Stephens ate a wide variety of mammals, but preferred kangaroos. He saw lots of kangaroos feeding on the young and tender grass that had sprung up after the fires of the natives (Dawson 1830: 215). Kangaroo hunts were a tribal event (Dawson 1830: 8, 237; Bennett 1929: 19). Dawson (1830: 81, 82), Scott (Bennett 1929:19) and Threlkeld (Gunson 1974: 46) both describe how the kangaroos were driven by beaters into an ambush. The hunts were however often unsuccessful (Dawson 1830: 49).

Catching possums was mentioned four times by Dawson (1830: 66, 68, 202, 237) and twice by Scott (Bennett 1929: 18, 21), as well as by Ebsworth (1826: 78) and Caswell (1841). Flying foxes were speared (Dawson 1830: 309) and according to Scott (Bennett 1929: 21) were eaten with gusto. Backhouse (1843) also refers to eating of flying foxes. Kangaroo rats were forced out of logs and killed (Dawson 1830: 243, 237), and bandicoots also appeared on the menu (Dawson 1830: 66; Threlkeld in Gunson 1974: 54), as did several species of wallaby (Threlkeld in Gunson 1974: 45). Scott (Bennett 1929: 18) refers to eating the partly-digested grass in the paunch of kangaroos. As well as the mammals listed above, there are reports of eating echidnas and koalas (Fitzpatrick 1914: 43).

Dawson (1830: 149) states that the Port Stephens Aborigines did not eat dogs, whereas Threlkeld reports that dogs could be eaten by initiated men (Gunson 1974: 47, 55).

Whales cast on the shore provided a feast, to which neighbouring tribes were invited (Gunson 1974: 55). In 1975, Mr. Cromarty (of Cromarty Lane, Bob's Farm) gave an account of an Aboriginal whale feast to W/Cdr Paul Johnson. Mr. Cromarty was then about 90, and said his father had told him the following story. During the annual whale migrations, a whale was often cast up, and the Aborigines would troop over to eat it. Since blubber burns in a fire, they cooked it on large stones, which had been heated in a fire and then rolled out with the aid of sticks. The oil ran down the sides [of the stones] and the Aborigines plastered themselves with it, so that they returned from the feast accompanied by a vast swarm of flies.

The blubber gave the Aborigines severe diarrhoea, which they remedied by resorting to the bush to eat pounded fern root. The whale feast would then be resumed.

Birds

Scott (Bennett 1929: 18) observed that birds were an abundant part of the daily diet, and mentioned emus, ducks, swans, parrots, and pigeons. Threlkeld, and Dawson, identified ducks, geese, swans, pigeons, parrots, quail, emus, and brolgas as items on the menu (Gunson 1974: 55; Dawson 1830: 50). According to both Dawson (1830: 68) and Ebsworth (1826: 78), the birds were sometimes killed with stones   At Lake Macquarie the natives visited Moon Island (close inshore at the seaward end of Swansea Channel) at one time of the year to feast on the eggs and young chicks of the shearwater (Gunson 1974: 55, 65).

Reptiles

According to Threlkeld, large lizards were a favourite food amongst the privileged class of the Awabakal people, and roast snake was reserved for certain tribal elders (Gunson 1974: 47, 55). Dawson (1830: 202, 237) mentions snakes and iguanas [?goannas] being eaten at Port Stephens, where Scott (Bennett 1929: 21) says they were greatly esteemed as food. Turtles also appeared on the menu (Dawson 1830: 50).

Crustacea

Dawson (1830: 50, 308) refers to "crawfish" and crabs being on the menu at Port Stephens. Scott (Bennett 1929: 19) describes how the women dived for crayfish among the rocks at the entrance to Port Stephens, while the men threw stones to scare away sharks. Threlkeld reports that the natives dived from their canoes for crayfish in fine weather. The artist Lycett painted a scene where natives (probably women) were diving to catch crayfish on an ocean beach at Newcastle, in about 1820. The painting is reproduced by Mulvaney and Kamminga (1999: Plate X). Leichhardt (Aurousseau 1968: 547) reported seeing both crayfish and crabs being caught near Newcastle, and said it was the men who dived amongst the offshore rocks to drag the crays out of their hiding places.

Grubs

To the disgust of European observers, grubs were often eaten, trees being cut open to extract them (Dawson 1830: 66, 151, 209, 237; Threlkeld in Gunson 1974: 55). Intestinal worms from kangaroos were a delicacy (Bennett 1929: 19). The cobra worm, which breeds in wood immersed in water, was also an item of diet (Grant 1803: 162). Strictly speaking the cobra, or shipworm, is a bivalve.

Shellfish

At Port Stephens, oysters were numerous (Bennett 1929: 18; Dawson 1830: 14) and Dawson several times referred to them being eaten by the Aborigines, who sometimes met together to feast on them (Dawson 1830: 50, 66, 327). At Lake Macquarie, cockles were the everyday dish (Gunson 1974: 55).

Fish

At Port Stephens, Dawson reported "the natives eat fish" (by which he implies it was a staple in their diet), and fish were easily caught (Dawson 1830: 66, 308). Eels were also eaten (Dawson 1830: 50). Barrallier (Gunson 1974: 5) reported from the Hunter estuary that "their nourishment is fish", and at Lake Macquarie fish was part of the usual Aboriginal supper (Gunson 1974: 45). Dawson said the men fished when it suited them, but the women supplied fish to the family. The Worimi people never ate stingrays because they believed them to be poisonous (Dawson 1830: 313).

Ascidians

According to Leichhardt (Aurousseau 1968: 547) the Newcastle natives collected and ate conjevoi (*Pyruva stolonifera*), ripping the animal from its tough sleeve with a small sharpened stick.

Vegetables and fruit

Dawson refers several times to the natives eating fern root ("bungwall"), which they roasted in the ashes and then pounded between stones. Sometimes the tribe gathered together to eat it (Dawson 1830: 92, 237, 327). Threlkeld (Gunson 1974: 55) also reported this sequence of roasting, beating with a stone on a larger stone, and then using the product as bread. On another occasion he remarked that "…hunger must be satisfied, and the wild fern root roasted forms a substitute for mere [sic] nutritious food." Barrallier reported that both fern roots and "a sort of root or yam" were eaten; the latter when raw burned his palate. The yam, he believed, was made palatable by roasting (Gunson 1974: 5). This yam, which almost certainly was *Dioscorea transversa*, requires soaking in water and cooking to remove a toxin (Cribb and Cribb 1974:141). Scott (Bennett 1929: 22) reported how the Aboriginal women at Port Stephens dug out the tubers of a slender vine that flourished in the scrubby gullies. These tubers were always baked in the ashes, and again were likely to have been *D. transversa*.

When Backhouse (1838: 64) visited Lake Macquarie in 1835, he was told that the natives had stopped eating fern-root, because they preferred potatoes and other European foods.

Threlkeld described in detail how the nut of the cycad (*Macrozamia communis*) was soaked and roasted. He also reported that a "blue plum" was eaten (Gunson 1974: 55). Backhouse (1838: 64) described how at Lake Macquarie the macrozamia seeds were roasted and pounded, then left in water for two or three weeks to remove "bitter principles" before being eaten. This is the reverse procedure to the one described by Threlkeld, but is probably equally successful in removing the toxin.

At times the Aborigines at Port Stephens gathered to roast the stalk of the giant lily (*Doreanthus excelsa*) (Dawson 1830: 310, 327). In 1835, Backhouse at Lake Macquarie observed that the Aborigines cut the flowering stalk when it was about a foot and a half high, and thicker than a man's arm; it was then roasted and eaten. They also roasted the roots, and made them into a sort of a cake, which they ate cold (Backhouse 1838: 64). At Port Stephens, the young shoots of the Gymea lily (*D. excelsa*) were soaked in water before being roasted. (Bennett 1929: 22). This detail does not entirely match with that given by Backhouse above, possibly because this last observer did not witness the entire process.

Scott also saw the Port Stephens Aborigines eating a fruit that grew on a little bush vine (Bennett 1929: 22).

Honey and syrup

The honey of the native bee was obtained by climbing trees and robbing the hive (Dawson 1830: 68, 202, 237; Ebsworth 1826: 79). Dawson also noted that the flower of the grasstree (*Xanthorrhoea* sp.) contains a considerable amount of juice, which in season is sweet and agreeable; the natives were very fond of it. The gum which exuded from acacia shrubs was also eaten (Dawson 1830: 244).

CHAPTER 8: EXCAVATED STONE MATERIAL

Note that, in this Section, the “cobble”, “slab”, and “large pebble” categories are lumped together, because there was difficulty in putting some items into one or other of these groupings. A “cobble” is considered by geologists to have a diameter in the range 64-256 mm.

The AB Trenches

Flaked material

These trenches yielded a total of 478 waste flakes, corresponding to 85 per cubic metre. (See **Table 8.1**). The A2 trench yielded most (243) of the flakes. In the other five AB trenches (whose volumes were all similar to that of A2), the numbers of flakes ranged from 26 to 73, and many of their excavated Levels yielded no stone flakes at all.

Chert made up 44% of the total waste flakes, and igneous materials 55%. (See **Table 8.2**)

Table 8.1. Quantities of excavated waste flakes

Squares[A]	No. of Waste Flakes	No. of Waste Flakes per m^3	Wt. (g) per m^3
AB	478	85	143
C	513	342	611
D	1421	812	335

[A] The volumes of the AB-Squares total 5.60 m^3, the C-Squares 1.50 m^3, and the D-Squares 1.75 m^3. The ashpit in Square D-11 is not counted here; it yielded no stone flakes.

Table 8.2. Distribution of lithologies in the excavated waste flakes

(Percentages are based on numbers of items)

Squares	% Chert	% Igneous	% Other	Range of % Chert Values[A]
AB	44	55	1	21-82
C	36	60	4	20-52
D	58	30	12	23-85

[A] These figures are the range of values for the individual Squares in each of the groups AB, C, and D.

Despite the presence in the AB-trenches of 478 waste flakes, only three utilized flakes were recognized. These three unmodified flakes, all made of chert, occurred in Square A4 Level 0, A5 Level 1, and A3 Level 5. The item from A4 Level 0 was made from a honey-coloured chert that is unusual at Birubi, where nearly all cherts are coloured grey. No flaking cores were excavated, though two examples (both of chert) had been picked up on the surface.

No items bearing signs of use, or secondary retouch, were recognized amongst the 262 flakes of igneous rock, or the 5 examples of “other” materials.

No useful discrimination of flake sizes between chert and igneous materials emerged. Attempts to make this discrimination were frustrated by the small sizes of the samples, and in the case of the igneous materials, by the great difficulty in drawing a boundary between “flakes” and “rubble”.

A curious feature of the waste flake distribution is that 140 (74%) of the 211 chert items occur in Levels 0 and 1, and only 71 (26%) in Levels 2 to 9 inclusive. In these two upper levels, chert easily dominated amongst the waste flake materials, being 78% of the total, whereas it was only 25% of the total material in the lower levels. This pattern emerged for the proportion of chert in all six Squares. In view of the small numbers, this outcome could be caused by a random event, such as reduction of one or two large cores of chert on the uppermost part of the midden. (We have not tried to retrofit the material). However, these uppermost levels also contain the greatest mass of shell, so there may be some significant change in lifestyle at this location. These upper Levels must be very recent (Square A2 Level 8 was dated to 490±90 years BP) and the change may in some way be connected with the appearance of European settlers in the Newcastle-Port Stephens area.

Like many shell middens, this one has failed to yield any excavated stone tools that form a well-defined "industry", but there was one surface find of an elouera to give it some character.

Non-flake material

Unflaked stone material was relatively common. The items showing signs of use were four hammerstones, a possible fishhook file, two cobbles with broken edges, and two battered lumps of rock. In addition there were four pieces of broken rock, and 110 examples of large pebbles (>20 g) and cobbles. With the exception of one pebble of shale (Square B2/6), and another of an unidentified siliceous material (B1/5), all this unflaked material consisted of local igneous material.

Remarks on cobbles and large pebbles

In Square A3 Level 7, there was a very large cobble (over 3 kg), set on end. Its flat top may have served as a workbench (see Field Sketch 11). Another possible workbench was uncovered in Square A2, Levels 7 and 8. It consisted of one slab (144 g) and a cleaver-like piece (466 g), set together on their edges to form an open-ended vee-shape (Field Sketch 5). A heavy slice (168 g) and a pebble (37 g) were in close proximity (see Field Sketches 4A and 4B). Other clusters of cobbles were recorded in the Field Sketches but do not lend themselves to interpretation.

Six of the cobbles found in the AB-trench were extensively fire-blackened from use as hearthstones. Four intact examples of small hearths, each defined by a roughly-circular group of cobbles, were found at B2 Level 3 (Field Sketch 19), A2 Levels 7 and 8, A4 Level 6, and A5 Level 5.

Many of the cobbles and large pebbles were not, however, associated with a hearth, and may have been stockpiled for use as flaking cores, hammerstones, hearthstones, or anvils. One of these stockpiles, in Square A4 Levels 5 and 6, was made up of 20 pebbles, a cobble, and a flat slab (Field Sketches 14A and 14B).

Seven of the cobbles had been broken across, which is presumably the first stage in preparing a flaking core (Flenniken and White 1985). In Square B2 Level 1, two acid volcanic pebbles (weights 113 and 116 g) were found broken in halves, and could be refitted.

It will be suggested in Chapter 9 that these igneous cobbles may also have been used to abrade the hole in a "blank" shell fishhook. Other uses may have included pounding tough reef shellfish to tenderise the meat, smashing open the heads of fish such as snapper to expose the brains, pounding bracken fern roots, and pulverizing shellfish that were to be used as burley to attract fish.

Cobbles were not uniformly distributed throughout the Levels. Of the 64 cobbles found in the AB-trenches, only 4 were in Levels 0 to 2 inclusive.

The C-Trenches

Flaked material

The 1.5 cubic metres of excavated material in the four C-Squares yielded a total of 513 waste flakes of stone, made up of 36% chert, 60% igneous materials, and 4% other lithic types. (See **Tables 8.1 and 8.2**). There was considerable variation between the four Squares: chert ranged from 20 to 52%, igneous materials from 46 to 78%, and “other” from 2 to 10%. These variations are not unexpected in view of the small sample sizes (69 to 207 flakes per Square). The “other” lithologies amounted to only 23 flakes, made up of quartz, quartzite, and silcrete.

These waste flakes were associated with five flaking cores, four of them found at Level 2 in Square C1. These cores were made up of 1 chert, 2 igneous materials, and 2 possible quartzites. In addition, there were four pebbles (1 chert, 1 igneous, and 2 possible quartzites) showing minor flaking. Perhaps these pebbles proved unsuitable for further flaking.

Implements

Despite there being 513 waste flakes, not one flake-and-blade tool was recognized. The nearest approach to one was a trimmed slice of porphyry, 111x76x23 mm (443 g), found with the assembly of large stones in Squares C3/C4.

The other items (see list below) are generally cobbles showing use as pounders. There is one massive slab (3.9 kg) that has been trimmed around the edges to form an anvil. These items are all made of the local porphyry, except for a small slightly-flaked pebble of chert (33.6 g). It is listed above as a possible flaking core, but appears to bear some polish and may therefore have been used as a millstone.

List of stone implements in the C-Squares

<u>Hammerstones</u>

C3 Level 2 1 wedge-shaped acid volcanic cobble (207 g) with a battered end
1 spade-shaped acid volcanic cobble (470 g) with one battered end
1 thin slice of acid volcanic (182 g), battered on one end

<u>Miscellaneous</u>

C1 Level 2 1 flaked pebble of chert (33.6 g), possibly used for grinding

<u>The C3/C4 Stone Assembly</u>

1 trimmed acid volcanic slab (3.9 kg), 290x190x48 mm
1 trimmed acid volcanic slice (443 g), 111x76x23 mm, possibly a very rough worimi cleaver
1 acid volcanic hammerstone (426 g), 95x64x43 mm; smooth, with slight end-battering

Cobbles, large pebbles, and slabs

These items are not readily separated, and are therefore combined. (Arbitrarily, “large” pebbles weigh above 20 g). There were 89 of these items (including two cobbles of coal), with a total weight of 23.78 kg (corresponding to 15.8 kg/m^3). These figures include cobbles and broken slabs in the large assembly of stones (19 items, total weight 9.3 kg) found at the C3/C4 boundary in Level 2. (See below). Some of these 89 items weighed above 500 g. All sizes, from the arbitrary lower one of 20 g and upwards, were represented, and there was no obvious size selection. The frequency of occurrence of these heavy items is obviously higher in the C-Squares than in the AB-Squares.

These 89 items invariably have waterworn surfaces, and only four of them are not local igneous materials. These four exceptions are a fragment (13.3 g) broken off the end of a quartz cobble, a large pebble of chert (95.3 g), one quartzite pebble, and a pebble of an unidentified green rock.

Twelve of these 89 items have been broken. There are three broken slabs in the assembly of large stones, and nine other cobbles or pebbles have been broken. These breakages possibly represent the first step in preparing flaking cores.

Arrangements of large stones

At Level 2, an assembly of 19 large stones was found, extending across parts of Squares C3 and C4. (See Field Sketch 25 and photo 30). The cluster was made up of 11 cobbles and small boulders (totalling 7.99 kg), 3 broken blocks (totalling 0.9 kg), a pebble (30 g), the three implements (4.77 kg) listed above, and a cobble of coal (69 g). One of the broken slabs had a rounded cobble resting on top of it. Four of the items in the cobble/boulder category weighed more than 1 kg (the largest 2.1 kg) and the trimmed slab, 3.9 kg. There must have been a definite purpose in carrying such heavy objects up from the strandline. The three broken blocks, and six of the cobbles, had at least one flat face, which suggests use as anvils or work-benches. This "working area" was not associated with a concentration of stone flakes; other possible uses for slabs and hammerstones have been suggested above under the AB-Squares heading.

There was another group of large stones in a corner of Square C1, Level 2. The cluster consisted of eight cobbles and boulders (see Diagram **4-9**). The three largest items formed a group consisting of a large stone resting on top of the other two, presumably to form a workbench (Photos 22 and 24). These three stones lay outside the boundaries of Square C1, so they were reburied.

The D-Trenches

Flaked material

The level of waste flakes was much higher in the D-trenches: 1424 items corresponding to 812 per cubic metre. (See **Tables 8.1** and **8.2**). The proportion of chert was rather higher (57.6%) than in the other excavated areas at Birubi, and of the igneous materials rather lower (30%). Quartz also appeared at a significant level (11%). The balance (1.5%) was made up of silcretes and quartzites. Four flaking cores were recovered: one chert, one silcrete, a grey igneous rock, and an unidentified siliceous material.

The waste flakes were noticeably more numerous towards the surface. The material from all Level 0 combined has a flake density of 2369/m^3; in Level 1 it is 676, and in Level 2, 234. These figures are to be expected, since the midden material in the lower Levels was mixed with a great deal of sterile sand.

Implements

Listing

Level	Square	Item	Material	Comments	Weight (g)
0	D1	elouera	chert	Heavily used	50.6
		slice	igneous	Broken and battered	134.8
	D2	flake	chert	Used on two edges	5.0
		flake	chert	Used on one edge	0.7
		blade	chert	Broken blade butt, roughly backed	0.1
	D3	elouera	igneous	Chord-used; 70 mm long	56.1
		flake	chert	Edge use	4.0
		blade	chert	Edge use	1.3
	D4	elouera	chert	Heavily used	10.2
	D9	flake	chert	Used	0.8
	D10	flake	chert	Heavy use on one edge	11.4
1	D1	elouera	chert	-	32.1
		flake	chert	Used	6.3
		flake	chert	Used and broken	1.0
	D2	flake	chert	Edge and end use	11.9

		flake	chert	Broken and edge-battered	0.8
		anvil	igneous	Battered on one face	250
	D-3	elouera	chert	Roughly made; heavily used	20.1
	D-9	flake	chert	Used	3.8
2	D-1	elouera	chert	Heavy retouch	22.4
		flake	chert	End-used; elouera-like	7.9

There are 19 flake-and-blade tools, plus an anvil and a heavy slice. There is a strong *eloueran* element, provided by six items. One item is described as a "roughly backed broken blade butt", but the "backing" is not unequivocal.

Of the 19 flake-and-blade tools, 95% are of chert, in contrast to the 58% chert in the waste flakes. Many of the waste flakes are igneous materials, and it has been commented for the other Trenches that the tools made from it are either unrecognisable, or were perhaps discarded elsewhere. Some of the igneous waste may have been generated while fashioning core tools, such as the worimi cleaver that is common enough on the surface of the Birubi middens.

There are no quartz tools, though some might be recognized if the waste flakes were subjected to microscopic examination of their edges.

Slabs, cobbles, and large pebbles

There were only nine of these items in total for the D-Squares, and generally they were small. This low occurrence may correlate with the limited use of tough reef shellfish, or with the low level of fish bone on this part of the midden.

Overall view of the excavated stone material

Possible zoning of Aboriginal activities on the midden site

The data given above make it clear that there was far less working of stone at the AB-trench area than at areas C or D. A possible explanation arises from the data summary shown in **Table 8.3**.

Table 8.3. **Comparison of some indices of occupation density**
(All figures are given in units per cubic metre)

Trenches	Shells (min. no.)	Fish Bone (g)	Shell Fish Hooks (no.)	Charcoal (g)	Stone flakes (no.)
AB	6357	4623	32	669	85
C	16285	955	0	155	479
D	13300	280	0	211	683

The amounts of charcoal can be used as a rough measure of cooking activity. While the areas used for cooking and stone-flaking obviously overlapped, it is reasonable to assume that some areas were preferred for one or other of these activities. The area of the AB-trenches emerges as the one preferred for cooking fish, and making shell fishhooks, but was less popular for flaking stone. Indeed, our excavation revealed that at times a lot of fish bone and shell accumulated without *any* stone-flaking taking place. Possibly the AB-trenches area was essentially the women's camp, where they made their fishing gear and ate their catch, but did much less stone-flaking than the men who used other parts of the Birubi site.

There is however another possible explanation. The material in the AB-trenches is all quite recent, less than 500 years old. In the C- and D-trenches, the bottom dates are much older (about 1400 years BP), and it is possible that all the material from these trenches is older than 500 years. If there were a stronger tradition of stone-flaking in these older times, our data would be explained. In the absence of any dates for upper levels in the C- and D-trenches, this hypothesis cannot be rigorously tested at the time of writing.

Relative sizes of waste flakes of chert

One can calculate from the data in **Table 8.1** that the average weight of waste flakes in the D-Squares is 0.38 g, much less than that in the AB-Squares (1.65 g) or the C-Squares (1.41 g). However, such an observation could be skewed by a few large pieces of waste in the samples. In order to check if these average weights indicate a real difference in stone-flaking practice, the data need to be analysed in various ways to see if these differences in average weight of the flakes appear consistently.

Below, comparisons are made *within* each Trench system as well as between them. **Tables 8.3**, **8.4**, and **8.5** list the data for Trenches AB, C, and D respectively. For each Trench, the Tables have been divided into an **a**-part for the total Squares, and a **b**-part in which data at each Level across a group of Squares are compared.

Table 8.4a. Mean weights (g) of chert waste flakes per Square in the AB-Squares

Square	No. of flakes	Total wt. (g)	Mean wt. (g)
A2	51	53.90	1.06
A3	60	61.23	1.02
A4	37	86.07	2.33
A5	22	67.69	3.08
B1	13	15.35	1.18
B2	28	62.94	2.25
Totals	**211**	**347.18**	**1.65**

Table 8.4b. Mean weights (g) of chert waste flakes per Level in the AB-Squares

Level	No. of flakes	Total wt. (g)	Mean wt. (g)
0	40	67.45	1.69
1	100	145.53	1.46
2-9	71	134.20	1.89
Totals	**211**	**347.18**	**1.65**

Table 8.5a. Mean weights (g) of chert waste flakes per Square in the C-Squares

Square	No. of flakes	Total wt. (g)	Mean wt. (g)
C1	42	25.04	0.60
C2	31	12.74	0.41
C3	58	118.84	2.05
C4	54	103.47	1.92
Totals	**185**	**260.09**	**1.41**

Table 8.5b. Mean weights (g) of chert waste flakes by Levels in the C-Squares

Level	No. of flakes	Total wt. (g)	Mean wt. (g)
0	35	24.71	0.71
1	57	146.79	2.58
2	68	58.08	0.85
3	25	30.51	1.22
Totals	**185**	**260.09**	**1.41**

Table 8.6a. Mean weights (g) per Square of chert waste flakes in the D-Squares

Square	No. of flakes	Total wt. (g)	Mean wt. (g)	Range in Levels
D1	137	58.25	0.43	0.31-0.64
D2	237	78.46	0.33	0.21-0.44
D3	109	47.28	0.43	0.35-0.89
D4	141	31.01	0.22	0.21-0.27
D9	73	27.51	0.38	0.31-0.39
D10	55	25.96	0.47	0.09-0.59
D11	68	40.61	0.60	0.12-0.77
Totals	**820**	**309.08**	**0.38**	

Table 8.6b. Mean weights (g) of chert waste flakes by Level in the D-Squares

Level	No. of flakes	Total weight (g)	Mean weight (g)	Ranges
0	472	168.00	0.37	0.21-0.77
1	269	101.84	0.35	0.09-0.89
2	75	39.11	0.52	0.03-0.64
3	4	0.13	-	-
Totals	**820**	**309.08**	**0.38**	**-**

As expected with rather small numbers of waste flakes, there is considerable local variation in their mean weights. Nevertheless, it is clear that the waste flakes of chert from the D-Squares are consistently smaller than those from the AB-Squares. Using Student’s t-test (see Chapter 11), we can be 99.5 % confident about this difference in size. The variations in flake size within the C-Squares are large, which leads to an unfortunate statistical outcome. Student’s t-test finds that there is no significant difference between flakes sizes in the AB- and C-Squares. For the difference between the flake sizes in the C- and D-Squares the level of confidence is only 90 per cent.

This type of analysis is not practicable for flakes of the local igneous materials, because, as noted earlier, there is great uncertainty about the division between “flakes” and “rubble”.

Choice of lithology by Aboriginal stone-flakers

Overall, for the AB-, C-, and D-Squares the percentages of chert in the waste flakes was respectively 44, 36, and 58 per cent. The range of values for individual Squares is however large (see **Table 8.2**) so that these figures do not necessarily reflect any real differences in the preference to use chert. (Large variations in preference for chert were also noted in the surface collections; see Chapter 2).

There can be little doubt that there was less use of local igneous rocks in the D-trench area, and in those D-trenches the percentage of "other" lithologies (mostly quartz) reached an appreciable level.

Table 8.3 data suggest that the high incidence of igneous waste in the AB-Squares may be connected with fishing. It was noted above that no flake-and-blade tools of local igneous rock were identified, which suggests that this rock was used to make tools that were used and discarded elsewhere. Some sort of use connected with fishing is consistent with these facts. The relatively poor cutting edge of porphyry flakes would be adequate for cutting bait or fish and one expects virtually all such artefacts to be lost at sea. The Aborigines would have seen little point in importing better quality stone (such as chert) to make flakes that had a very short working life.

Comparisons between Squares for cobbles, pebbles, rubble, coal, and ochres

These materials occurred in all parts of the midden. Amounts of these items are listed in **Tables 8.7** and **8.8** so that comparisons can be made. Note that cobbles, large pebbles, and slabs have been lumped together, because the boundaries between them are rather arbitrary. For the present purposes, I have defined a "small pebble" as one weighing less than 20 g. The high density of large stones in the C-midden has already been noted.

Table 8.7. Excavated cobbles, slabs, pebbles, rubble, coal, and ochre.

Squares	Cobbles, large pebbles, and slabs (no.)	Small pebbles (no.)	Wt. rubble (kg)	Wt. coal (g)	Ochres (no.)
AB	110	223	16.55	196.6	48
C	89	31	9.51	191.6	6
D	9	50	6.92	5.8	134

It is more meaningful to compare these items on the basis of amounts per cubic metre (**Table 8.8**).

Table 8.8. Amounts of excavated cobbles, slabs, pebbles, rubble, coal and ochre per m^3

Squares	Cobbles, large pebbles, and slabs (no./m^3)	Small pebbles (no./m^3)	Rubble (kg/m^3)	Coal (g/m^3)	Ochre (no./m^3)
AB	20	40	2.96	34.5	9
C	58	21	6.34	128	4
D	5	29	3.96	3.3	77

The heavy use of ochre at the D-Squares is striking, as also is the low incidence of slabs and cobbles there. If the C- and D-middens are actually contemporary (as their base dates suggest) then the activities carried on at these two areas of the total Birubi site are quite different.

Rubble

Fragments of the local "country rock", a reddish quartz-felspar porphyry, were very numerous. This material has such poor flaking characteristics that this rubble just might be the outcome of attempts at making tools by flaking. However, the rubble is much more likely to have been produced by heat shatter of hearthstones, or by pounding. Some of the rubble was fire-blackened.

In Square A5 Level 3, there were six fragments of indurated sandstone amongst the rubble. This rock, which would have to be imported to the Birubi area, is usually associated with grindstones or fishhook files.

Small pebbles

These items occurred throughout the Birubi midden, but were most numerous in the AB-trenches. Most of these pebbles were local acid volcanic rocks, but others of them were quartz or an assortment of sedimentary materials. The smallest weighed less than a gram. Nearly all of them could be called "pretty" and it is quite possible that they were the playthings of children. Another possibility, that some were intended as fishing sinkers, seems improbable since the existing illustrations of Aboriginal fishing gear do not depict sinkers (see Chapter 7).

Coal

Nearly all the coal occurred as crumbling fragments with a mean weight under 1 gram. Many of the pieces were so brittle that they broke up on our sieves. There was very little coal in the D-trenches. (See **Table 8.8**).

Many of the fragments included a waterworn surface. There were three intact pebbles (weights ranging from 9 to 31 g) and two cobbles (69 and 90g). One can presume this coal has floated to Birubi. It will have originated in the Newcastle Coal Measures that are exposed in coastal cliffs between Newcastle and Catherine Hill Bay. Tiny pebbles and fragments of coal are common on the strandline of Little Beach, and it is likely that gale force winds can shift these very light pieces up onto the sand dunes. The high incidence of such quite tiny pebbles in the AB-trenches fits this model. Another possible route for tiny pieces of coal to reach the midden is by entanglement in the roots of kelp, which may have been gathered as fuel or for wrapping up fish for cooking.

The larger pebbles, and cobbles, of coal mentioned above would not have reached the midden by either of these routes. Probably these larger pieces were collected for burning, though we have no evidence of the actual burning. I am aware of only three previous reports of coal being present in Aboriginal occupation debris; these sites were at Swansea Channel (Dyall 1975), Audley (Cox, Maynard and Megaw 1968) and on the coast south of Swansea (Stockton 1972).

Ochres

These small, gritty lumps of sand were cemented together with a ferruginous material. Red-orange pigment might have been obtained from these low-grade ochres. Such lumps of iron-cemented sands, bonded together by humic colloids and iron oxides, commonly occur in the dune systems of the Newcastle Bight (Thom *et al* 1992: 116). All the ochres in the AB- and C-Squares were red-orange in colour. In the D-Squares, there were 56 red ochres and 78 yellow ochres. The high incidence of ochres in the D-Squares (**Table 8.8**) has been commented on above.

Some brown iron-cemented sandy lumps were also found, but it is doubtful if they were a useful source of pigment. I have not counted them above.

Pumice

Pumice occurred throughout the archaeological deposit, in the form of small rounded pieces. Hughes and Sullivan (1974) have argued that pieces of pumice larger than 10 mm in diameter in a midden indicate that this midden has been reworked by wave action. They observed that smaller pieces are moved by wind.

We have only two large pieces amongst 8068 pumice items (at Square B2 Level 4 and Square C2 Level 2). Apart from those two pieces, the pumice we excavated was indeed small: the mean weight was 78±26 mg in the AB-Squares, 135±61 mg in the C-Squares, and 77±27 mg in the D-Squares. The well-rounded shapes of the pumice pieces indicate a long history of deposition and re-exposure in the beach sands, and we believe they reached the midden by wind action. The lack of evidence for storm wave action on these middens is discussed in Chapter 6. The origin of this pumice is believed to be volcanoes in the Hawaiian Islands.

The numbers of pieces of pumice per cubic metre are 1324 for the AB-Squares, 145 for the C-Squares, and 251 for the D-Squares. The high number for the AB-Squares is to be expected, because these Squares are the closest to the sandy beach.

A curious feature of the distribution by Level in the AB-Squares is that pumice is most dense in Levels 1, 2, and 5-8. There is, then, a rough correlation with the density of occupation material (shell, fish bone, charcoal). I suggest that windblown pumice is most likely to be trapped and buried on a loose midden surface when people are present to scuff the sand and trample objects down into the midden.

Sources of stone

The possible sources of the flaked stone material found on Aboriginal sites in the Stockton – Tomago – Williamtown – Birubi area have been reviewed by Dean-Jones (1990). There are in fact a large number of possible sources: “Nobby’s Tuff” (chert) from the sea cliffs south of the Hunter River; “Shortland tuff” from the Tomago Coal Measures which outcrop at Shortland and Tomago; quartzites occurring in conglomerates near Grahamstown Dam; and a wide range of lithologies from outcrops of the King’s Hill Group and Gilmore Volcanics to the northwest of Port Stephens. Tracing the specific sources of the stone material found at Birubi would be a major project for a professional geologist.

The following notes put some personal observations on record, but are not intended to be a definitive survey.

Chert (“tuff”)

Other investigators (Enright 1932 and 1935b; Hall 1928; McCarthy 1947) have assumed that the Aborigines in this area used “Merewether chert” (which is known to geologists as “Nobby’s chert” or “Nobby’s tuff”) from the cliffs on the south side of the entrance to Newcastle harbour. Since the Nobby’s source is only 32 km from Birubi along the beach, it is highly likely that most of the chert from Birubi came from there.

Nobby’s is however not the only possible source of chert near Port Stephens. At the Williamtown site (see Map 2), Dr. Noreen Morris (*pers. com*. 1972) found “several” pieces of flaked chert containing the plant fossil *Rhacopteris*, which she had demonstrated in her doctoral thesis (Morris 1977: 204) to come from a seam of chert found below the waterline at nearby Tanilba. I myself found an example of *Rhacopteris* in a chert flake on another Aboriginal site at Williamtown. (This fossil was identified for me by Professor Brian Engel).

My own fieldwork revealed that the best quality of chert at Tanilba does not come from the obvious seam in a low cliffline behind the beach, but in the form of cobbles found along the shore below the highwater mark. These cobbles are coloured cream or grey on the outside, though both sorts flake to reveal a grey interior. While I have seen numerous

Rhacopteris fossils in the seam of low-quality chert, I have not seen any in the strandline cobbles I have broken open.

I am not aware of any fossils in the chert found on the Birubi midden, but in view of their absence in the strandline cobbles at Tanilba, it must be allowed as possible that Tanilba chert was brought to Birubi. The two places are within easy reach of each other: about 11 km if a crossing of tidal Tilligerry Creek is made.

Igneous materials from lavas

The headlands at Birubi are composed of quartz-felspar porphyry, which makes up nearly all the slabs, cobbles, pebbles, and rubble in the midden. Most of this material is of a red-brown colour, but some of it is grey. Further north-east along this coastline, there are dykes of dolerite, a material which appears at a low level of occurrence amongst the waste flakes. One of the edge-ground axes I found in surface collecting at Birubi was made of dolerite. According to Hall (Hall 1928) the lava flows north-east of One Mile Beach include andesite.

Ignimbrite

This welded tuff is almost certainly the material that was quarried to make two of the edge-ground axes I found at Birubi, and there were also waste flakes of it on the surface (see Chapter 2). I have a bondi point (found at One Mile Beach) made of ignimbrite. and C. Whitehead has shown me a cleaver (from Oakvale Farm; see Map 2) made of the same material.

Whitehead brought to my attention a possible source of this ignimbrite. It is a very small outcrop at the back of the Port Stephens shoreline at Mallabula (see Map 2), 9 km from Birubi. We found multiply-flaked pieces of ignimbrite, and the shattered appearance of the outcrop indicated that it had been quarried. The Birubi axes match the material in this outcrop (so far as one can tell without microscopic examination of a thin section), but some of the other items have a much higher incidence of black fragments present in the rock, and may come from some other outcrop. These identifications of the material were all made by Dr. S. Warne. According to Nashar (Nashar 1964), ignimbrite is widespread in the Hunter Valley.

Another source of flakeable ignimbrite has been pointed out to me, at the north-east corner of One Mile Beach (GR187745) about 5.5 km from Birubi. Numerous cobbles of ignimbrite have been washed up into a tiny inlet within the rocky headland. The rocky slopes bordering the inlet are strewn with thousands of waste flakes of fine-grained ignimbrite, but I was able to find only one flaking core, and no tools I could recognize. It would appear the Aborigines tested the cobbles for suitability by striking a few flakes off before taking them to some other workshop area, which may have included the dune slopes behind the adjacent sandy beach.

The very small sizes of these two sources of ignimbrite point up the difficulty of locating the sources of stone material used by the Aborigines for flaking into tools. Col Whitehead and I have not been able to identify any similar sites along the ocean shore between Birubi and the entrance to Port Stephens, but small sites may nevertheless exist.

Silcrete

The level of flaked silcrete from our excavations was quite low, but my surface collections contained appreciable levels (about 10 per cent), both as waste flakes, flaking cores, and recognizable tools. I made the identifications of this lithology myself and they need checking. The colours are variously red, pink, grey, and yellow.

Dr. S. Warne has examined some artefacts collected from One Mile Beach and Williamtown, and has made positive identifications of silcrete. It occurs on all the Aboriginal sites on the south side of Port Stephens. At Williamtown, I estimate it made up 22% of the recognized stone tools.

The waste flakes, and flaking cores, of silcrete often show coroid surfaces, originally belonging to pebbles or small cobbles. Thus, this material has been obtained from strandlines or stream beds. Dr. Warne remarks that, during the last geological period of low sea levels, rivers such as the Hunter and the Karuah would have had much steeper falls to the sea. Thus, these rivers would have brought down large material (such as cobbles and pebbles) and deposited it in estuaries now covered by the sea. (In those times, the Hunter flowed into Port Stephens). Today, these deposits might be stirred up during severe storms and end up on the strandlines. We have not yet made a systematic search for silcrete on the Port Stephens strandlines.

Another suggestion, made to me by geologist Imants Kavalieris, is that the Hunter River has brought down silcrete from its upper valley and dropped this material to form cobble beds in its present-day estuary. Such beds might have been exposed from time to time in the wake of floods. However, the channel of the Hunter is believed to have silted appreciably as a result of European land clearances (Moore 1970) and these cobble beds are not likely to be visible today.

As well as this silcrete in the form of waterworn cobbles, there is a silcrete-like material outcropping along low ridges at Shortland and Tomago. Dean-Jones (1990: 18) states that these outcrops are technically tuffs and tuffites, but have some characteristics of silcrete. The outcrops show wide variations in crystallinity, degree of weathering, and colour. Baker (1994: 37) considers this material to be silcrete. Whatever the label one attaches to it, Dean-Jones has found this material on Aboriginal sites in the Williamtown area and we must allow it could be present at Birubi.

Comparison of surface-collected and excavated material

There was no surface collection on the C-Squares, and the AB-midden surface yielded little in the way of waste flakes or recognizable stone tools. Only for the D-midden can the comparison be made. Chert was used to make 95% of these tools in the excavated sample (n=19), and 80% of the surface-collected tools (n=124). For the waste flakes, 58% chert in the excavated sample compares with 51% and 25% in two total collections on the surface. The proportions of the other materials were also disparate (11% quartz in the excavated waste flakes, 2% in the surface collections). These variations could be due to individual flaking events (such as reduction of one large core in the sample area) and point up the futility of making much of the percentages.

The surface collections gave a much broader suite of recognizable tools. Whereas the excavation recovered only elouera, simple used flakes, simple blades, and an anvil, the surface collection had in addition to those items the following: a thumbnail scraper, edge-ground axes, worimi cleavers, hammerstones, a fishhook file, utilized pebbles, “fabricator flakes”, mortars, and mullers. This result is to be expected: the volume of midden that collapsed during a number of years to yield the surface collections clearly exceeded the small volume that was excavated. Note that the excavated sample would give a poor impression of the range of stone tools actually present on the site.

CHAPTER 9: IMPLEMENTS OF BONE AND SHELL

Implements of bone

Two types of bone implement were found at Birubi. One of these is an awl formed by grinding one end of a macropodid fibula, and the other type is made from small slivers of bone by grinding one or both ends to a point.

Awls

Two examples were excavated, both from the AB-trenches. These items had been made by breaking one end off a macropodid fibula and then grinding the broken shaft to a point. One of these awls (from Square A4 Level 7) is 95 mm long, and has an old break at the tip of the point. There is extensive use-polish back along the shaft from the tip. The other example (from Square A4 Level 1) is shown in Figure **9.1**. It is 123 mm long and bears polish on about 60% of its length. This item was broken in half during excavation but the freshly broken ends fitted together exactly. It is identical with the one illustrated by McCarthy (McCarthy 1976: 88, Figure 66 item 8), which came from North Cronulla in NSW, and also matches one from the Lake Burrill rockshelter on the south coast of NSW (Thorpe 1932: 78).

Threlkeld (Gunson 1974: 54) has described the use of a bone awl to perforate bark sheets so that they could be sewn as patches onto a bark canoe at Lake Macquarie. Other uses that have been listed by McCarthy (1976: 86) include pegging out skins to dry and the perforation of the edges of skins so that they could be sewn together. Dawson (1830: 116) reports an unexpected use at Port Stephens: "a young man carried a small sharp pointed bone, from the leg of a kangaroo. This was used as a comb, or rather to unravel the hair." This use of a bone point for toiletry was apparently not exceptional, because Enright (1900) recorded the Worimi word "kooyeroo" for a bone used to comb the hair.

These awls seem to have been multi-purpose tools and any one of these possible uses might have imparted the polish observed on our specimens.

Some years after our dig was completed, a private collector found another awl at the AB-midden. This specimen was broken, and only the pointed end was found. This highly-polished tip had been shorn off to leave a very oblique broken edge, which suggests the awl broke during rather rough usage. The remnant, 53 mm long, is a close match to our two excavated examples.

Small unipoints and bipoints

Excavation yielded three bone points that had been ground to form a sharp tip. These items were a unipoint (32 mm long) from Square A4 Level 5 (the bone probably from a small mammal, but possibly from a bird); another unipoint (42 mm long) from Square B2 Level 0 (ground on the fibula of a small mammal); and a bipoint (21 mm long and slightly curved) made of mammalian bone, from Square C2 Level 2. There was slight damage, of very recent origin, on one tip of the bipoint.

Bone slivers

Slivers and fragments of long-bones, from both birds and mammals, were common in all our excavation trenches. Again it appeared that most long-bones had been broken up to manufacture bone points, though one cannot exclude the possibility that some of the smashing was done to extract the bone marrow. The smashing produced broad fragments as well as slivers, and the dividing line between these two categories was quite arbitrary. Because I took 15 years to sort the excavated material, it is improbable that I maintained a consistent dividing line. Thus I do not propose to make a detailed statistical treatment of the numbers.

Most of the slivers found in the AB-trenches are bird bone. (Only Square A3 has more mammalian slivers than avian). This preponderance of bird bone slivers is strikingly different from the picture for the D-trenches, where virtually all the slivers are made of mammal bone. The C-trenches have a modest dominance of mammal bone over bird bone.

Table 9.1. Occurrence of bird and mammal bone slivers

Squares	Level	Bird Bone (no.)	Mammal Bone (no.)	Total Items
All AB combined	0	9	22	31
	1	13	19	32
	2	7	2	9
	3	6	1	7
	4	14	2	16
	5	42	16	48
	6	14	-	14
	7	9	2	11
	8	2	3	5
	Totals	**116**	**57**	**173**
All C combined	0	14	11	25
	1	26	43	69
	2	-	18	18
	3	1	1	2
	Totals	**41**	**73**	**114**
All D combined	0	3	82	85
	1	-	59	59
	2	-	1	1
	Totals	**3**	**142**	**145**

The numbers of bone slivers in the various Levels parallel other measures of "occupation density" (weights of fishbone, numbers of shellfish, etc); see **Diagram 6-1**.

Summary of bone artefacts

Both the finished bone tools, and the numerous slivers of bone, found at Birubi are typical of Aboriginal sites in Australia (McCarthy 1976: 86). My belief that the slivers were made by shattering the bones (rather than by graving the outline with a stone burin) matches the conclusion drawn by Lampert (1966) from his excavations at Durras North on the south coast of New South Wales.

The small unipoints and bipoints ("muduks") are generally agreed to function as the point, or combined point and barb, on spear heads. Examples of bone muduks mounted on the prongs of fish spears from New South Wales are held by the National Museum of Victoria (McCarthy 1940). Muduks are also attached to two fish spears collected at Botany Bay in 1770 by Cook and Banks (Megaw 1969). The Australian Museum has a series of wooden spearheads, found at Lake Wonboin on the south coast of New South Wales, which have single-ended muduks bound onto them (McCarthy 1976: 88). Early observers in the Newcastle region of New South Wales have recorded muduks serving as barbs or points on hunting and fishing spears (see Chapter 7).

It has been argued by Massola (1956) that some short muduks were probably used as fishing gorges. Such a gorge would be tied with the line about its middle. A fish taking the bait could be secured by jerking the line to lodge the sharp ends of the gorge in its mouth.

At Birubi, the conversion of long-bones (both mammalian and avian) to slivers was a major activity. It will be suggested later that the numerous shearwaters brought to the site may have been intended for bone points rather than eating. The predominance of bird bone slivers at the AB-midden is consistent with this being a women's camp, while the D-midden would then belong to the men, who hunted mammals. However, this possibility assumes some overlap of the two middens on the time scale, and we need more dates before we can safely make that assumption.

Shell fishhooks

General remarks

The shell fishhooks provided the most exciting discovery at the Birubi site. A total of 181 hooks were found, 9 of them intact and the rest of them broken or incomplete. Moreover, nearly all the stages in their manufacture were revealed. These hooks were all found in the AB-Squares. Two of the C-Squares yielded the trimmed "blanks" from which the hooks were made, but the status of these blanks is uncertain and will shortly be discussed in more detail. There was no indication of shell fishhooks at the D-midden.

Two types of shell hook have been recognized on the south coast of New South Wales. Wooley (1966) has called these the C-hook and the J-hook. Both these types are represented at Birubi: see Figure **9.2(a)** for an intact example of a C-hook and **9.2(b)** for a complete J-hook. The hooks were made in a wide range of sizes (see Figures **9.2 (b, c, d)**). At Birubi, the J-hooks easily predominated (91 examples, as against 19 C-hooks; the other 71 hook items were indeterminate fragments).

Both the occurrence of these shell hooks, and the method of manufacture, placed this Birubi site firmly within the hook-making industry so well documented for the Sydney region and the south coast of New South Wales. Birubi appears to be the northern limit of shell fishhook manufacture on the New South Wales coast. It is noteworthy that at Birubi the J-hook was strongly preferred, whereas nearly all the hooks reported from further south were the C-type (Lampert 1966; Lampert and Turnbull 1970; Megaw 1972; Megaw and Roberts 1974; Rolfe 1931; Wooley 1966).

Raw materials

The shell hooks at Birubi were nearly always made from the heavy turban shell, *Turbo torquatus*. This shell can be found in the low-tide zone on the adjacent rocky shore, and it has an appreciable level of occurrence in the shell middens (see Chapter 10). This species is the usual one reported for hook manufacture on the south coast of New South Wales (Lampert and Turnbull 1970; Megaw 1972; Wooley 1966). However, on the northern side of the Sydney region, at the Great Mackeral rock shelter in Kuring-gai National Park, McDonald (1992) reported that the shell hooks seemed to be made of the rather smaller green turban (*Turbo undulatus*). It was not always possible for us to distinguish between the two *Turbo* species with fragmentary material, but we do have one definite example of a trimmed hook "blank" made of *T. undulatus* (see later). I believe that all the finished and near-finished hooks were made from *T. torquatus*. The other local *Turbo* species, *T. militaris*, has not been identified in the Birubi middens.

There are two early reports from within Port Stephens of fishhooks being made of oyster shell (Caswell 1841; Ebsworth 1826: 79), and one of "oyster or pearl shell" (Dawson 1830: 66, 308). Oysters were abundant within the harbour and this use of oyster shell is possible, though whether these observers made a correct identification of the shell is uncertain. There is one report of finding a hook made of oyster shell, at Lemon Tree Passage on the south side of Port Stephens (Dean-Jones 1990: 110). The shank of this hook is bored through, which is unique amongst the hundreds of shell hooks known from coastal New South Wales. According to the illustration provided in the report, the hook is incomplete, and in my opinion one cannot be certain it really is a hook. It might have been a pendant ornament. Be that as it may, there was very little oyster shell in the Birubi middens (see Chapter 10) and it is hardly surprising that we found no involvement of oysters in the fishhook industry.

Scott has reported that at Port Stephens "Some of the hooks were fashioned of bone after the primitive style" (Bennett 1929: 18). We did not find any bone hooks at Birubi.

Stages in making a shell fishhook

The following description of how shell fishhooks were made makes the task sound a protracted one. However, Collins (1798: 283), writing at Port Jackson, says the hooks were "quickly made".

<u>(i) Preparation of "blanks"</u>

The spade-shaped blanks were broken out of the turban shell, following the spiral opening around the columella, until no more pieces could be removed (see Figure **9.3(a)**). There is no ethnohistorical record of how this exercise was carried out. I have been able to produce blanks by placing the turban shell on a bed of sand, inserting a wooden punch into the opening, and striking a smart blow with a hammerstone. Nevertheless, the Aborigines may have used some other method.

One can ask whether the heavy turban shells were collected live or dead for making into fishhooks. If they were collected live, the shellfish had to be removed so that hook blanks could be made from the empty shell. Either there was some way of getting the securely-anchored shellfish out without smashing up the shell, or the large edible shellfish was sacrificed by allowing it to rot. Alternatively, empty turban shells were collected from the strandline, where they are cast up in appreciable numbers during storms. The presence of 85 *intact* heavy turban shells in Square C2/2, and 30 of them in Square C3/2, may represent caches of such collections, because generally there were very few intact turban shells in the middens at Birubi. On the other hand, there is no totally compelling evidence for making shell hooks at the C-midden and these caches may be due to some other cause.

Heavy turban shells were often found smashed into pieces, apparently to get out the meat, and it seems impossible to determine the proportions of turbans treated this way or kept intact for making into shell hooks. I have analysed the data for turban material in various ways without being able to determine if the turbans destined for shell hook manufacture were collected live or dead.

The "broken spiral" of a heavy turban shell (see Figure **9.3(a)**) is characteristic of a shell hook industry, but it is often difficult to distinguish such a shell from one that had been broken into in order to eat the shellfish. Most turbans were broken: in the D-Squares, 177 out of 189 heavy turbans had been smashed, but there was no evidence there of shell fishhook manufacture. The breakage looked to be haphazard, and not directed towards producing hook blanks. Probably, smashing turban shells to get at the meat also occurred in the AB- and C-Squares, but some of the shells here looked to have been broken to obtain hook blanks.

It is not practicable to make an accurate count of the shell blanks the artisans intended to make into hooks. Some spade-shaped pieces were doubtless produced accidentally when smashing up turban shells to get at the meat. There are also blanks that split end-to-end while being broken out of the parent shell, and it is unlikely I recognized all of these. The *apparent* numbers of hook blanks are 223 from the AB-Squares and 183 from the C-Squares.

The haphazard occurrence of archaeological items is well exemplified by the C-Square shell hook blanks: all 183 came from C1 and C2 and *not one* from C3 and C4.

The sizes of the blanks are quite variable. The largest I have recorded is 46x32 mm and the smallest, 12x10 mm. However, only 9 examples were recorded, because when I came to make the measurements in 1994 many of the shell items were seen to be disintegrating. Therefore I shipped them off to The Australian Museum for urgent conservation. The largest shell hook I have seen was a J-hook measuring 45 mm from the shank end to the outer edge of the curved base; it was collected by another person on the surface of the AB-midden. The smallest I have seen is the one illustrated in Figure **9.2(b)**; its corresponding measurement is 20 mm. Presumably these different hook sizes were manufactured with different target fish species in mind.

<u>(ii) Trimming the blanks</u>

The outer edges of the blanks were trimmed by delicate chipping. Some blanks were trimmed right around (Figure **9.3(b)**) whereas others were only partly trimmed (Figure **9.3(c)**). Some of the blanks split lengthwise during this trimming, probably because their initial fabrication had produced hairline cracks. I am not able to say how this trimming was done, but there are several possibilities, such as pressure flaking with a stone flake, or delicate hammering along the edge of the shell with a pebble. In the latter case another pebble, chosen to match the natural curvature of the shell blank, would be a suitable anvil.

The blanks at Birubi confirm the observations made by Wooley (1966) at Lake Wollumboola on the south coast of New South Wales: the long axis of the intended hook lay parallel to the spiral striae and the shorter axis parallel to the growth lines of the shell.

(iii) Making the hole in the blank

The shell fishhook is a widespread artefact in the Pacific region, and its manufacture has sometimes been closely observed. At the Society Islands, Beasley noted the speed with which a hole could be bored in a pearl shell with a shark's tooth. Sometimes the hole was drilled with a sharp-cornered stone mounted on a cane shaft (Beasley 1928: 38, 40). We found no suitable shark's teeth at Birubi, and the drill has not been reported from the east coast of Australia. It is however feasible that the shell blank, once thinned down by abrasion, could easily be perforated by a few twists on the corner of a stone flake. An alternative method, reported by Roth (1904) from Cape Grafton in North Queensland, was to heat the centre of the blank until it was brittle enough to knock out. Rolfe (1931) refers to this method in connection with shell hooks he collected at Quibray on Botany Bay, but he provided no evidence and may have been quoting Roth without acknowledgement.

Ethnohistorical sources in the Newcastle–Port Stephens area are generally vague about how the local Aborigines produced the hole in the blank, and my own experiments indicate it is not as easy as it sounds. An example of an unfinished hook (see Figures **9.3(d)**) shows that the convex surface of the blank was abraded on a rough surface. The scratches from this back-and-forth rubbing can be clearly seen. Because the blank is quite curved in the direction of both axes, the effect of this rubbing is to wear away the centre and leave the edges intact.

The best way I have been able to devise is to firmly rub the blank back-and-forth on a wet stone whose surface is rough. Weathered cobbles of acid volcanic material from the Birubi headland serve admirably for the purpose. Threlkeld's observation, at Lake Macquarie, of hooks being made by grinding a shell down on a stone (Gunson 1974:54) is a good description of the method. I have used rounded cobbles, but the wider end of a spatulate fishhook file would also be suitable for this abrasion, the file being held stationary by its narrow end.

While my grinding method quickly produced a blank whose centre was very thin (as in Figure **9.3(d)**), I needed some practice before I could achieve the final perforation without disaster. A firm downward pressure is needed to abrade the shell blank on the grindstone, and it is important to exert this finger pressure on the *bottom* of the concavity when perforation is about to occur. If there is any pressure on the raised edges of the curved shell at the instant the shell is worn through, the blank will split from end to end. The Aboriginal artisans only rarely broke their hook blanks this way.

With large shell hooks, the pressure on the bottom of the concave blank during grinding requires several fingers and avoiding the end-to-end split is more difficult. A solution to this problem involves a pebble of matching curvature, placed inside the blank to relay the downward pressure. Alternatively, the partly-abraded blank can be inverted over the pebble while the hole is filed through from above. There were numerous pebbles in the AB-midden, and they may have been used for such purposes. On the other hand, a practised operator drawing upon generations of experience may have been able to file holes in blanks without needing such aids.

Whatever the method of making the perforation, it would have been a simple matter to enlarge it by chipping out the shell already thinned by abrasion. There are many hundreds of tiny chips of turban shell from the excavation of the AB-Squares, and I believe they came both from this enlarging of the hole and the trimming of the blanks in the previous stage.

(iv) Refining the shape: C-hook or J-hook?

In one version of making a hook, both the inside and the outside of the perforated blank were filed smooth. The outer edges may have been filed on a large stone, but the inner edges would have required an elongated fishhook file (see Sketch **2.4**). The end result then was an oval annulus (Figure **9.3(e)**). According to Roth (1904), and Lampert and Turnbull (1970), one corner was filed off this annulus to obtain a crescentic ("C-type") hook. Megaw (1972) has illustrated an example from Kurnell, which has the "corner" of the annulus filed off but the hook otherwise incomplete. I find that this filing requires great care, and it is easiest to do it with the annulus held down on the curved face of a pebble.

The oval annulus looks an unlikely precursor to the J-hook, and my experiments suggest that the J-hook shape is determined right back at the stage of grinding a hole in the blank. If the abrading is done on the angled edge of a grinding slab, the thinning of the blank can take on a pronounced oval shape extending out from the middle to one edge of the blank. Once the hole appears in the middle, it is easy to chip out the thinned edge with the corner of a stone flake. The result is a partly finished but easily recognized J-hook, similar to the one shown in Figure **9.3(f)**. The rough shape of the inturned point is already in place.

The chipping out of the "opening", or gape, of the J-hook would be facilitated by giving the original blank a bevel such as that shown in Figure **9.3(d)**. This bevel would serve no useful purpose in making a C-hook, and there can be little doubt that the blank shown in Figure **9.3(d)** was intended to become a J-hook.

Almost all the hooks we recovered had been broken near the point. It seems unlikely that these hooks were broken while in use for fishing, because numerous points were found in the AB-midden. More likely, these hooks were broken at the stage of filing the point. One of the broken points had not yet been filed on its second edge. The other common breakage was in the wide bend at the lower end of the shank.

The outer mantle of the original shell was always left on the medium- and large-sized hooks, but was often missing from the small hooks. In some cases (see Figure **9.2(b)**) the mantle had been filed off, but in others it may have weathered off while buried in the midden.

The points on the four intact J-hooks were noticeably "turned in" (see Figure **9.2(b)**). This feature can more readily be seen in Figure **9.2(d),** even though part of the point of this much larger hook is missing. Also, we have many examples of broken tips showing this incurving (Figure **9.2(e)**). At first sight this incurving of the hook is surprising, because it seems to make it difficult to hook the fish. However, as Anell (1955: 116) has pointed out, the hook with inturned point has a most useful property: it does not easily get snagged on the bottom. He states that there is a special technique for using these barbless hooks: one must never "strike" the fish, but keep a steady gentle tension on the line and let the fish hook itself. The inturned point is a general feature of hooks from the Pacific region.

With the J-hooks, the inturned point lies a little above the plane defined by the rest of the hook. This feature reflects the curved shape of the blank from which the hook was made.

Amongst the J-hooks, there is considerable variation in the relative lengths of the shank and the other half (the "point-leg") of the hook.

(v) Notching the shaft

The shanks of the J-hooks were always notched, on one or both sides, to make the attachment of the line more secure. The C-hooks were not always notched (see Figure **9.2(a)**); a private collector has shown me another such example from the AB-midden.

According to Anell (1955), the Aborigines wound the line in a spiral around the entire shaft, afterwards reinforcing it with some kind of resin. The two extant drawings of fishing lines from Newcastle, made by the convict artist Browne (Sotheby's 1987; McCarthy 1945) do not show the whole shank covered with windings of line, but do appear to have the line stuck on with a blob which might be resin.

Indicators of shell hook manufacture

Even when no actual shell hooks (whether broken or not) were present, there were other indications of their manufacture. Firstly, there was the columellum of the heavy turban shell, discarded after several "blanks" had been broken out of the spiral shell. Many of these shells were of course broken into so that the meat could be extracted and eaten, but in numerous cases the spiral shows clear evidence of the removal of two or three spade-shaped pieces. The seven D-Squares, in which there was no evidence of hook manufacture, yielded only three heavy turban shells which had been broken into this way. The four C-Squares yielded 186 of them (along with other possible evidence of shell hook manufacture to be discussed later), and there were 525 such items in the six AB-Squares.

Secondly, there are the "hook blanks", many of which were discarded. Some of these had split during their production. Undoubtedly some of these spade-shaped pieces were produced – along with numerous fragments with other shapes – when turban shells were broken up to get at the shellfish meat. But the number of apparent "blanks" correlates quite well with the absence or presence of shell hook manufacture. The D-Squares yielded only three possible blanks, none of them convincing. The C-Squares yielded 183 of them, and the AB-Squares 220. As with the broken shells discussed in the previous paragraph, one should not associate occasional "blanks" with definite hook manufacture, but the possibility of association is strong when numerous blanks are present.

The *trimmed* blanks are almost certainly connected with making shell hooks. None of them was found in the D-squares, but there were 5 in the C-Squares, and 26 in the AB-Squares. In these counts I have not included the "worked edges" of heavy turban shells (see later), which probably are blanks that broke during the trimming process.

Finally there are the tiny chips (<1 cm long) which were detached in trimming the edge of the blank, and perhaps also when enlarging the perforation in the abraded blank. We must concede that *some* chips would form accidentally when shellfish were smashed open to get at the shellfish. Nevertheless, we note the distribution of these chips: none in the D-Squares, 19 in the C-Squares, and 7926 in the AB-Squares.

Samples of shell chips were retained from all Levels in Square A5, as well as from B1/5 and B2/5. Some other researcher may wish to use computerised retrofitting techniques to learn more about how and why these chips were detached.

Were green turbans used?

Extraction of the meat from the green turbans (*T. undulatus*) had broken them up much more extensively than was the case with the more robust *T. torquatus*. Thus it was not always possible to decide whether the fragments of *T. undulatus* were accidentally or deliberately shaped. From the AB-Squares, there were 135 green turbans that had been broken into by enlarging the opening, 40 from the C-Squares, and one from the D-Squares, but the breakage is possibly no more extensive than was necessary to extract the shellfish meat.

I have not identified green turban shell in any of the finished hooks. However, there was one definite *trimmed* shell hook blank of green turban shell from Square A4/5, so there can be little doubt that *T. undulatus* shell was sometimes used to make the smaller hooks. We also found examples of *untrimmed* blanks made from green turbans in Square C2/1 but there is no certainty these were precursors to shell hooks (see below).

Dates of shell fishhooks

Shell hooks occurred in the AB-midden all the way back to its base date of 490±90 BP. That age is younger than some other shell hooks found on the coast of New South Wales (Sullivan 1987). We also have indications of shell hook manufacture in Square C1 Level 2, which was dated to 1340±80 BP. That is a surprisingly early date for shell fishhooks, which hitherto have not been thought to appear before 1100 BP (Mulvaney and Kamminga 1999: 292). We must therefore carefully consider the evidence for this very early date at Birubi.

We did not in fact find any shell fishhooks in the C-Squares, and must rely on less persuasive evidence that hooks were actually made there. The indicators of shell hook manufacture have been discussed above. In the AB-Squares, the hooks found there were associated with turban shells broken open in stages around their spirals, shell hook blanks trimmed around their edges, and large numbers of tiny chips removed in the shaping of blanks.

The four C-Squares have a total of 186 heavy turban shells that appear to have had hook blanks broken out of them. Squares C3 and C4 have no spade-shaped blanks, but C1 and C2 have 183 of them. However, only 5 of these showed evidence of edge-trimming.

The date was obtained from Square C1 Level 2, in which there were 7 possible shell hook blanks. These spade-shaped pieces could of course have arisen accidentally when shells were broken open to extract the meat. Only one of these blanks was trimmed around the edges as if in preparation for making a hook. The evidence for shell hook manufacture at Level 2 rests heavily on this single item. Its status as a hook precursor was not supported by association with numerous tiny shell chips: there was only one such chip.

If we accept this one trimmed blank as evidence hooks were made here 1340 BP, we must be quite certain that trimmed spatulate pieces of heavy turban shell were always intended as precursors to fishhooks. In my view we cannot be certain on this point, because we have found other shell items with chipped edges that are not related to fishhooks (see below). Even if this lone item really is a fishhook blank, there is no guarantee that it has not been pushed down from some higher (more recent) level in the midden.

There is no compelling evidence that shell hooks were made even in the upper Levels of the C-middens. Despite all the broken heavy turban shells and spatulate fragments, there are only 19 tiny chips of heavy turban shells altogether in these four Squares, and these might well have been produced while extracting the meat from the shells. If hooks were made here, one would certainly expect to find broken or discarded hooks, and there are none. A possible explanation is that the blanks were made at the C-midden, but the later stages of making hooks were carried out elsewhere, perhaps closer to the water that was needed for the grinding process.

Manufacture of miscellaneous shell items

From Square A3/6 we recovered an item, chipped from a heavy turban shell, in the form of a shallow crescent. It measured 49 x 11 mm. If this item is some sort of fishing tackle (such as a lure), it may be unfinished. Another possibility is that it was intended as an ornament. There was another such item, measuring 47 x 14 mm and only roughly shaped, from B2/4.

Use of unmodified shell

While sorting and identifying the excavated shell material, I recognized 97 pipi shells with obvious use on the edge. The AB-Squares yielded 79 of these, of which 9 were broken. In the C-Squares, C1 gave one example, and Square D1 gave 17. The distinction between "obviously used" and "casual damage by treadage" is highly subjective; it is likely that I overlooked large numbers of pipi shells bearing only slight damage from intentional use as tools. Many of those I recognized had been used as edge scrapers. Shell scrapers are documented from other coastal sites in New South Wales though the species used there were cockle (*Anadara trapezia*) or tapestry shell (*Tapes watlingi*) (McDonald 1992; Megaw 1972).

In addition to the pipi shell examples from Birubi, we recovered 29 heavy turban shell fragments with worked edges, all from the AB-Squares. It is likely these broken fragments were produced by mishap while trimming the edges of shell hook blanks, but use as scrapers or graving tools is also possible.

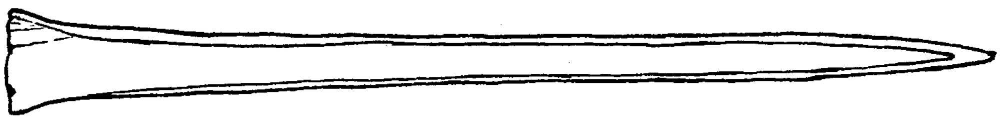
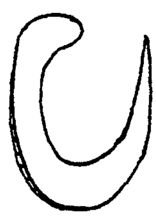
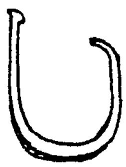


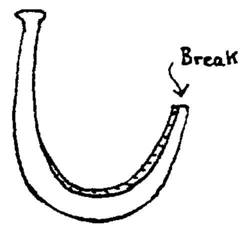
Figure 9.1. Awl made of macropodid fibula. (Actual size). The surface shown uppermost is slightly concave.



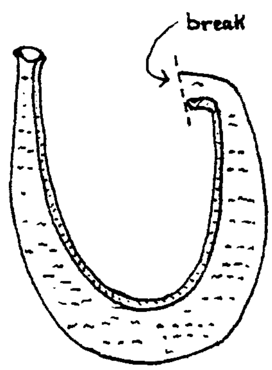
9.2(a)
C-hook (Square A5/3)



9.2(b)
J-hook (Square A4/6)

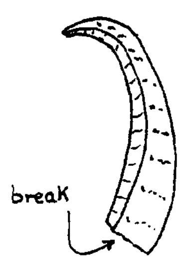


9.2(c)
J-hook with point missing (Square A4/5)



9.2(d)

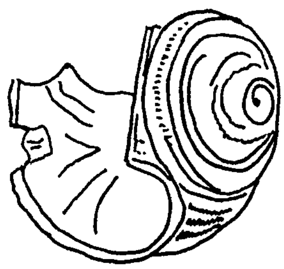
J-hook with point missing
(Surface find, AB-midden)



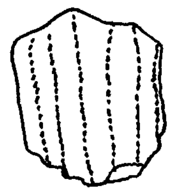
9.2(e)

Broken hook point
(Surface find, AB-midden)

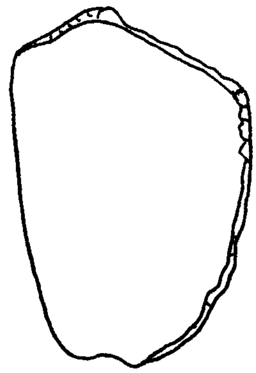
Figure 9.2. Shell fishhooks from Birubi. (Shown at actual size).



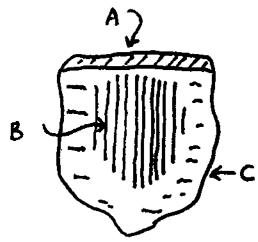
9.3(a)
Heavy turban shell after removal of "hook blanks". (Surface find)



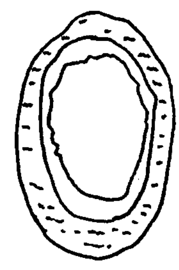
9.3(b)
Hook blank with edge trimming, shown convex side up. (Surface find).



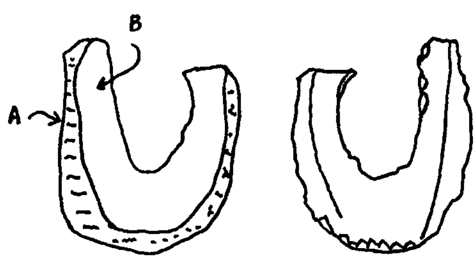
9.3(c)
Hook blank chipped on right edge and left shoulder. The concave side (15 mm deep) is shown uppermost. (Surface find).



9.3(d)
Shell blank thinned by abrasion (Square B2/1). A: bevelled edge. B: scratches from abrasion. C: edges shaped by chipping but not ground smooth.



9.3(e)
Shell annulus (Square A2/5). The outer edge is ground smooth; the inner edge is chipped but not filed.



9.3(f)
Top and bottom views of an unfinished shell hook (Square B1/5). A: residual mantle of shell. B: area with mantle filed away.

Figure 9.3. Items associated with shell fishhook manufacture. (Shown at actual size).

CHAPTER 10: EXCAVATED SHELLFISH

See Appendix 3 for a list of common and scientific names, and Chapter 3 for the methods of identifying and counting shellfish. Numbers quoted here are minimum numbers of individuals (MNI).

A caution

The shellfish brought to this base camp for consumption may be only a small part of the total shellfish collected (see Meehan 1982). The extensive pipi middens along the Newcastle Bight near Birubi show that these shellfish were often consumed near the place of gathering rather than back at the base camp. Whether that was also the case with rock shellfish is not known. The analysis of excavated shellfish undertaken in this Chapter refers only to the material we excavated at the Birubi base camp, and the conclusions drawn do not necessarily apply to the overall picture of shellfish gathering and consumption.

An overall picture

The data in **Table 10.1** show that the densities of edible shellfish in the C- and D-Squares are very much higher than in the AB-Squares. These figures bear out the impressions gained at the time of excavation: the C- and D-Squares were in a compacted shell midden, whereas the AB-trenches cut into a mixture of shells, ash, sand, and fish bones.

The Table also shows that "tiny" shells are much more numerous in the AB-Squares than anywhere else, while calcareous tubules (*Gaeolaria caespitosa*) are rare in the D-Squares. These features will be discussed later in this Chapter.

Edible and tiny shells

The shells found in Aboriginal middens range from minute to large in size, and it is unlikely that those at the minute end of the range were deliberately collected for eating. These tiny shells were probably brought there accidentally by humans, being attached to seaweed, conjevoi, cobbles, or larger shells. Some tiny shells may have been blown in by the wind. Unfortunately, it seems impossible to draw a reliable line between "large enough to be worth collecting to eat" and "too small". The problems associated with drawing this arbitrary line had been cogently discussed elsewhere (Rowland 1994).

Nevertheless, a line must be drawn somewhere. Quite arbitrarily, I have defined shellfish as "edible" if their maximum dimension exceeded 1 cm (or 2 cm for mussels), and all other shells have been classed as "tiny". This procedure is satisfactory for comparing shell distributions in the middens, though it will be seen later that some of the tiny shells probably were collected to be eaten.

Table 10.1. Shell occurrences in the AB-, C-, and D-Squares

Item	AB-Squares	C-Squares	D-Squares
Edible shells (MNI)	30733	18644	14078
MNI/m^3	549	12429	8045
Tiny shells (number)	15135	565	607
Number/m^3	2703	377	347
Tubules (number)	886	111	8
Number/m^3	158	74	5

Edible shellfish

Table 10.2 lists the numerous edible species of shellfish found in the Birubi middens, together with their levels of occurrence. One notes that most of the shellfish came from either

Table 10.2. A listing of edible shellfish[A] excavated at Birubi

Habitat and Common Name	AB-Squares (MNI)	%	C-Squares (MNI)	%	D-Squares (MNI)	%
Sandy beach species						
Cockle – flame dog	54		8		1	
Cockle – southern	10		-		-	
Pipi	16057	52.2	7500	40.2	10427	74.1
Sand snail	319		13		9	
Total	16440	53.5	7521	40.3	10437	74.1
Rocky shore species						
Abalone	179		40		4	
Barnacle[A]	290		4		-	
Cartrut	1525	5.0	1606	8.6	110	0.8
Chiton	1194		828		49	
Elephant snail	104		5		-	
Limpets	3419	11.1	3035	16.3	367	2.6
Mussels	644	2.1	24	0.1	-	
Nerita	3569	11.6	3244	17.4	1412	10.0
Topshells	462		43		242	
Tritons	661		407		81	
Turbans – Green	1086		799		42	
Turbans – Heavy	817		783		189	
Total	13950	45.4	10818	58.0	2496	17.7
Estuarine species						
Australian horn	11		1		1	
Cockle – Sydney	21		8		43	
Hercules club	2		139		230	
Oyster – Floating	8		1		-	
Oyster – Rock	34	0.1	86	0.5	864	6.1
Total	76	0.2	235	1.3	1138	8.1
Miscellaneous						
Frilled Venus	42		2		1	
Scallop	84		1		1	
Volute	35		17		-	
Other[B]	76[C]		48[D]		5[E]	
Unidentified	30		2		-	
Total	267	0.9	70	0.4	7	0.05
Grand Total	30733		18644		14078	

A “Edible shellfish” are those with a maximum dimension of at least 1 cm (or 2 cm for mussels). Barnacles (actually crustacea) are listed here for convenience.

B Other species identified were: Australian wentletrap, brooch, brown mitre, brown trough, gay fanshell, hollow cardita, horsehoof, latticed platter, mulberry, orange jingle, pear helmet, ramshorn, shining wedge, slipper limpet, tapestry shell, and violet snail.

C 17 species represented.

D 7 species represented.

E 4 species represented.

the sandy beaches or the rocky shorelines, but the proportions of shellfish taken from these two habitats vary widely between the AB-, C-, and D-Squares. Shell species taken from estuarine environments made up very little of the total in the AB- and C-Squares but reach an appreciable level in the D-Squares.

These comments are intended only as an overview. They take no account of local variations in shell composition within the excavation trenches, or with changes in proportions of shellfish species over the span of time the Birubi site was in use. Such issues are taken up in the following detailed discussion.

Edible shellfish in the AB-Squares

Comparison of the data from the various Squares reveals an appreciable variation in the numbers of edible shellfish per cubic metre (from 6896 in Square A2 to 4216 in Square A5) but a reasonably constant distribution of shellfish species. The sandy beach species average 53.6% of the total (mean deviation 3.0, range 49.3-60.0) and the rocky habitat species 45.2% (mean deviation 3.0, range 38.8-48.8). Nearly all the sandy beach component is pipi, but a wide variety of species were gathered from the rocky shores. In this latter category, nerita (12%), limpets (11%), the two turban species (6% combined), and cartrut (5%) make up most of the total. Some of the rock shellfish, especially the tritons, topshells, mussels, and limpets, were usually smashed and impossible to identify to a specific species. Thus there are actually many more species than are listed in **Table 10.2**: there are two species of tritons, two of mussels, at least three topshells, and at least four limpets (see Appendix 3). The two mussel species occurred in about equal proportions. The military turban (*Turbo imperialis*) is common on the reefs near Birubi but we have not identified it in the shell middens.

The pipis were obviously gathered from the ocean beach, while the shellfish from rocky habitats would have been gathered by wading and diving around the rock pools and reefs of the headland. The overall picture from our large sample of shellfish in the AB-midden is that they came about equal proportions from the ocean beach and the rocky habitats. The number of species the Aborigines considered worth collecting is quite high, 46 having been identified. It is possible that a few of the rare species were collected, already dead, as curiosities (perhaps by children). The ramshorn (*Spirula spirula*) comes from deep water and the animal – which is actually a crustacean – is rarely found alive (Child 1968: 75). Scallops also come from deep water but likewise can be picked up on the strandline after heavy storms.

The high incidence of neritas (12%) is interesting. This small shellfish could not have provided much nourishment, but its use by Aborigines as a sweetmeat, or as a garnish for other meat, is well documented from other parts of Australia (Rowland 1994). The meat can be extracted by using a sharp fishbone as a corkscrew. Probably the various small species of common topshells (*Austrocochlea obtusa*, *A. concamerata*, and *Thalotia contessei*) were eaten for the same reasons as neritas.

Possibly all the species of shell discarded on this midden were usually gathered for human consumption, but no doubt some fraction of these shellfish was also used as bait or "burley" for catching fish. The First Fleet diarists at Sydney noted Aboriginal men using burley to attract fish close enough to be speared (White 1962: 153; Collins 1798: 286), and the women were seen spitting chewed cockles, mussels, or boiled fish into the water while fishing with hook-and-line (Collins 1798: 283). We do not have any detailed record of the baits used for fishing around reefs on an ocean shore (see Chapter 11), but they are highly likely to have included shellfish. The species listed in **Table 10.2** include a number of baits (such as pipis, chitons, mussels, cartruts, tritons, and abalone) that are popular with modern-day fishermen. If the Aboriginal fishing methods involved the use of traps, then the usage of shellfish for baiting these traps would have been quite high.

Temporal distribution of shellfish species in the AB-Squares

Relative proportions of pipis and rock shellfish

Table 10.3 presents the percentage pipi in the total edible shell for each Level of the six AB-Squares. It is assumed that corresponding Level numbers in the various Squares contain material of closely similar ages.

Table 10.3. Levels of occurrence (as a percentage) of pipi in the edible shellfish from the AB-Squares

Level	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**[A]
A2	56	70	28	28	21	34	28	53	51
A3	64	58	37	34	30	51	66	70	29
A4	73	66	56	44	53	52	41	64	19
A5	63	62	43	45	32	53	52	44[B]	-
B1	63	54	54	28	39	43	62	86	-
B2	77	69	58	43	38	36	39	64	-
Mean	*66*	*63*	*46*	*37*	*36*	*45*	*48*	*63*	*33*
Standard devn.[C] ±	7.0	5.8	11.0	7.3	9.8	7.7	13.3	13.2	13.4
No. pipi	1704	5793	1235	840	1447	2060	1340	1225	383

A Only Squares A2, A3, and A4 are counted. The other three Squares had a total of only 26 pipis.

B Square A5 Level 7 had only 17 pipis and the apparent percentage (44) is unreliable, but it has been used in calculating the mean.

C These standard deviations (s) have not received Bessel's correction for small numbers of samples. (Here n is only 6). The corrected values (σ) can be calculated as $s\sqrt{[n/(n-1)]}$. The σ-values have been used to calculate the levels of confidence mentioned in the text.

Diagram 10-1 shows these variations in (percentage of pipi) versus Level number, with data for all six Squares combined. There appear to be trends from Level to Level, but the scatter about the mean at any selected Level is very large. (These scatters are shown as error bars, whose size is twice the standard deviations shown in **Table 10.3**). In order to have any confidence that the apparent trends are real, we need to apply additional statistical methods.

To assess if the mean percentages of pipi are different for two Levels, we need to know the size of the uncertainty in their difference. This "standard error of the difference" is explained more fully in Chapter 11; see especially the footnotes to **Table 11.4**. Obviously a large difference in the two mean values, and a small standard error in this difference, gives us a high level of confidence that the mean values are truly different. The ratio of (difference of the means) to (standard error of the difference) is known as Student's t-value, and it can be converted into a percentage level of confidence (Moroney 1956: 230).

Table 10.4. Levels of confidence in the observed changes in percentage pipi from Level to Level in the AB-Squares.

Levels under comparison	**Student's t-value**	**% Confidence**
1 and 2	3.07	99
1 and 3	3.80	99.5
7 and 4	3.67	99.5
7 and 5	2.64	96
7 and 8	2.64	96

Table 10.4 shows some comparisons between Levels for the percentages of pipi. We can be reasonably sure that Level 1 has a higher percentage of pipi than Levels 2 or 3, and Level 7 has a higher percentage than Levels 4 or 5. The decrease between Levels 7 and 8 has 23 chances in 24 of being correct. Thus the general trend of mean values shown in **Diagram 10-1** is supported by this statistical treatment.

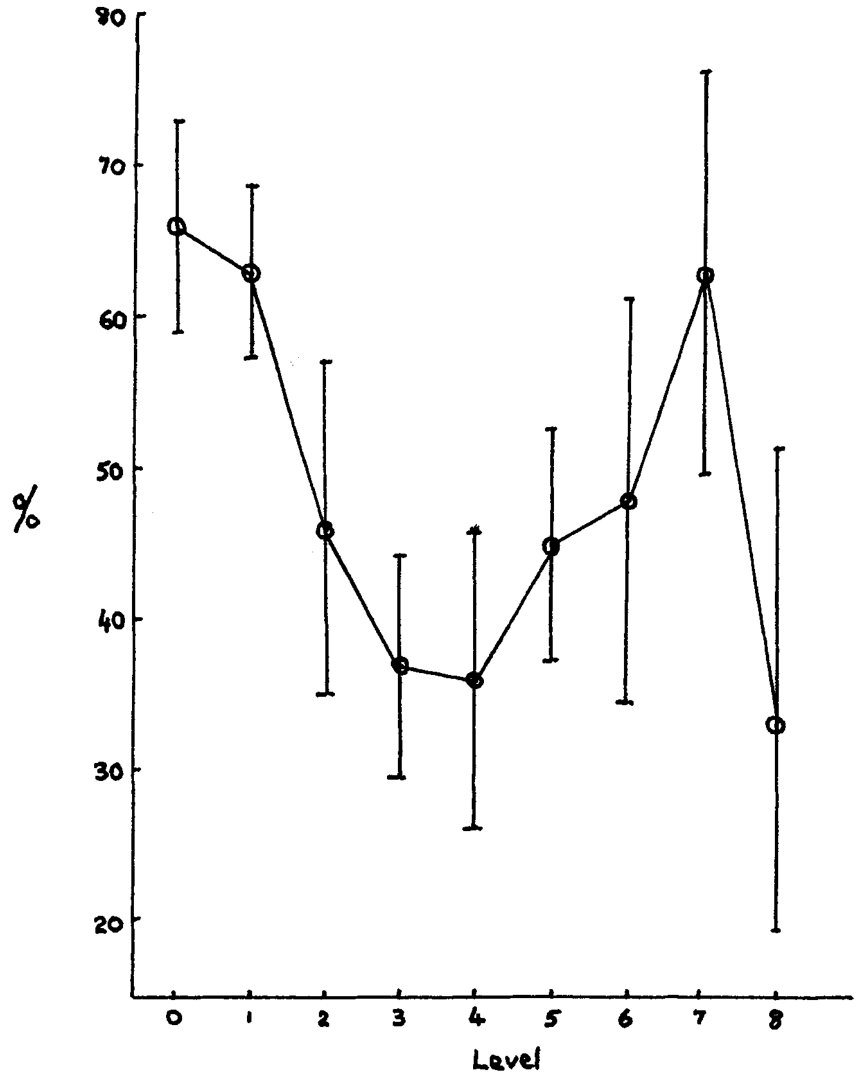


Diagram 10-1. The plot of (% pipi) versus Level number for the combined AB-Squares
(The error bars are equal to twice the standard deviation, s).

The variability of pipi populations on this coastline within living memory has already been remarked upon (see Chapter 6). It is likely that the variations shown in **Diagram 10-1** reflect the availability of pipis rather than swings in the Aboriginal preference to eat them. Without doubt these variations are important, and interpretation will be made in conjunction with the analysis of fish bone in Chapter 11.

Variations in the total shell density

A striking feature of the shell densities is the presence of a compacted shell layer on the top of the AB-middens. This cap extended through Levels 0 and 1. At lower Levels, the shell formed lenses or scatters, but not a compacted layer. The density rose again at the lower levels, to a peak in Level 5 (see **Diagram 10-1**) but the shell was not compacted at that Level.

The low shell densities in Levels 2 and 3 may (as already noted in Chapter 6) have been caused by episodes of windblown sand that diluted the cultural deposit. Why the compacted shell layer developed on this AB-midden late in its occupation span is not clear. Perhaps more shellfish had to be gathered to supplement a declining yield from fishing, but that is pure speculation. Another possibility is that the Aborigines took advantage of a high point in the variable population of pipis to have communal feasts of them. Dawson (1830:327) reported that such feasts (of oysters) sometimes occurred at Port Stephens.

Sizes of pipi shells

The shells from Square A4 were weighed, with a view to identifying any trends in the average sizes. Such measurements face certain problems: it is impossible with turban shells to be certain all the dirt had been shaken out of the spiral, and with some other species (such as cartruts) the shells are so fragmentary that the MNI counts may be in error. Pipi shell, however, suffers from neither of these problems and the average weights (per half-shell of the total bivalve) have been calculated (see **Table 10.5**). The weights include not just the hinged pieces used in the MNI counts, but also the smaller rubble.

Table 10.5. Average weights per half-shell of pipis from Square A4.

Level	0	1	2	3	4	5	6	7	8	9
Total number of half-shells	544	1567	297	188	980	1220	272	472	58	12
Mean wt (g)	2.86	2.83	3.38	2.66	2.52	1.85	2.88	3.77	3.29	3.19

The mean weight is (2.92±0.29)g (range 1.85-3.77g). Thus there is a two-fold variation in the mean weight of these pipis, but no special significance of this fact suggests itself.

The tiny shellfish from the AB-Squares

The number of these tiny shells is large (see **Table 10.1**) and one must ask how they arrived in the midden. No attempt has been made to reliably identify most of these tiny shells, but there are sufficient data to provide a general picture.

Table 10.6 lists the occurrence (by excavation Level) of the total tiny shell items in the AB-midden. The highest proportions occur at Levels 4 and 5. Peaking at these Levels matches the distribution of human occupation indices (edible shellfish, bones, stone rubble, charcoal, shell fishhooks) as shown in **Table 6.1** and **Figure 6-1**. Therefore there is a close link between the incidence of tiny shells and the level of human activity at the midden, except at Level 1 which will be separately discussed shortly.

Table 10.6. Level-by-Level occurrence (in percentage terms) of tiny shells in the AB-Squares
N= 14861 items.[A]

Level	1	2	3	4	5	6	7	8	9
%	11.9	10.3	10.7	22.3	23.8	13.5	5.9	1.4	0.3

A The number of items has not been reduced to MNI. In practice, most of the tiny shells are univalves, so the use of MNI would not alter the trend in the percentages.

This pattern of percentages across the levels is confirmed by each of the five families of tiny shell actually identified. These were barnacles, kelpshells, limpets, sandsnails, and winks, with total numbers of 1257, 2081, 1905, 308, and 404 respectively. That the close link with human activity levels holds even for sandsnails and kelpshells rules out the possibility that most or all of these two lightweight species were blown onto the site, because there were very few of them in the lowest Levels where signs of human occupation were scarce.

The means by which people could have brought these tiny shells to the midden are various. Barnacles, winks, and limpets would have been collected incidentally during the gathering of hearth stones and large shellfish. We did actually excavate examples of barnacles attached to shells and stones. However, the greater part of the tiny shells would appear to have come to the midden while attached to seaweed. Kelpshells, despite their name, do not attach to living kelp, but live in vast numbers on the sandy bottom close inshore (Thom *et al* 1992: 28). Dead kelpshells are very common on sandy beaches, where they become caught up in piles of dead seaweed.

There is no ethnohistorical account of seaweed being used by Aborigines in the Newcastle-Port Stephens region, but then we have no detailed account of Aboriginal life on the ocean shore. Wet seaweed might have been used to wrap fish for cooking, while dry seaweed could have supplemented the supply of firewood and been used for bedding. One also notes that the Tasmanian Aborigines ate cooked seaweed (Hiatt 1967). In addition, fronds of bull kelp were possibly used at Birubi to place shellfish upon, in the same way that the Anbara people used leaves and grass (Meehan 1982: 113).

Another feature of the "tiny shell" population is the appearance of juveniles of the (large) edible species. There are 102 cartruts, 171 mussels, 11 nerita, 28 pipi, 191 tritons, and 54 turbans (all numbers expressed as MNI). These shellfish too might have been attached to seaweed, though it seems unlikely for pipi. Possibly all these species of juvenile shellfish were sometimes collected by young children (see Meehan 1982: 71), or by everybody when food was scarce. One notes that there is a continuum of sizes of these "edible" species. It is likely that some of the tiny shellfish were eaten, and equally likely that some of the "edible" shellfish came accidentally to the midden while attached to other objects, and were not eaten. These occurrences point up the arbitrary nature of our division between "edible" and "tiny" sizes.

The documented use of conjevoi (*Pyura stolonifera*) as food (Leichhardt in Aurousseau 1968: 547) would also bring certain juveniles (tritons, cartruts, limpets) to the midden. I am indebted to Col Whitehead for observing that these immature shellfish are common on conjevoi in the Birubi area.

It was remarked that the distribution of tiny shells did not match that of some other occupation indices for Level 1. The data in **Table 6.1** show that percentages of edible shells, stone rubble, and charcoal are all higher in Level 1 than in Level 2 (see **Figure 6-1**), but this is not the case for the total count of tiny shells. This situation is attributed to the very high proportion of pipi shell in Level 1 (see previous Section), which has the effect of reducing the proportions of everything else (most notably tiny shells, bone, and the shell fishhooks). Also, few tiny shells could have arrived in Level 1 while attached to cobbles, because cobbles were scarce in that Level (see Chapter 8).

Another feature of the tiny shell counts is shown in **Table 10.7**, where their numbers are compared with those of the edible shells.

Table 10.7. Level-by-Level comparison[A] of tiny shell items with edible shell MNI

Level	1	2	3	4	5	6	7	8	9
%	19.8	52.1	69.7	85.2	81.9	73.2	46.7	20.4	15.6

A The percentages are calculated as 100(tiny item count)/(MNI edible shellfish).

These striking changes in percentages can be interpreted in various ways. **Table 10.3** indicates that there are more rock shellfish in the middle Levels, and tiny shells would have been attached to these hosts. The low proportions of tiny shells in the upper Levels are consistent with the high level of pipis, which rarely have attachments of other shells. Other possibilities relate to using seaweed as fuel, especially if firewood became depleted during the times of the middle Levels when numerous fish were being caught and needed cooking.

Shellfish in the C-Squares

The C-squares have the highest density of edible shellfish in the three midden samples we excavated (see **Table 10.1**), while the proportion of pipi is, at 40%, the lowest (see **Table 10.2**). The variation in proportion of pipi between the four C-Squares is considerable, ranging from 33% in Square C-2 to 49% in C-3 (see **Table 10.8**). Such a variation points up the difficulty of sampling shell middens and drawing meaningful conclusions. One would say of Square C-3 that the proportions of sandy beach shellfish and rocky shore shellfish were virtually equal, and very similar to those in the nearby AB-midden. But Square C-2 gives a quite different picture: it reveals a strong preference to collect rocky shore shellfish.

Table 10.8. Variation by Level in percentage pipi in the edible shellfish from the C-Squares

Level	**0**	**1**	**2**	**3**	**Overall[A]**	**MNI pipi**
Square C1	75	30	34	25	43	2798
Square C2	55	27	26	21	33	1728
Square C3	79	40	25	21	49	1804
Square C4	49	33	22	26	37	1170
Mean (%)	*65*	*33*	*27*	*23*	*41*	
Mean devn.	±12	±4	±4	±2	±6	

A This overall figure is based on total pipi MNI and total edible shellfish MNI for the Square.

The Table shows the proportion of pipi to be quite low in all the C-Squares at Levels 1, 2, and 3, but it is rather higher in the surface trim (Level 0). This variation may reflect changes in populations of pipi available to the collectors, as I also posited for the AB-Squares. Another possibility is that the loose surface of the midden has somehow been enriched in pipi by a post-deposition process, such as flotation in stormwater runoff. However, that seems unlikely since the Level 0 material included appreciable levels of fish bone and charcoal. One cannot exclude the possibility that Europeans contributed much of the pipi shell on the surface.

One notes the striking difference in number of tiny shells per cubic metre for the AB- and C-middens (**Table 10.1**). Possible explanations can be floated: children may have used the AB-midden but not the C-midden; seaweed may have been introduced into the cooking methods at the (recent) AB-midden; and so on. However, we do not know the extent to which the AB- and C-middens overlap in dates of occupation and these explanations must remain speculative.

Edible shellfish in the D-Squares

Table 10.9 shows that the proportion of pipi is uniformly high in these D-Squares, and there is no discernible trend over the period of time during which the shell accumulated.

Table 10.9. Percentages of pipi in the edible shellfish from the D-Squares

	Level 0	Level 1	Level 2	Level 3	Mean	Mean devn (±)	MNI pipi
Square D1	91	83	65	70	77	10	3992
Square D2	78	65	69	-[A]	71	5	3797
Square D3	59	54	-[B]		57	3	1054
Square D4	67	56	-[C]		62	6	226
Square D9	81	-[D]			81	-	225
Square D10	76	74	-	-	75	1	248
Square D11	87	85	94	-	89	4	885
Mean per Level	77.0	69.5	76.0				
Mean devn.	±7	±11	±11				

A Only 11 pipis B Only 8 pipis C Only 5 pipis D Only 12 pipis.

Because the C- and D-middens have similar base dates (1340 ± 80 and 1445 ± 70 BP respectively) one can compare their shell material, though it has to be borne in mind that we cannot be sure both middens were occupied to the same terminal date. We note that the D-midden not only has a higher proportion of pipi than the C-midden, but there are large differences among the rock shellfish. In the D-Squares, neritas make up 57% of the rock shellfish, and topshells a further 10%, whereas the figures for the C-Squares are 30% and 0.4% respectively. Thus most of the rock shellfish on the D-midden were collected as garnishes and tidbits rather than for nourishment. The larger species (cartrut, tritons, and turbans) were a minor component of the shellfish diet. Expressed as percentages of the total edible shellfish, these large rock shellfish amounted to 13% for the AB-Squares, 19% for the C-Squares, and only 3% for the D-Squares. Since these large shellfish are often encrusted with calcareous tubules (*Galeolaria caespitosa*), the low level of such items at the D-midden (see **Table 10.1**) is explained.

Another notable feature of the D-midden shell counts is the appreciable level (8%) of estuarine species, much higher than in the C-Squares or AB-Squares. These estuarine species (cockle, Hercules club, and rock oyster) have presumably been brought from mudflats on Port Stephens. The nearest mudflats are 6 km distant, at Cromarty Bay. Rock oysters do occur in small numbers on the rocks at Birubi, but they are always small. The oysters we excavated were large, and there is little doubt they grew in an estuarine environment. One oyster shell (from Square C1 Level 1) bears the groove from its original attachment to a mangrove stem.

Two explanations of these estuarine shellfish in the D-Squares suggest themselves. One is that the Aborigines brought these shellfish with them when they moved camp from Port Stephens to Birubi. Dawson (1830: 66) has reported the habit of carrying "oysters and fish" when moving camp. The other possibility is that Port Stephens was sometimes visited on the daily foraging trips from Birubi.

These estuarine shellfish are distributed throughout the D-midden, but are especially conspicuous in certain Squares and Levels. Rock oysters were numerous at D-2 Level 1 (MNI 320), and extended across D-1 Level 1 (141) and D-3 Level 1 (98). There were only 43 Sydney cockles, and 23 of them occurred in D-2 Level 1. Hercules club shells also clustered, most of them in D-2 Levels 0 and 1, and D-3 Level 0. These local concentrations indicate discrete events when a large number of these estuarine shellfish were eaten.

Local concentrations of certain shellfish species

Since a midden builds up from individual feasts on shellfish, one must expect a great deal of variation, in both the numbers of shells and the species represented, in an excavated sample. The various Tables in this Chapter include sizable mean deviations in the species compositions of the midden. Local concentrations of estuarine shellfish have been mentioned above. Other variations include mussels in the AB-Squares. Levels of mussel shells were low overall, and most of them occurred in Squares A-2 and A-3. Clusters of intact heavy turban shells – perhaps collected for manufacturing fishhooks – occurred in C-2 Level 2 and C-3 Level 2. Nearly all the small bonnet shells (*Sigapatella calyptraeformis*) found in the D-Squares were in Levels 0 and 1 of Squares D2 and D3.There were also striking variations in shell density: Square A-2 had twice the shell density of Square A-5.

These local variations should make us very cautious about interpreting shell middens on the basis of small samples.

Comparison of the excavated and surface-collected shell samples

The AB-midden

Surface collection (see Chapter 3) gave a sample containing 61% pipi and 38% rock shellfish, which agrees quite well with the excavated shell samples from Levels 0 and 1 (65±5% pipi). Shells from the depths of the midden were obviously poorly represented in the sample I collected from the surface of a collapsed part of the midden.

In terms of species, the excavated sample of shell yielded 40 identified species, while the total collection on the surface yielded just 12, or 17 if some randomly collected material is included. This difference can be attributed to the very large size of the excavated sample. However, surface collection did recover the more common species. The only excavated species with an occurrence above 1%, but not represented in the surface collection, was the sand snail *Conuba aulocoglossa*. This quite fragile shell can be expected to crumble rapidly once it falls out of the compacted midden and is subjected to tumbling by the wind.

While the picture of edible shellfish distribution obtained from the surface collection is good, the story is quite different for the 'tiny" shellfish. Whereas these made up 31% of the total shell numbers excavated from the AB-midden, they represented only 6.5% of the surface-collected sample.

The D-midden

No total collection from the surface of a collapsed part of the D-midden was ever made. However, the impression that pipi shell predominated was borne out by the excavation. Random surface collecting recovered 13 identified edible species (*cf* 22 by excavation) and established the presence of estuarine species, but failed to recover any tiny shells.

General conclusion

There can be no doubt that excavation is the best way to sample a shell midden. But if excavation is not practicable, a total surface collection on deflated midden recovers most of the available information. The sample should be reasonably large: the sample of 243 MNI from the AB-midden was too small.

Miscellaneous items

The shell of a common land snail was found in Square A2 Level 6, and in Square B2 Level 2 there was a bone fragment probably belonging to a cuttlefish.

Shell samples lodged with The Australian Museum

It was not practicable to retain the enormous quantity of shell we excavated at Birubi. However, some samples have been lodged with The Australian Museum, as follows.

Edible shellfish (excluding shell rubble): Square A2 Levels 0-9; C1 Levels 1-3; D1 Levels 0-3; D2 Level 3.

Tiny shellfish: Square A5 Levels 1-7; C2 Levels 0 and 1; C3 Levels 0 and 1; D2 Levels 0 and 1; D3 Level 0.

Turban shells: Square C2 Levels 0 and 1.

Pipi shell: Randomly-selected pipi shell samples, suitable for C-14 dating, have been retained for Square D2 Levels 0, 1, and 2.

CHAPTER 11: ANALYSIS OF EXCAVATED FISH BONE

Preamble

The amounts of fish bone excavated at Birubi are remarkably high. In this Chapter, I shall attempt a detailed analysis of this fish bone, in the hope of obtaining information about the fishing methods the Aborigines used at this location.

The species of fish represented in the middens were identified by the methods described in Chapter 3, and the minimum numbers of individual fish (MNI) were calculated. Chapter 5 includes a sample of fish bone items to illustrate how the MNI's were obtained. With some species, approximate live weights were assigned to the individual fish.

The fish bone we excavated from the middens is, of course, the result of numerous separate fishing events. The ethnohistorical record (see Chapter 7) indicates that some of these fishing trips at Birubi would have used spears, others hook-and-line, and yet others, perhaps, nets. Maybe fish were caught in other ways as well. Ideally, we would like to recover the bones of fish caught in the individual fishing events. Then we could determine the species and sizes and hope to establish how these fish were caught. Since the availability of many fish species varies with season of the year, we could even hope to establish the months of the year when the fishing was done. Perhaps one could also estimate the number of people who enjoyed the meal.

In practice, excavation will rarely recover the bony remnants of individual meals of fish. There is no indication that the Aborigines placed their fish bones in discrete piles for the convenience of archaeologists. Rather, the bones were tossed aside, on top of the remnants of other meals, and this mixed material was often accidentally trodden down into the loose sandy soil, so that further mixing occurred. The fleshy bits of fish skeleton would have been targeted by seagulls, dogs, and other scavengers, to be widely dispersed, often beyond the area of the Aboriginal camp. Lighter fish bones would also have been moved appreciable distances by gale-force winds. We note too that many of the excavated fish bones have been charred. That suggests that the bones were often tossed into the cooking fire, or were accidentally burned by subsequent cooking fires. One is left to wonder how much of the bone was burned up completely.

The picture that emerges is one of fish bone widely scattered, and much of it lost. Even the bone that remains in the midden has undergone a certain amount of vertical mixing, so that material from a given fish catch is muddled up with that from catches made both before and after it. It is unrealistic to look for some of the answers we would like to have. For instance, it could be that young members of a certain fish species were caught at one time of the year, and mature members at another time, but their bones will all be scrambled together in the midden. Nor can we tell whether a species was caught in small numbers on many occasions, or very occasionally caught in large numbers. The possibilities of extracting reliable conclusions about fishing methods and seasons look quite unpromising.

The scattering and mixing of the fish bones are not the only problems we face. We are attempting to establish the nature of the fish catch, but there are at least three reasons why the midden contents do not equate to the fish catch.

1. Selective decay. Some fish species have massive bones that resist decay, and these species will be identified even in samples many centuries old. Snapper, groper, bream, and wrasse fall into this category. Other species, such as mullet, luderick, drummer, and tailor have fragile bones and may disappear in a relatively short time. Colley (1987) has reported a striking example, from Rocky Cape in Tasmania, of species distribution markedly affected by selective decay.
2. Some of the fish caught at sea were probably eaten on the spot. There are a number of accounts (see Chapter 7) of Aboriginal women cooking fish on a

small fire on the bottom of their canoe. Since the fire was small, the fish cooked this way must also have been small, and this practice would skew the size distribution of the fish brought ashore.

3. The landed catch of fish may not all have been eaten at one place. For instance, some of the fish could be given to the men's camp, and the rest taken to the cooking fires used by the women and children. The results of an analysis of fish remains would then depend on whether one dug trenches at the men's camp or the women's camp. A further complication is that these dining arrangements probably changed from time to time, depending upon whether a large group or a small family unit were at the site.

Taking into account the picture given above, we cannot expect miracles from a detailed analysis of fish bones (Colley 1987; Walters 1987). However, useful analyses have occasionally been possible (Colley 1987), under special conditions. The Birubi material does possess two special characteristics: it is recent enough to avert the worst effects of selective decay, and there are very high MNI values to work with. The AB Squares yielded an MNI of 3171, and the C-Squares 378.

These large MNI values suggest another way of looking at the fish bone assemblage. Rather than despairing that the individual fish catches become rather mixed in the archaeological deposit, one can regard this mixing as a randomisation process that enables statistical treatments to be applied. The fish bone recovered from a certain Level in a certain Square can be treated as a fairly homogeneous sample of all the fish whose bones were deposited there during the corresponding time frame. It seems a fair assumption that scavenging and other losses are uniform across neighbouring Levels and Squares. Therefore it is reasonable to compare Squares to one another, and Levels to one another, using statistical methods to test whether perceived differences have a high degree of significance or are merely chance.

Our decision to excavate this site by arbitrary Levels (see Chapter 4) has turned out to be an advantage: it provided fish bone samples of adequate size for the comparisons.

An overview of the fish sample

Table 11.1 lists the fish species, and their numbers, found in the AB-, C-, and D-Squares. The numbers of fish are especially high in the AB-Squares (566 MNI/m^3), and quite high in the C-Squares (252 MNI/m^3), but quite low in the D-Squares (57 MNI/m^3). In fact the total number of fish present in the D-Squares (MNI only 100) is rather too low for reliable analysis. The most that can be said about the D-Squares is that eating fish was not a major activity there.

The overwhelming majority of the fish in the middens were carnivorous. In the AB-Squares, only 44 herbivorous fish (19 drummer, 3 luderick, and 22 mullet) were identified. (Actually, neither drummer nor luderick is a strictly herbivorous species (Whitley 1980)). Clearly the Aborigines at Birubi concentrated on catching carnivorous fish.

The Aboriginal fishing methods yielded an impressive number (29) of species from the AB-midden. The number is actually still larger, for I have not sub-divided the flathead, leatherjacket, mullet, or *Tetradonts* families into their component species. (The *Tetradonts* family includes toadfish and porcupine fish). There are also five uncommon species that could not be matched in my reference collection of fish skeletons.

Table 11.1. Occurrences of various fish species in the excavated Squares at Birubi
See Appendix 4 for the scientific names of the fish

Fish Name	AB-Squares	C-Squares	D-Squares
Bream (black)	181	25	27
Drummer (black)	19	-	-
Estuary catfish	12	-	-
Estuary cod	14	1	-
Flathead	5	4	2
Flounder	3	-	-
Groper	212	26	10
Kelpfish	902	70	4
Kingfish	-	1	-
Leatherjacket	126	5	2
Ling	3	-	-
Luderick	3	-	1
Morwong	7	-	-
Mullet	22	1	-
Mulloway	7	4	-
Port Jackson shark	33	3	-
Red rock cod	201	14	-
Salmon (Australian)	32	4	-
Shark[A]	6	-	-
Snapper	529	96	16
Stingray	4	-	-
Sweep	14	-	-
Tailor	15	-	-
Tarwhine	72	34	6
Teraglin	29	-	-
Tetradonts	17	1	1
Trevally	22	-	-
Whiting	94	7	4
Wirrah cod	168	15	4
Wrasse	370	56	11
Unidentified[B]	49	11	12
Total MNI	3171	378	100
No. species identified	29	18	12[C]
MNI per m^3	566	252	57

A Two of these sharks were identified (from a tooth) as wobbegong and two others may be wobbegong (though one of these latter could be a nurse shark). I am indebted to Dr. John Paxton (The Australian Museum) for these identifications.

B Most of these MNI are assigned from material that is too fragmented to allow full identification. In addition there are 21 instances of well-preserved dentaries from the AB-Squares that could not be matched in my fish skeleton collection; five separate species appear to be involved. There were no such instances from the C- or D-Squares.

C The surface collection in the D-area (see Chapter 3) yielded two more species (mulloway and Port Jackson shark).

It is inevitable that uncommon species will show up in such a large population of identified fish (MNI=3171 for the AB-Squares). For the C-Squares (MNI=378) the number of identified species was much less (18), and the 100 individual fish from the D-Squares involved only 12 species. (Two more species were found in the total of 35 MNI collected from the surface of the D-middens; see Chapter 3). We cannot be sure that the D-middens contained a narrower range of species than the other middens: no doubt more species would have turned up had we obtained a much larger sample of the fish.

Perusal of **Table 11.1** reveals that a small number of fish species make up most of the total number of identified fish. **Table 11.2** shows the percentages of those fish, along with some mean deviations to indicate whether there are real differences between the three sets of Squares. The D-Square percentages are seen to be highly variable, which is doubtless a function of the small numbers of individual fish.

Table 11.2. Occurrence (by percentage) of major fish species from the excavated Squares at Birubi.

See Appendix 4 for scientific names of the fish.

The mean deviations are calculated from the percentages obtained for each individual Square.

Species	AB-Squares	C-Squares	D-Squares
Bream (black)	5.7 ± 1.1	6.6 ± 2.3	27.0 ± 12.1
Groper	6.7 ± 0.5	6.9 ± 2.3	10.0 ± 7.7
Kelpfish	28.4 ± 3.6	18.5 ± 5.7	4.0
Red rock cod	6.3 ± 1.0	3.7 ± 0.9	-
Snapper	16.7 ± 2.6	25.4 ± 6.0	16.0 ± 4.0
Wirrah cod	5.3 ± 0.6	4.0 ± 0.2	4.0
Wrasse	11.7 ± 1.1	14.8 ± 1.9	11.0 ± 6.3
Others	17.7	17.2[A]	16.0
Unidentified	1.5	2.9	12.0
Total MNI	3171	378	100

A Tarwhine alone contributed 9.0%.

There is little point in comparing the AB-Squares with the C-Squares at this stage; there are more meaningful comparisons to be made and the real point of **Table 11.2** is to draw attention to the major species so that we can compare their levels of occurrence from one excavated Level to another. Presumably these seven species were those the Aborigines set out to catch, and other carnivorous fish were a “bycatch” incidental to the endeavour. Possibly even red rock cod and wirrah cod were a bycatch incidental to fishing for bream and snapper.

Note that the levels of unidentified fish in the AB- and C-Squares are very low, and will not therefore introduce uncertainty into the statistical treatments that follow. The seven common species are all readily identified, even with fragmentary material, and it is unlikely that a serious level of misidentification exists.

This general overview reveals that the AB-, C-, and D-Squares differ considerably in the density of fish remains present, and we must bear in mind that the AB-Squares have a much more recent basal date than the C- and D-Squares. I shall therefore deal separately with these three sets of Squares.

Trends in fishing success across the time span of the AB-midden

Ideally we would look for these trends by listing the number of each species of fish per unit of time. This unit of time would be large enough to give a sizeable number of fish; it might say be 50 years. But in practice we do not know the exact connection between our arbitrary excavation Levels and their dates. The midden varies considerably in its composition (see Chapter 4): sometimes it is mostly sand, and at others largely shell. Thus it is unlikely that the midden has accumulated at a constant rate.

We cannot, therefore, realistically compare numbers (taken as MNI) between Levels to measure success in fishing for the various species. The alternative approach is to use *percentages* of the various species in each Level, which has the advantage of not needing accurate dates. Percentages, however, are not independent figures: if one goes up, the others have to come down. This interdependence of percentage figures must be kept in mind when looking for trends across a period of time.

Table 11.3 presents the proportions of the seven major fish species from the earliest to the latest Levels in the AB-Squares. If we assume the Aborigines abandoned this Birubi site in about 1850 AD (that is, 100 BP), then this AB-midden (reservoir-corrected base date 490 ± 90 BP) accumulated during 400 years. In that time, the proportions of kelpfish changed dramatically, from over a third of the total MNI in the oldest Levels (7 to 4) to less than a tenth in the most recent (Level 1).

Table 11.3. Variations by Level for major fish occurrences in the AB-Squares
Quoted values are mean percentages for the six Squares. The ± values are standard deviations calculated from the six individual percentages (one from each Square) at each Level.

Level	Total MNI	Kelpfish %	Snapper %	Whiting %	Black bream %	Groper %	Red rock cod %	Wrasse %
1	292	8.2 *± 2.5*	24.6 *±6.0*	14.4 *± 8.1*	10.0	8.6	2.7	10.0 *±3.5*
2	190	15.5 *±2.7*	26.2 *±5.6*	5.2 *± 4.7*	7.6	5.3	5.4	13.5 *±1.7*
3	372	20.3 *±3.7*	21.4 *± 3.4*	1.3 *± 1.4*	8.0	8.2	4.8	12.3 *±2.2*
4	603	29.5 *±5.5*	19.6 *± 5.4*	0.6 *± 1.0*	5.0	5.9	6.5	12.6 *±4.9*
5	761	34.8 *±7.6*	12.4 *±5.2*	0.5 *± 0.5*	4.5	6.1	8.2	13.0 *±2.7*
6	487	36.3 *±6.6*	13.1 *± 1.4*	0.6 *± 0.6*	4.2	6.7	6.0	10.8 *±2.9*
7	251	36.0 *± 9.4*	12.6 *± 4.4*	0.5 *± 1.1*	5.6	5.2	7.5	7.6 *±2.6*

During the same time span that the kelpfish declined, the percentage of snapper doubled, and that of whiting changed from negligible to quite appreciable. These changes are large enough to warrant closer study. One can also see small trends in the figures for black bream and groper, and perhaps for red rock cod, but these lesser trends are greatly at the mercy of the interdependence of percentage figures, as discussed above. We shall examine the reality of these lesser trends later.

Statistical evaluation

In order to identify any changes with time in the proportions of identified fish, we have to compare samples from different excavated Levels. These samples are themselves quite variable from Square to Square. This scenario is a familiar one for statisticians, and can readily be dealt with. We have, from the six AB-Squares, six independent samples of identified fish. For some given Level we can therefore calculate the mean percentage for a certain fish species, together with the standard deviation about this mean value. If the mean values for the two selected Levels are different, and the difference appears large in comparison with the standard deviations, it is worthwhile to calculate the level of confidence that the mean values are truly different.

There is a formula (see footnote to **Table 11.5**) for calculating the standard error in the difference between the mean values. The larger the difference between the two means in comparison with the standard error, the more certain we are that the difference is real. The ratio (difference of means)/(standard error) is known as Student's t, and can be compared with standard graphs to yield the level of significance. (In practice, the smaller the number of samples in the two Levels, the larger t needs to be for a high level of significance). I have chosen to express levels of significance as "confidence levels", in percentage terms, since most readers will readily understand what these percentage terms mean.

These statistical approaches do not yield certainties. A 90% confidence level means that our conclusion has 90 chances of being right and 10 chances of being wrong. Clearly a 99% level is rather more compelling. If the t-value corresponds to a better than 99.9% confidence level that two of our Levels have different proportions of a certain fish species, then there can be very little doubt about the difference being real.

Changes in proportion of kelpfish

The details of the changes in percentages of kelpfish are given in **Table 11.4**. The percentages are given for each Square at each of the seven Levels for which there are sufficient numbers of fish. (Level 0 is ignored because it is possibly disturbed by vehicle traffic. Level 7 is included in the Table but in the case of Squares A5, B1, and B2 there are insufficient MNI to work on, so its data will not be used).

Table 11.4. Variations by Level for kelpfish occurrences in the AB-Squares

Occurrences expressed as % of the total MNI

Level	A2	A3	A4	A5	B1	B2	Mean	Std. Devn.
1	9.6	12.2	8.5	4.3	7.8	6.5	8.2	2.5
2	12.5	14.3	21.4	14.3	16.0	14.3	15.5	2.7
3	15.2	21.2	17.9	27.3	19.0	20.9	20.3	3.7
4	32.5	26.4	34.0	37.2	26.1	21.2	29.5	5.5
5	26.4	32.7	41.5	48.0	31.5	28.4	34.8	7.6
6	29.5	41.9	35.5	40.0	26.3	44.6	36.3	6.6
7	41.9	38.1	41.7	30.0[A]	18.2[A]	46.2[A]	36.0	9.4

A The total MNI in Squares A5, B1, and B2 at Level 7 were only 10, 11, and 26 respectively.

The sizes of the standard deviations indicate clearly enough that the percentage of kelpfish is high, and steady, in the lower Levels. Between Levels 5 and 4, the percentage appears to drop, and thereafter rapidly decreases from Level 4 to Level 1. Bearing in mind that the standard deviations at each Level are rather large, these apparent differences have been subjected to Student's t-test, and the level of confidence has been converted into a percentage (Moroney 1956: 230). The results of the calculations are shown in **Table 11.5**.

It is seen that the apparent decrease in percentage kelpfish between Levels 5 and 4 is not significant, being within the scatter of the two sets of percentages under comparison. However, we can have a very high degree of confidence that the decreases between successive upper Levels (4 to 1) are real.

Table 11.5. Levels of confidence for comparisons of kelpfish percentages between Levels in the AB-Squares

Levels compared	Difference in mean percentage	Standard error of difference	Ratio (Student's t)	Level of confidence
2 and 1	7.3	1.64	4.45	99.5 %
3 and 2	4.8	2.06	2.33	95 %
4 and 3	9.2	2.96	3.10	99 %
5 and 4	5.3	4.18	1.27	Very low
3 and 1	12.1	1.99	6.08	>99.9 %
4 and 1	21.3	2.68	7.96	>99.9 %

[A] This standard error is calculated as $\sqrt{(\sigma_x^2/n_x + \sigma_y^2/n_y)}$ where σ_x is the adjusted standard deviation for one set of data and σ_y is the adjusted standard deviation for the other set; n_x is the number of samples used to derive the mean and standard deviation for one set and n_y for the other. The adjusted standard deviation, σ, is calculated as $s\sqrt{[n/(n-1)]}$ where s is the standard deviation and the other term is Bessel's correction for small numbers of samples. Here $n_x = n_y = 6$ (the number of AB-Squares). (Moroney 1956: 220).

In searching for an explanation of this trend, we take account of three other observations. One is that whiting – a rare fish in the lower levels – become more common in Level 2 and quite common in Level 1 (see **Table 11.3**). Despite the large standard deviations in the mean values for Levels 3 and 1, the difference between the mean percentages of whiting in these two Levels (namely 13.1) is 3.6 times the standard error of the difference (3.67). We can be 99% confident that the trend is real.

The second observation is that the proportion of pipi – a sand-dwelling shellfish – also increased sharply between Levels 3 and 1 (see **Diagram 10.1**); again the changes are highly significant despite the scattered values obtained from the individual Squares. The confidence levels for the differences being real are 99.5% between Levels 3 and 1, and 99% between Levels 2 and 1.

The third observation is the drift sand observed in Levels 2 and 3. Taken together, these three observations tell a coherent story: that at about the time of Level 4, sand in the shallow waters at Birubi began to move, covering some of the inshore reefs and blowing onto the land. Kelpfish live around rocks, in shallow water, and their habitat would have been severely reduced by these sand movements. As the sand movements went on, fishing for these small rockfish would have become less and less profitable. Harvesting of rock shellfish, too, would have given diminished yields. In due course, as the new sandflats stabilized, there were more sand whiting to catch, and pipi collected from the beaches became a more important source of shellfish. The sand movements responsible for these changes would be those thought to have begun less than 500 years ago (450 years BP). In Chapter 6, I mentioned some published evidence for the sand movement starting 300±70 years BP.

Changes in proportions of snapper

The data in **Table 11.3** show that the percentage of snapper also underwent substantial change, approximately doubling during the period of occupation of the AB-midden. Taking these percentages at their face value, we can be 95% confident that a real increase occurred between levels 5 and 4, and there are better than 99% confidence levels for the increases between Level 5 and any one of the most recent Levels (1, 2, or 3).

The face values of these percentages of snapper do however need modification, on account of the interdependence of percentages I alluded to earlier. Because the percentage of kelpfish decreased very markedly between "early" and "late" Levels, it is inevitable that the *percentage* of snapper will be seen to increase in unison with it, even if the *number* of snapper being caught per unit time stayed constant. A rough-and-ready way of dealing with this problem is to express the snapper MNI as a percentage of the MNI of all species *except kelpfish*. The adjusted data are presented in **Table 11.6**. (Some readers will remark that kelpfish percentages could likewise have been adjusted for changes in snapper percentages. The adjustments, however, are so interdependent that the only workable approach is to take the largest changes – which are for kelpfish – at face value and adjust the changes for the other species).

Table 11.6. Percentage of snapper occurrences at various Levels in the AB-Squares

Level	% Snapper in the total MNI	% Snapper in adjusted MNI (no kelpfish counted)	Standard deviation (adjusted MNI)
1	24.6	26.6	6.6
2	26.2	31.1	6.8
3	21.4	26.9	4.3
4	19.6	27.4	5.9
5	12.4	18.5	6.1
6	13.1	20.9	3.5
7	12.6	19.5	6.0

Table 11.7. Significance of differences from Level-to-Level of snapper occurrences
(The % snapper figures relate to a total MNI figure with the kelpfish removed, as in Table 11.6)

Levels compared	Difference in mean percentages	Standard error of difference	Ratio (Student's t-value)	Level of confidence
5 with 3	8.4	3.33	2.52	> 95 %
5 with 4	8.9	3.78	2.35	>95 %
6 with 2	10.2	3.41	2.99	98 %

From **Tables 11.6** and **11.7** we see that the adjusted percentages of snapper in the lower (earlier) Levels (5 and 6) are less than those in the upper Levels with reasonable levels of confidence (95 – 98 %). The increase from the average of the three lower Levels (5, 6, and 7) to the average of the four upper Levels (1, 2, 3, and 4) is however not very large (43 %). This modest change could be due to an increased level of offshore fishing, to improved skills at catching snapper (such as a better bait), or even to some unidentified environmental factor that changed the population of snapper. It is idle to speculate.

Changes in the percentages of red rock cod and wrasse

Table 11.3 suggests that the proportions of red rock cod fell sharply between Levels 2 and 1. However, the numbers of these cod in Levels 2 and 1 are very small (9 and 8 respectively for all the AB-Squares combined) and statistically speaking, the apparent difference is not significant. In order to find out if there is a trend between "early" and "late" Levels, we need to combine some Levels in order to build up the numbers of fish. In **Tables 11.8** and **11.9**, Levels 1, 2, and 3 are combined (n = 35 red rock cod) and these data can be compared with those for Levels 5 and 6 combined (99 red rock cod). Data are presented both for the "raw figures" (that is, with kelpfish included in the total MNI) and for "adjusted" figures (in which the total MNI do not include the kelpfish).

Table 11.8. Percentages of red rock cod in "early" and "late" Levels of the AB-Squares
(Kelpfish are included in the total MNI)

Levels	A2	A3	A4	A5	B1	B2	Mean	Std. devn.
1, 2, 3	4.6	2.6	3.5	3.7	6.5	4.5	4.2	1.21
5, 6	10.1	10.5	8.4	7.2	5.3	3.3	7.5	2.55

Comparing these two groups of Levels, Student's t is 2.62, which corresponds to better than 95% confidence that the means are different.

Table 11.9. Comparison of red rock cod (using adjusted percentages) in "early" and "late" Levels of the AB-Squares
(Kelpfish numbers are excluded)

Levels	A2	A3	A4	A5	B1	B2	Mean	Std. devn.
1, 2, 3	5.5	3.1	4.1	5.9	7.6	5.2	5.2	1.41
5, 6	14.0	16.5	14.0	13.3	7.5	5.1	11.7	4.03

Using these adjusted percentages of red rock cod, the comparison of the two groups of Levels gives a Student's t-value of 3.41 which means we can be more than 99% confident there has been a real change between the "early" and "late" Levels. Since red rock cod, like kelpfish, live around rocks and weed, the explanation for the decline in both species is likely to be accumulation of sand along the shoreline.

The story about wrasse is similar. **Table 11.3** shows the variation from Level to Level for this group of labrids, and the changes are generally within the range of their standard deviations. There is however some change in percentage (about 90% confidence level) between Levels 2 and 1. This trend remains when kelpfish are removed from the total MNI, and the level of confidence improves to 98 %.

There are no significant trends across the various Levels for black bream or groper.

Fish proportions in the C-middens

Although this C-midden had a base date (from Level 2) of 1340 ± 80 BP, and had possibly been occupied for as long as 1200 years before Europeans arrived, the deposit was comparatively shallow. We lack sequential dates through the deposit and do not therefore know why it was shallow: it may have accumulated much more slowly than the AB-midden, or perhaps it was abandoned long before Europeans arrived. If an early abandonment actually occurred, one possible reason would be the onshore sand movements thought to have begun less than 500 years ago (Thom 1992: 365). An alternative explanation, proposed by Bryant (2001: 259) and discussed in Chapter 6, is a tsunami that may have swept across the site around 450 BP.

The lack of depth in this midden makes it impractical to compare fish samples of different ages. Level 3 (which is older than the shell sample whose date is given above) yielded only 10 individual fish from the four C-Squares combined, and Level 2 with only 64 MNI is of limited use. Only Level 1 (MNI 164) and Level 0 (MNI 140) provided large samples of identified fish.

Although the fish identifications from Level 0 are numerous, there are good reasons not to use them. When we conducted our excavation, this C-midden had only recently been uncovered by drift of its sand mantle, but it nevertheless contained in the surface Level (0-5 cm depth) appreciable amounts of rusty iron, broken glass, and other European rubbish. Obviously there had been previous exposures of this midden surface. If these exposures were lengthy, some of the fish bone would have disintegrated, and the more massive bones (such as those of snapper) would be more likely to survive. There is also the possibility that some of the fish bone on the surface was discarded by Europeans, for this headland at Birubi was until quite recently a "hot spot" for catching snapper, and it was occupied by Europeans during the Great Depression. We cannot rely upon the Level 0 material being an unmodified Aboriginal midden.

Thus Level 1 provides the only reliable sample of identified fish (see **Table 11.10**). The data are not too dissimilar to those for some of the Levels in the AB-Squares, except that in the C-Squares tarwhine form an appreciable percentage (10.9). Only in Square C2 Level 2 is there a similar proportion of tarwhine (12.5%), which elsewhere in the C-Squares, and throughout the AB-Squares, is not a common species. We have here in these C-Squares the relics of one, or several, prolific catches of tarwhine.

We can try matching this **Table 11.10** data with the various Levels in the AB-Squares. Previously we have noted that although many species show little variation from Level to Level in the AB-Squares (see **Table 11.3**), the proportions of snapper and kelpfish change markedly, in opposite directions. The data in **Table 11.10** (Level 1 for the C-Squares) show the best fit to Levels 3 or 4 in the AB-Squares, apart from the tarwhine already mentioned. Whether this matching is a real matching in time is questionable, and it would be best to use direct radiocarbon dating of shell samples to confirm it.

Table 11.10. Percentage distribution of major fish species in Level 1 of the C-Squares

Species	**C1**	**C2**	**C3**	**C4**	**Mean, %**	**Std. devn.**
Black bream	7.1	4.7	7.3	7.9	6.8	1.2
Groper	7.1	4.7	14.6	7.9	8.6	3.7
Kelpfish	23.8	18.6	22.0	26.3	22.7	2.8
Red rock cod	7.1	-	4.9	7.9	5.0	3.1
Snapper	21.4	20.9	24.4	13.2	20.0	4.1
Tarwhine	9.5	16.3	7.3	10.5	10.9	3.3
Whiting	-	4.7	-	-	1.2	-
Wirrah cod	4.8	4.7	7.3	7.9	6.1	1.4
Wrasse	11.9	23.3	7.3	10.5	13.3	6.0
Other	7.1	2.3	4.9	5.3	4.4	1.8
Unidentified	-	-	-	2.6	0.7	
Total MNI	*42*	*43*	*41*	*38*		

Fish samples in the D-middens

The species composition of the fish sample from this midden is uncertain, partly because the sample is so small (MNI = 100), and partly because 12% of the MNI were unidentified. These individual "unidentified" fish are not rare species, but are represented by fragmentary material probably belonging to common species. Such items get counted as individual fish when other fish bone is rare.

There appear to be a lot of black bream (27% overall, see **Table 11.1**). Many of these bream came from Square D2 (15 out of the total of 27 from all D-Squares), but even if this Square is removed from the total MNI count, the bream still make up 18%. Leaving out Level 0, on the grounds that it may be disturbed and contaminated by modern fish bone, still leaves black bream making up 28% of the residual MNI count. Thus the high proportion of these bream, when compared with the AB- or C-Squares, is probably real. What to make of this observation is problematical. We do not have a sequence of dates for the D-Squares, and cannot therefore say whether these fish remains are contemporary with any of the material in the AB- and C-Squares.

Aboriginal fishing methods at Birubi

General remarks

We must now attempt to establish the fishing methods that were actually used during the time span of the Birubi middens.

The presence of shell fishhooks throughout the AB-midden firmly establishes that the hook-and-line technique was used during the occupation of that midden (from about 490 ± 90 years BP to its abandonment). The question is whether other techniques were also in use during that time.

Fish spears were widely used at the time Europeans arrived (see Chapter 7). Firm archaeological evidence for their use at Birubi is lacking, though the presence of bone points (and bone preforms for such points) is consistent with manufacture of the fish spears described by European informants. We can extrapolate the use of these fish spears back at least a few centuries with a high degree of confidence. But convincing physical evidence of other fishing techniques, such as nets and traps, is absent at Birubi (see later).

The fishhook made of shell is reckoned to have come into use in coastal New South Wales about 700 BP, or perhaps as long ago as 1100 BP (Mulvaney and Kamminga 1999: 292; Sullivan 1987; Walters 1988). Both the C-midden and the D-midden have basal dates older than that, and we might hope to see a marked change in the species of fish caught when the shell hooks came into use. We have already seen that there are not enough MNI fish or radiocarbon dates from the D-Squares for any useful analysis. In the C-Squares, Level 2 (dated at 1340 ± 80 BP) can be considered as an "early" sample of fish, too old for the shell hook. It is compared with Level 1 in **Table 11.11**. The percentages shown for Level 2 have very large standard deviations and should not be taken too seriously. I have already commented that the sample (MNI 64) from this Level is so small that its usefulness is limited.

We see that there is no convincing evidence for a change in either species or proportions of the species between "early" and "late" Levels. The only possible exception is the wirrah cod that appear in Level 1 (6% occurrence). However, in view of the quite small total sample for the "early" Level, and the very large standard deviations for the percentages in it, the absence of wirrah cod may be nothing more than a random event.

Table 11.11. Comparison of proportions of identified fish species in early and late Levels of the C-Squares

N = 163 for Level 1; n = 60 for Level 2
Level 1 is considered "late", and Level 2 as "early"

Species	Level 1 MNI	Level 1 %	Level 2 MNI	Level 2 %
Black bream	11	6.7	7	11.7
Flathead	1	0.6	-	-
Groper	14	8.6	5	8.3
Kelpfish	37	22.7[A]	15	25.0[B]
Leatherjacket	1	0.6	-	-
Mulloway	3	1.8	-	-[C]
Port Jackson shark	1	0.6	1	1.7
Red rock cod	8	4.9	1	1.7
Salmon (Australian)	1	0.6	1	1.7
Snapper	33	20.2[D]	8	13.3[E]
Tarwhine	18	11.0	8	13.3
Tetradonts	1	0.6	-	-
Whiting	2	1.2	4	6.7
Wirrah cod	10	6.1	-	-
Wrasse	22	13.5	10	16.7

A The standard deviation is 2.8, calculated by treating each of the Squares as a separate sample.
B Standard deviation 19.7.
C One mulloway was identified in Level 3.
D Standard deviation 4.1.
E Standard deviation 10.5

The lack of evidence in **Table 11.11** for the advent of the shell fishhook can however be questioned. In Chapter 9 it was mentioned that there *may* be evidence for shell hook manufacture in Level 2 of Square C1. In view of that possibility, it is not absolutely certain that **Table 11.11** compares a pre-shell hook Level with a post-hook Level.

Another approach is to compare the fish identifications from the AB-Squares (where the shell hook was undeniably present) with those of another site whose material is certainly too early for the shell hook. Our 1972 excavations at Swansea Channel, at the entrance to Lake Macquarie, provide this pre-hook sample. The Swansea Channel midden had been "scalped" by European lime-burners, so that the material on its surface was dated 1965 ± 85 years BP (charcoal, SUA-238). Thus everything in this midden was much older than the arrival of shell fishhooks. The most intensive occupation phase extended back to 2720 ± 90 BP (charcoal, SUA-1720) and was underlaid by sparse occupation material from much further back in time (7870 ± 115 BP (SUA-150) and 7530 ± 140 BP (SUA-421), both dated with charcoal). The fish identifications, and MNI numbers, are given in **Table 11.12**. In this tabulation, the fish remains found in the grave fills are excluded because one excavated burial is known to be younger (1690 ± 200 BP) (Donlon 1993) than the rest of the midden.

Table 11.12. Positive fish identifications from the Swansea Channel midden
Total MNI = 749

Species	MNI	Percentage	Species	MNI	Percentage
Black bream	291	38.9	Porcupine fish	2	0.3
Eel	1	0.1	Red rock cod	1	0.1
Estuary catfish	1	0.1	Salmon (Australian)	1	0.1
Estuary cod	1	0.1	Shark[A]	1	0.1
Flathead	60	8.0	Snapper	65	8.7
Groper	31	4.1	Tarwhine	95	12.7
Kelpfish	10	1.3	Toado	3	0.4
Leatherjacket	113	15.1	Whiting	27	3.6
Luderick	8	1.1	Wirrah cod	2	0.3
Mullet	2	0.3	Wrasse	15	2.0
Mulloway	19	2.5			

A Dr. John Paxton (The Australian Museum) reports that the shark tooth probably came from a bronze whaler over two metres long.

The Swansea Channel site is close to both estuarine and rock platform environments. Thus it differs sharply in its proportions of estuarine fish (bream, flathead, leatherjacket, and tarwhine) when compared with the AB-Squares from Birubi. These differing proportions do not concern us here: we are looking for major occurrences of species *at Birubi* that were caught only after shell hooks came into use.

The blunt fact is that *there is no such major species*. The major species of fish found in the AB-midden at Birubi were all being caught at Swansea Channel without the aid of shell hooks. A detailed comparison of **Table 11.12** with **Table 11.1** finds that there are 10 additional identified species on the Birubi list, but altogether these 10 species contribute only 4.7 % of the total MNI in the AB-Squares.

This surprising outcome of the fish analysis needs explaining. One explanation is quite obvious from the ethnohistorical record: the Aboriginal men spent a lot of time spearing fish. In the hands of a skilled operator, the fish spear is a highly effective and versatile device. The spearman can work from rocks at the shore, or while standing in shallow water, or from a canoe. It is recorded that the Aboriginal fisherman attracted fish to him by using “burley”, or, if spearing at night, with a bright light. (See Chapter 7). The whole range of fish caught at Swansea Channel could have been speared. Most of the fish species at Birubi likewise could be speared, and indeed some species must have been. One needs a tiny hook to catch leatherjacket, luderick, or mullet, and even the smallest of the shell hooks I have seen would be much too large.

If spearing was widely practised and could take all or nearly all of the species found in the Birubi middens, it is unlikely we shall readily recognise changes with the advent of the shell hook. It will be even more difficult to identify changes *if angling was already practised before the shell hook arrived.*

Most Australian archaeologists assume, or imply, that angling began with the arrival of the shell fishhook (eg Bowdler 1976; Blackwell 1982). There are however contrary views. The bone bipoint (“muduk”) was first viewed as a line-fishing “gorge” or “toggle” by Hale and Tindale (1930). In a review of fishing techniques around the Pacific, Anell (1955) pointed out that the fishing gorge has been widely used around the world, and he rated it as very effective. The method of using such a gorge is simple. The line is tied around the middle of the bipoint, which is baited. When the fish takes the bait, a jerk on the line sets the sharp ends of the gorge into jaws or throat. Roughley (1951: 326) has illustrated a different version of gorge that was tied to the line with two hitches, so that line and gorge were sub-parallel. In this latter version, presumably only one of the sharp ends became embedded in the mouth of the fish.

If the muduk was indeed used as a gorge, its use on the New South Wales coastline had apparently ceased before Europeans arrived. There are however two reports of its historical use in eastern Victoria, at Lake Tyers (McCarthy 1976: 86) and Geelong (Roughley 1951: 321). The Geelong example was made of hardwood, which would be unlikely to survive long when buried in a midden.

Australian archaeologists generally have decided that the muduks were almost invariably used as points or barbs on spears (Lampert 1966; McCarthy 1940, 1976; Bowdler 1976). Massola (1956) suggested that uses as both barbs and gorges were probable, and thought the shorter bipoints with round cross-sections were likely to be gorges. Lampert and Hughes (1974) viewed fishing gorges as inefficient precursors to the shell fishhook, which does imply that angling has a longer history than the shell hook. Walters (1988) speculated on whether the gorge introduced the *concept* of line fishing.

In this debate, I side with the idea that angling predated the shell hook, and that is why we cannot pinpoint the arrival of shell hook technology in the archaeological record of fishing.

While bone muduks do occur at Birubi (see Chapter 9), and at Swansea Channel, they were not necessarily the only devices used on the end of a line to catch fish in early times. Other suitable devices include thorns, bird talons, and two-piece hooks made of wood or bone (Roughley 1951:324; Massola 1956; Anell 1955: 241). Most of these devices would not survive burial in a midden.

How effective is the shell fishhook?

The fishhook made of shell is a very obvious artefact in an excavation, and most archaeologists attribute increased fishing success to it. What they mean by that attribute is not usually clear. From a purely technological viewpoint, the shell hook may not have been any more effective than a bone or wooden gorge, and fabrication was probably not easier. One advantage claimed for the shell hook is that its opalescent surface acted as a lure, so that no bait was required (Kamminga and Mulvaney 1999: 292). The only support for this view I have been able to trace comes from Lt. James Grant (1803: 129) whose Aboriginal servant told him Australian salmon at Sydney would bite on the bare hook. Now salmon were not common in the midden at Birubi (their occurrence in the AB-midden was 1.0 % of total MNI), and at least some of these salmon were doubtless speared. Thus the luring properties of the silvery hook did not achieve much on the salmon shoals. There can be no doubt, from both ethnohistorical writings and Browne's painting (see Chapter 7) that Aboriginal women customarily used bait on their hooks. The only reported advantage of the shell hook was that its inturned point reduced snagging on the bottom (Anell 1955: 116), but that is an advantage over the barbed European hook rather than one over the fishing gorge.

The real advantage of the shell hook appears to be that it was adopted by the *women* on the New South Wales coast, so that they were brought into the fishing economy to complement fish spearing by the men. Walters (1988) has offered the opinion that this "fishing revolution" was really a *sociological change*, and I see considerable merit in the idea. I suggest that one advantage of the hook made from turban shell was that the women had full control over the raw materials, instead of having to obtain mammalian bone from the men to make muduks. The women's control of hook-and-line fishing was reinforced by ritual, such as amputation of a finger from certain girls (Scott in Bennett, 1929: 3).

I have mentioned that shell hooks have high archaeological visibility. As a result, several reports of other types of hooks used at the time of European contact have achieved very low visibility. Scott (Bennett 1929:17) at Port Stephens tells us "some of the hooks were fashioned of bone after the primitive style". At Port Jackson, Watkin Tench (1961: 47) mentioned "fishhooks made of bone", and White (1962: 200) reported a fishhook "some ¾-inch" [19 mm] "long, of hard black woodlike substance, neatly executed, and finished with a small knob for fastening the line… the point much turned in."

How were kelpfish caught?

The numbers of kelpfish represented in the AB- and C-middens are very large, and in some of the Levels in certain AB-Squares, make up more than a third of the total MNI (see **Table 11.4**).

Kelpfish are well known to present-day anglers as greedy little fish and, like the wrasses, will struggle to swallow baits too large for them. Inevitably, Aborigines trying to catch larger fish, such as snapper and bream, by hook-and-line must have caught kelpfish in significant numbers. However, the kelpfish represented in the middens appear to be more than just an incidental catch made by anglers trying to catch bigger fish. The percentages of kelpfish are too high, and many of the kelpfish are too small. At the lower end of their size distribution, they are less than 100 grams in weight, and such a small fish could not possibly get hooked on even the smallest of the shell hooks we excavated. The Aboriginal shell hook, with its sharply inturned point, can only catch a fish that has taken the hook well inside its mouth.

One explanation of these very small kelpfish is angling by children, using some type of tiny hook that has either not survived in the archaeological record, or is not recognizable. A plant thorn falls into the first category, and a fish spine gummed onto the end of a line into the second.

However, given the large numbers of kelpfish being caught, the evidence points to a fishing technique specifically aimed at catching kelpfish. Probably this technique was a baited trap. Kelpfish lurk amongst weed and under rock ledges, and must be lured out of cover by the offer of food if they are to be taken in a trap or net. Whitley (1980: 197) reports that the Maoris caught a similar fish by lowering a baited trap-net shaped like a parasol, and then drawing it up suddenly to enclose the fish. Undoubtedly this method would catch small members of other species of carnivorous rock-fish, such as wrasse and wirrah cod, at the same time.

Trap-nets like this might also explain the presence of *Tetradonts* (such as the common toadfish) in the middens. In the AB-Squares, 17 of these fish were identified. These fish contain a lethal toxin (tetrodotoxin) in their ovaries and (in both sexes) the liver. It is well known that specialist Japanese chefs offer these fish to their customers, some of whom – about 60 per year - are fatally poisoned despite the expertise of the chefs. In the breeding season (January to February in Australia), the toxin spreads throughout the fish and it is then dangerous to eat it even if the ovaries and liver have been removed (Armarego and Tucker, 1977). It is conceivable the Aborigines knew how to remove the organs containing the toxin, but in that case I would expect there to be lots of toadfish represented in the midden, for they are very easy to catch. The most probable explanation for their presence is that trap-nets were emptied out on the midden and any toadfish present were left to rot.

Large nets and tidal traps

The first European visitors observed nets being used in the Lake Macquarie – Newcastle – Port Stephens area (Enright 1900; Gunson 1974: 190; Grant 1803: 154), and a stone-built fish trap was reported from Broughton Island (Enright 1935a). The Aborigines at Birubi were thus familiar with the concepts of netting and trapping, but we found no evidence for, or against, these techniques actually being used at this location.

Bearing in mind that geomorphologists believe the shoreline along the Newcastle Bight has receded considerably in recent centuries (see Chapter 6), it is futile to look at the present-day shoreline at Birubi with a view to identifying likely sites for tidal traps. Had there once been stone-walled traps, it is unlikely they would have survived, for the Newcastle coastline has been battered by several cyclones per century.

Sizes of snapper

In the detailed lists of "finds" from these Birubi excavations, lodged with The Australian Museum in Sydney, the sizes of the identified snapper have been estimated. These estimates were made by comparing the sizes of excavated skull bones with those of fresh fish. Heads of large snapper (over 450 g) were provided by a helpful fishmonger. We obtained smaller snapper ourselves, and weighed them uncleaned. I had no control over whether the fishmonger guessed or measured the weights of the fish whose heads he gave me, and there was some vagueness about whether the weights were before or after cleaning. The weights of the larger fish are, therefore, not very reliable.

Table 11.13 shows the *apparent* weight distributions for the AB- and C-Squares. (The D-Squares had only 15 snapper altogether). The commonest size was around the 400 – 500 g range, and the range of sizes extended from 100 g to 5 kg. There is some indication of a "trough" around 600 g, but this is more likely to be due to unreliable weights given by the fishmonger than to a real bimodal distribution of weights.

Table 11.13. Weight distribution of snapper in the Birubi middens

N = 509 for the AB-Squares; n = 93 for the C-Squares[A]

Fish size (g)	AB-Squares (%)	C-Squares (%)
100	2.0	1.1
175	1.3	2.1
200	12.5	6.4
250	12.5	3.2
350	14.8	15.1
450	22.2	22.6
600	9.7	9.7
750	10.6	15.1
1000	8.3	16.1
2000	4.0	6.4
3000	1.0	1.1
5000	1.0	1.1

A These figures include snapper identified in the surface clean-off (Level 0), which might be contaminated with European material. However, the pattern of size distribution is not altered if the Level 0 snapper (19 for the AB-Squares and 49 for the C-Squares) are removed from consideration.

Bowdler (1976: 255) has suggested that barbless hooks and a vegetable fibre line imposed a size limit on the fish that could be taken this way – that is, very large fish must have been speared. I doubt if that is true: some of the shell hooks are so large (up to 45 mm long) that the target must have been large fish, and several Europeans remarked on the strength of the lines used at Port Stephens (Ebsworth 1826: 79; Scott in Bennett 1929: 18).

The real difficulty with large fish was lifting them out of the water, and with controlling them once landed aboard a small shallow canoe. First Fleet observers at Port Jackson noticed that the women always carried a fish spear in their canoes for striking any large fish they caught and, if the fish was too strong to land, they towed it ashore to be speared by a second person (Tench 1961: 287; Phillip 1970: 42; Collins 1798: 287). There is one record of an Aboriginal man catching snapper up to 9 kg with a sinkerless handline baited with octopus, off a rock platform on the Central Coast (Govett 1837). However, at this comparatively late date it is quite likely the man was not using traditional fishing gear.

In summary, it appears that snapper sizes, like the other characteristics of fish that we have considered, fail to distinguish between spearing and hook-and-line capture.

Is there any fish specific to hook-and-line capture?

All the common fish species in the Birubi middens can be taken by spearing. The less common species (see **Table 11.1**) include the teraglin, which normally inhabits deep water (15 to 50 fathoms) (Whitley 1980: 172) well out of the reach of spears, but accessible to fishing lines. However, Roughley (1951: 73) tells us that hungry teraglin will come right up to the surface if bait is offered. We cannot be sure that the small number (MNI 29) of teraglin identified in the AB-middens were not speared during such feeding frenzies.

Tailor is another species not likely to be speared, for these fish move very fast and do not commonly come close to shore. But the numbers are so small (MNI 15) that freak spearing or netting events might account for them. Overall, there is no fish species we can say *with certainty* was captured only by hook-and-line.

Seasonality of fish captures

Attempts have been made (Poiner 1976) to identify the months when Aborigines could catch the various species of fish on the coast of New South Wales. It is very difficult to do this, because nearly all the available data come from commercial fishing. There is a world of difference between making lean commercial catches offshore and picking up enough fish to eat by inshore fishing. In the case of Birubi, the commonest fish in the middens (the lowly kelpfish) is not fished commercially and we know very little about its movements, except that anglers report they catch it all year round. A further problem is that an archaeological "dig" cannot distinguish between fish caught in low numbers on numerous forays during the "off season" and those caught in good numbers on just one or two occasions during the "peak season". Anglers tell me that the chief species represented at Birubi (those listed in **Table 11.2**) are in fact caught year round, albeit with some seasonal fluctuations.

We have Scott's report of the annual mullet run (which occurs around Easter) being attacked by spearing inside Port Stephens (Bennett 1929: 18) but there is no indication from the Birubi middens of such a major event occurring there. Mullet otoliths should have survived, at least in the rather recent AB-midden, but only 23 individual mullet were identified, and most of those were not the species (*Mugil cephalus*) that shoals in that area today. This other species could not in fact be identified (Paxton 1991).

The only secure evidence for a season of occupation at Birubi is provided by the Port Jackson shark, which is known to come inshore to breed in the late winter (Coleman 1980: 18). There are sufficient Port Jackson sharks represented at Birubi (see **Table 11.1**) to prove that the Aborigines were in residence on at least some occasions during these winter months. This snippet of information is however of trivial importance.

In summary, there is no reason to think the Birubi site was occupied only at specific seasons of the year.

The importance of canoes

The length of rocky foreshore suitable for fishing along the headland at Birubi is actually quite short. Some of the rock faces are exposed to heavy swells and breaks in which the (apparently) sinkerless lines of the Aboriginal women would have been unusable. Other rock faces shelve into a zone of weeds and broken rock where fishing tackle is rapidly entangled and lost. Moreover, according to a scuba diver who knows this area well, the rocky faces of the headland have few fish about them. By contrast, the offshore reefs carry large populations of fish (Oswald 1977).

These reefs are about 200 metres off the end of the headland, and I estimate them to cover about two hectares. The fearlessness of the Aborigines in putting to sea in small bark canoes is well documented (see Chapter 7), so these reefs would have been readily accessible, and the small sheltered beach alongside the AB-midden would have been a convenient launching place. It would usually be possible to reach the reefs without encountering a surf break. I suggest it was the reefs, rather than the headland, that provided most of the fish. The small sheltered bay at Little Beach would also have been an important fishing ground, assuming that something resembling it existed a few centuries ago. Fish taking refuge in this bay during rough weather could have been speared, while in calm weather, it may have been possible to spear fish by torchlight at night.

Hughes and Lampert (1974), writing about the south coast of New South Wales, attributed the apparent rise in Aboriginal population of recent millennia to the efficient fishing brought about by the combination of the multi-pronged fish spear, shell fishhook, and canoe. It is unlikely that these three items first came into use at the same time, but the general proposition has much to commend it. The same combination was undoubtedly working at Birubi.

The importance of the canoe for reaching the best fishing grounds cannot be too strongly emphasized. Aborigines of the Port Stephens area were even prepared to go offshore to Broughton Island, 3 km from the nearest land (Wright 1975). The advent of the simple bark canoe is not yet dated, and perhaps it has been in use for millennia. Once canoes were allied with efficient fishing tackle, and the women took up hook-and-line fishing, the result was the substantial fish catches to which the AB- and C-middens at Birubi bear testimony.

A comparison of excavated and surface-collected fishbone

We can compare the percentages of various fish species in the surface collections (**Table 3.2**) with those from the excavations (**Table 11.2**), bearing in mind that there was no surface collection from the C-middens. The key elements of the comparison are shown in **Table 11.14.**

We see that snapper are greatly exaggerated in the surface collections, which reflects the durability to weathering of their massive cranial bones. Once bone has fallen out of its protective matrix in the midden, it is exposed to cycles of wetting and drying and the more fragile bones soon disintegrate.

Surface collecting at Birubi did not recover very much fish bone, doubtless because most of the bones falling out of the crumbling face of the midden were soon covered with sand. Thus the surface collecting failed to build up an adequate number of identified individual fish. No doubt there would have been more species identified if the MNI figures had been much higher.

Table 11.14. Comparison of excavated and surface-collected fish bone at Birubi. Proportions of various species are given as percentages of total MNI, and only the commoner species are listed here

Species	**AB-Squares Surface** MNI 92 14 species	**AB-Squares Excavated** MNI 3171 29+ species	**D-Squares Surface** MNI 35 9 species	**D-Squares Excavated** MNI 100 12 species
Black bream	6.5	5.7	20.0	27.0
Groper	5.4	6.7	2.9	10.0
Kelpfish	13.0	28.4	0	4.0
Snapper	43.5	16.7	54.3	16.0
Whiting	0	3.0	0	4.0
Wrasse	7.6	11.7	3.0	11.0

Some species are inherently unlikely to be identified in surface collections. Mullet, whiting, and teraglin are usually identified from their otoliths, and it would be very difficult to recognize these tiny buttons of bone amongst a scatter of broken shell lying on loose sand.

The collapse of a midden does of course mix material of varying ages. The significant variations in the percentages of various species with the passage of time (as seen in the AB-Squares) cannot be identified in the surface collections.

Overall, one has to conclude that surface collections of fish bone may give misleading information about species distribution. Surface collections are obviously better than nothing, but excavated samples of fish bone give a much better picture of what is in the midden. Even the excavated sample is not free from selective decay for certain fish species.

CHAPTER 12: EXCAVATED AVIAN, CRUSTACEAN, MAMMALIAN, AND REPTILIAN BONE

Proportions of birds, crustaceans, fish, mammals, and reptiles

Occurrence by weight

The occurrences, by weight, of the various kinds of bone in the Birubi middens are shown in **Table 12.1**. (For convenience, chitinous material from crustaceans is included here). The densities (g/m^3) reveal striking differences between the three parts of the middens we sampled. In the AB-Squares there is a very high density of fishbone and an appreciable one of crustacean material. The D-Squares are as rich as any other in mammal bones but have no crustacean remains, few of bird, and only modest levels of fishbone. The C-Squares have bone densities of intermediate values, though resembling the AB-Squares more than the D-Squares.

Reptilian bone is omitted from the Table because the weights are so low (0.79 g from the six AB-Squares, 0.22 g from the four C-Squares, and 0.75 g from the seven D-Squares).

Table 12.1. Occurrence by weight of bones in the Birubi middens

Item	AB-Squares	C-Squares	D-Squares
Bird bone (g)	218.7	26.7	3.20
Density (gm^{-3})	*39.1*	*17.8*	*1.8*
Crustaceans (g)	1213[A]	22.38[B]	0
Density (gm^{-3})	*261*	*63.9*	*0*
Fish bone (g)	16597	1609	300
Density (gm^{-3})	*2964*	*1073*	*171*
Mammal bone (g)	361.9	47.1	141.4
Density (gm^{-3})	*76.2*	*31.4*	*80.8*

A This figure does not include data for Square A5, whose crustaceans were not weighed. The volume of the A-Squares has been reduced from 5.60 to 4.65 m^3 for this entry.

B This datum is for Square C1 only, because the crustacean material from the other three C-Squares was not weighed.

To some degree these densities are affected by the extent to which there has been dilution by the mass of shell present. The amount of sterile sand included in the bottom Level of each Square is also a factor. Both these factors are eliminated by presenting the bone data as percentages by weight of the total bone recovered (see **Table 12.2).**

Table 12.2. Percentages by weight of various types of bone in the Birubi middens.[A]

Values are means of the figures for individual Squares in each designated group of Squares.

Squares		Birds	Crustacea	Fish	Mammals
AB ([B])	%	1.2	6.6	90.2	2.0
	Mean deviation	±0.4	±1.9	±2.6	±0.4
	Range	0.9-1.8	3.7-10.1	87-93	1.1-2.9
C1 ([C])	%	1.0	4.4	90.8	3.8
D	%	1.1	0	66.4	32.3
	Mean deviation	±1.0	-	±9.8	±9.8
	Range	0-2.8	-	49-83	17-51

See footnotes next page.

A Reptile bone is omitted. It made up 0.004% of the bone weight in the AB-Squares, 0.02% in the C-squares, and 0.2% in the D-Squares.

B Data for Square A5 are omitted because its crustacean material was not weighed.

C The crustacean material was not weighed for the other three C-Squares. Crayfish generally made up most of the weight of crustacean items, and Square C1 with 10 MNI was below the average (17 MNI) of the other three Squares. With respect to the other material, the four C-Squares were closely similar: *with crustaceans omitted*, they had 1.6±0.4% bird bone, 95.6±0.4% fish bone, and 2.8±0.7% mammal bone.

We see that the AB- and C-Squares are very similar, the faunal remains being dominated by fish (90 and 91% respectively), and they both have a moderate level (6.6 and 4.4% respectively) of crustacean remains. The D-Squares have a much lower percentage of fishbone (mean 66%) and a correspondingly high level of mammalian bone (32%).

The ranges of values within each group of Squares provide a salutary warning to those who assume shell middens are so homogeneous that one can take small samples. In Square D3, the percentages by weight of fish bone and mammal bone are both 49, while for the adjoining Square D4 the values are 83 and 17 respectively. One would draw a quite different conclusion about the balance of fishing and hunting from D3 than from D4. Given the high weights of some of the items of mammalian bone, these variations are not surprising. In addition, Square D4 contained neither bird nor reptile bone, but D3 contained examples of both.

Occurrence in MNI terms

Yet another way of presenting the bone data is in terms of minimum numbers of individual fauna (MNI) that one can identify in the excavated material. The MNI counts contain certain systematic errors (such as the division of bone from one individual between the arbitrary Squares and Levels of an excavation), and fall a long way short of the original numbers of fauna present in the midden before decay and other losses. Allen and Guy (1984) estimate that MNI are 4 to 5 times smaller than these unobservable "original numbers", but conclude that MNI are useful for comparing samples.

There are problems with the reliable identification of species of both birds and mammals in the Birubi material (see later), but the MNI figures assigned here (see **Table 12.3**) should not be too much in error. These MNI figures tell a significantly different story to the ones told by bone weight per cubic metre, or percentage by weight. According to MNI figures, the D-Squares have only a marginally lower proportion of fish than the other Squares. The important differences between the groups of Squares are that the D-squares have a high level of individual mammals (17%) and a zero level of crayfish, while the AB- and C-squares are similar to one another in having a high level of crayfish and a quite low level of mammals.

The levels of birds and reptiles counted by MNI are low. The relative figures for the different groups of Squares would probably change were the numbers of individuals to be recounted by a competent zoologist.

Crayfish MNI have been calculated using only the mandibles. There is other crustacean material (claws, test, and spines) and not all of it belongs to crayfish. Small numbers of sea urchins, and occasional crabs, are represented, but I am not competent to assign MNI to these, and the numbers are anyway too small to affect the overall picture given by **Table 12.3**.

In MNI terms, some of the major differences between Squares D3 and D4 disappear: D3 has a MNI count of 11 fish in a total of 17 and D4 has 7 fish out of a total of 10. (These Squares still differ in that there are no avian or reptilian remains in Square D4). Overall, the

MNI comparisons are the most satisfactory because the effects of a few large pieces of bone are eliminated.

Table 12.3. Occurrence by minimum numbers of individuals (MNI) of fauna in the Birubi middens

Data from all excavated Squares are included in this Table.

Item		AB-Squares	C-Squares	D-Squares
Birds	MNI	67	16	6
	%	1.7	3.4	4.5
Crayfish	MNI	621	61	0
	%	15.7	12.8	0
Fish	MNI	3171	378	100
	%	80.2	79.6	75.2
Mammals	MNI	75	16	23
	%	1.9	3.4	17.2
Reptiles	MNI	18	4	4
	%	0.5	0.8	3.0
Total MNI		3952	475	133
MNI/m^3		706	317	76

The discard rates of shell

The MNI figures given in **Table 12.3** are presented in such a way as to show proportions of birds, crayfish, fish, mammals, and reptiles. The most abundant food items on the site are of course shellfish: their MNI numbers are 30733 for the AB-Squares, 18644 for the C-Squares, and 14078 for the D-Squares. Shellfish therefore make up 88.5, 97.5, and 99.1% respectively for the dietary individual fauna present in these three groups of Squares. Incorporating the shellfish figures reduces the next most abundant food item (namely fish) to respective figures of 9.1, 2.0, and 0.7%.

One must ask why shellfish are so much more dominant at some parts of the midden than at others. For the midden locations with especially high shell abundance, one can postulate either that the shell discard rate was highest there, or that other dietary items were discarded less often. There is no obvious way of distinguishing these alternatives. Rates of scavenging (see below) may play a part but are unlikely to be the whole story. There may also be a sociological explanation, namely that some parts of the midden were used for feasting on shellfish by large groups of people.

Scavenging

Examination of the faunal remains from Birubi indicates that a very high rate of scavenging of bones must have occurred during the years the site was in use. Although at least 114 individual mammals were excavated, only 550 g of mammalian bone was recovered. There are examples of quite large individual macropods represented by just a few fragments of teeth. The Aborigines appear to have broken up many of the bones, to extract marrow or to make bone tools, but these activities do not cause wholesale disappearance of large bones. Those bones that have survived are in good condition, so we cannot invoke chemical dissolution to explain the missing mammalian bone. The disappearance of most of this bone must be due to scavengers, such as dingoes, goannas, and large birds.

The evidence for scavenging of the discarded bones of small fauna (birds, fish, reptiles) is less clear, but we can be certain that it occurred: sea gulls are especially adept at taking such morsels.

We have to ask whether the bones that survived scavenging are representative of those discarded at the time of Aboriginal meals, and to what extent it is reasonable to compare data such as those in **Tables 12.1**, **12.2**, and **12.3**.

Very few empty shells would be taken away by scavengers. Thus one effect of heavy scavenging of bones is that a midden becomes greatly enriched in shells. The figures given above, where shellfish made up 89-99% of the MNI we excavated at Birubi, have undoubtedly been greatly distorted by scavenging. Such experiments as those carried out by Coutts (1970: 45) warn us that the Aborigines could not have lived on such a heavy diet of shellfish for any length of time.

I am not aware of any study of bone scavenging from a coastal site, but a thorough study of a currently-used central Australian camp site has been published (Walters 1984). Walters kept track of the animal bones discarded by a group of Aborigines at their meals, and after six months he found the survival rate was *only two per cent by weight*. Not all of this massive attrition was caused by dogs, lizards, rats, and birds: some of it was due to site clean-ups by the Aborigines themselves. Small bones had more chance of being trodden into the sand, where scavengers would overlook them. The crucial part of Walters' study lay in comparing the meat diet he had recorded each day with the "reconstructed diet" made by identifying the few bones he could recover at the end of six months. The correspondence of the two diets was poor.

Obviously we cannot expect the excavated fauna from Birubi to provide a balanced view of the meat diet. The ratios of birds, fish, etc in **Table 12.3** provide some broad impressions, and I do not propose to analyse the percentages in any more detail. It would be possible to translate the MNI figures into approximate meat weights and calorific values, but in view of the heavy scavenging, and the unknown extent to which meals were eaten away from this base camp (see below), these sophisticated analyses are almost meaningless.

Bush cooking

A further complication noted by Walters was that the Aborigines in his study group often cooked and ate large animals some distance away from the main camp, so that these important items did not appear in his bone sample at all. Meehan (1982) has described the dining habits of a group of Aborigines in detail, and reports that a good deal of the fauna were cooked and eaten during the daily foraging trips, rather than being brought back to the base camp. The existence of small pipi middens along the ocean beach near Birubi is consistent with this practice. Even the fish caught close to the main Birubi camp might not have all been brought ashore, for early European observers noted the women sometimes cooked fish on the small fire they carried in their canoe (Dawson 1830: 314; Threlkeld in Gunson 1974: 191; Hunter in Cobley 1962: 89; Parry 1830).

Birds

Nearly all the bird bones recovered by excavation match those of a shearwater (*Puffinus tenuirostris*), a species which nests at Broughton Island between the months of October and March. When the birds first arrive in October, after migrating from Siberia, some are so exhausted that they settle on the water and drown. At these times one could easily collect dead and dying birds from the beach. Dead shearwaters can also be seen on the beaches after heavy storms. Presumably the birds represented in the Birubi middens were collected to be eaten, though perhaps some were sought purely as a source of bone for making points (see Chapter 9).

The avian longbones we excavated had usually been smashed. In the AB-Squares, the 1045 avian items included 91 slivers of longbones possibly intended for point manufacture. Lampert (1966) reported for the Durras North site that these "blanks" for bone point manufacture were made by simply smashing the longbone – a technique that makes it impossible to distinguish point manufacture from similar breakage to get at the bone marrow. In the C-Squares there were 45 slivers amongst 173 avian bones, and in the D-Squares, 14 out of 61. The distinction between "slivers" and "fragments" of longbones is so subjective that not too much should be made of the proportions of slivers in the total avian bone.

I do not have skeletons of any other bird species than *P. tenuirostris*, and it is therefore impossible to rule out the presence of other medium-sized birds in the midden record. The ethnohistoricic record (see Chapter 7) suggests that other species are likely. On the basis of bone sizes, two clavicles from Square B2 Level 5 belong to larger birds than shearwaters, and from the same spit there is an ilium bone too small for a shearwater. Another large item was found in Level 2 of the same Square, and may be the coccyx of a marine turtle rather than the caudal section of a big bird.

Crustaceans

Various crustacean remains occur in the AB- and C-middens. The most numerous items are the mandibles of crayfish (*Jasus* sp.). Other remains are the spines and occasional test fragments of sea urchins (Echinoderms), and an assortment of claws. Some of the claws belong to crayfish, but others to crabs. A competent zoologist could doubtless identify the species involved.

The crayfish mandibles were invariably very crumbly – so much so that I did not always think it worthwhile to weigh what was left of them. (Those mandibles from Squares A5, C2, C3, and C4 were not weighed). There can be little doubt that many of these fragile items broke up on the sieves during excavation, so that their numbers are under-estimated. In older parts of the middens, these mandibles may have weathered away completely. Very little of the chitinous test of the crayfish has survived. These tests are fragile, especially after being cooked in a fire, and once broken into fragments there is an enzyme (chitinase) that probably makes short work of them. This enzyme occurs naturally in some soils (Dr. R. Murdoch, *pers. com*.).

The early European observers (see Chapter 7) all agree that the Aborigines caught crayfish by diving. There is no mention of using baited traps in the manner of commercial fishermen.

Crabs and sea urchins appear to have been much smaller components of the crustacean diet. One cannot assume that these delicacies were all for human consumption: the Aborigines at Birubi caught numerous groper (see Chapter 11) and there are no better baits for this purpose than crabs and urchins. The urchin species are *Centrostephanus rodgersii* and *Heliocidaris erythrogramma*, both of which are common on the reefs at Birubi.

Barnacles, which are crustacean, have for convenience been listed along with shellfish in Chapter 10. Large barnacles may have been eaten, but if so they made up only a very tiny part of the diet.

Mammals

Mammal bone has tentatively been assigned to species by comparing cranial material with the illustrations in a standard text (Morrison 1981). Nearly all the excavated bone was fragmentary, and often charred, so that my identifications are open to considerable error. This material needs to be identified by a competent zoologist with access to a comprehensive set of mammalian skeletons.

Nevertheless, even the partly-identified mammalian bone tells a useful story. A wide range of species is represented, from very small marsupials, to medium-sized ones (bandicoot, possum, water rat) and large ones (wallaby) and dog. Teeth of dogs (presumed to be dingoes) are a common item. European informants agree that the Aborigines domesticated puppies (Dawson 1830: 176) and used them to hunt bandicoots (Threlkeld, in Gunson 1974: 54, 190) but disagree on whether they were eaten (see Chapter 7). The bones of dogs at Birubi are not those of carefully buried domestic pets: they have been broken up (and mostly gone missing) like all the other mammalian bone on the site. That dogs were eaten at Birubi is beyond reasonable doubt.

Overall, the archaeological record is in good agreement with the reports of Aboriginal hunting from early European observers (see Chapter 7).

Reptiles

Reptiles are quite a minor faunal component of these middens, whether measured by bone weight or MNI. Not having an adequate set of reptile skeletons for comparison, I have not attempted to identify the species. All but two of the 26 individuals are lizards. Some of the jaw fragments could be identified by family: there are 5 instances of agamid lizards (a family that includes frilled lizards and bearded dragons) and 3 of *Scincidae*. The latter group ranged in size from small skinks up to one the size of a common bluetongue. A set of 63 vertebrae, from Square D3 Level 1, belong to something much larger, possibly a snake, and there is one jaw (Square C2 Level 0) probably from a snake.

All these reptiles are found in the immediate hinterland at Birubi.

Possible octopus identifications

One recurrent unidentified item in the AB-Squares is a small jaw-like bone with a cutting edge. It is described in my field notes as a "bony incisor" and originally I thought it belonged to an unidentified fish, but I now think that unlikely.

There are 112 of these items recorded (59 from Square A3, 45 from A4, and 8 from B1). This item closely resembles the beak of an octopus but I am not fully convinced by this possible identification. Comparison with a comprehensive collection of cephalopod beaks is needed.

Comparison of excavated and surface-collected bone samples

The samples of bird, mammal, and reptile bone recovered by these two methods actually agree quite well, both in their relative amounts and in the species represented. The one exception is the crustaceans, whose presence was not noted during surface collecting.

No whale bone was excavated, but fragments of whale vertebrae were found on the surface at the AB-midden.

CHAPTER 13: ARCHAEOLOGICAL SITES ASSOCIATED WITH BIRUBI

In common with other hunter-gatherer societies, the Port Stephens Aborigines had no settled place of abode (Ebsworth 1826: 75). Undoubtedly the people who used the base camp at Birubi also used other sites. Whereas the hunter-gatherer activities at Birubi exploited mainly marine resources, it is distinctly likely that other habitats with different food resources were utilized from time to time. It is important to identify and investigate these other sites if we are to get a well-balanced view of Aboriginal life along the south side of Port Stephens.

Territorial boundaries

The first task is to identify the "home territory" of the clan of people who occupied Birubi from time to time. In the view of Elkin (1932), Birubi falls within the territory of the Maiangal, who were a local group of the Worimi subdivision of the Kattang tribe. (The accepted spelling is now Maaiangal). Elkin, and Enright (1932) reached consensus on this social structure after revising an earlier version (Enright 1900). The territory of the Maaiangal was thought by these authors to be along the south side of Port Stephens, being bounded by the ocean to the east and south, and Tilligerry Creek to the west. Their neighbours were the Garuagal (who occupied the Hunter River estuary as far inland as Maitland), and the Gamipingal who lived along the north side of Port Stephens as far to the east as Tea Gardens.

Elkin (1932) admitted to uncertainty about the western boundary of the Maaiangal clan territory, and there is now field evidence to question the position he gave it. The almost continuous occupation sites on the Stockton peninsula between Williamtown and Stockton make it unlikely that the boundary between the Maaiangal and Garuagal clans was located there. A further difficulty is that Elkin's boundary places major sites at Williamtown and Fullerton in Garuagal land, yet the people using these sites collected pipis that could only have come from the ocean beach belonging to the Maaiangal.

I have raised this boundary problem with Carol Ridgeway-Bissett of the Maaiangal Heritage Group. She asserted that the Elkin-Enright western boundary for the Maaiangal Ngura (Clan) is wrong, and located it along the eastern shore of Fullerton Cove, with an extension to include Swan Bay on Port Stephens. The clan territory, on this basis, includes all the Stockton peninsula, the Williamtown area, all the southern shore of Port Stephens from Tomaree to the present-day township of Karuah, and the ocean shoreline from Stockton to Tomaree.

The Worimi Local Aboriginal Land Council view (Lennie Anderson, pers. com. August 2004) is different again. In addition to the territory assigned to the Maaiangal by Elkin, they add Stockton, the eastern shore of Fullerton Cove, the islands in the Hunter estuary, and Williamtown. In their view, the northern side of Tilligerry Creek, and the western end of Port Stephens between Lemon Tree Passage and Karuah, belonged to the Garuagal clan.

I am in no position to resolve the different opinions held by the Land Council and the traditional Maaiangal owners about who owned the western end of Port Stephens. The two parties do agree that the Stockton and Williamtown areas belonged to the Maaiangal clan, and that removes my concerns about Elkin's western boundary.

How many people?

Estimates of Aboriginal populations by early European settlers are always questionable. There can be little doubt that European diseases (especially smallpox) diminished Aboriginal populations in many areas before any European people arrived there. It was also difficult for these European settlers to make an accurate head count of a nomadic people. There were occasions when some special Aboriginal gathering gave an opportunity to make an accurate count, but the reasons for such gatherings were generally unknown to the European spectators and people from distant tribes may have been present.

Dawson (1830: 323) saw no evidence of smallpox among the Aborigines he mixed with at the Australian Agricultural Company's settlement at Carrington. He estimated there were 150 men, women, and children in the group living on the north side of Port Stephens (Dawson 1830: 277). Ebsworth (1826), for the same people, estimated nearly 200. The large gatherings where these counts were made could have included visitors from other Aboriginal clans, but the local Gamipingal clan probably had 100 people at least.

There is no known count of the Maaiangal clan members from the southern side of Port Stephens, so I must advance some rough estimates. One approach is to compare the food resources with those on the north shore of Port Stephens. The Maaiangal territory, because it matched all the habitats of the Gamipingal lands and had a long ocean shoreline as well, would have offered superior food resources. If there were at least 100 Gamipingal people, there could have been 150 in the Maaiangal clan, or perhaps even 200.

The population in Maaiangal territory can also be estimated using figures worked out by Hall (1982) for the Moreton Bay area. He calculated the very rich resource zone there to have had one Aboriginal per 1.25 km^2 at the time of European settlement. On this basis, the Maaiangal territory of 190 km^2 (using Lennie Anderson's version of the boundaries) could have had a population of 150, or 240 people using Carol Ridgeway-Bissett's clan territory.

All these estimates are very crude, but they do suggest there could have been about 200 people living in the Maaiangal territory. According to the lifestyle described by Dawson (1830: 327) all these people would at times have gathered together, but usually they were dispersed in family groups. The population estimate of 200 suggests about 40 family camps at any time, and each family would use quite a number of such camps during the annual cycle of seasons. We should expect to find a large number, perhaps several hundred, of these family-sized encampments in the clan territory. The number of sizable base camps, used on occasions by the whole clan, would be very much smaller.

Possible food resources

Birubi, being located at the rocky end of a very long sandy beach, provided opportunities both for collecting pipis from the beaches and for exploiting the shellfish and fish of the reefs. The woodlands on the Outer Barrier dune ridges could provide a range of vegetable foods, mammals, reptiles, and birds. The territory of the local clan also included extensive estuarine and salt marsh ecosystems along Tilligerry Creek and (for one version of the clan boundary) at Swan Bay (see Map 2), and these areas would have been a rich source of food. Then there were the extensive freshwater marshes at the head of Tilligerry Creek, and along the landward edge of One Mile Beach. These marshes would have yielded waterfowl, eels, snakes, and the bungwall plant. Other useful ecosystems were the rocky headlands between Birubi and Tomaree (sources of rock shellfish and fish), the sandy dune systems (for giant lilies, macrozamias, and wildlife), the estuary of Fullerton Cove, and the south shore of Port Stephens. This last ecosystem provided the estuarine fishing that was such a dominant activity at Carrington on the north shore of Port Stephens (see Chapter 7).

Clearly there was a wide range of different ecosystems to exploit for food, and some of them must have been every bit as attractive as the Birubi site. We should now attempt to determine which ecosystems were in fact used, and what activities took place at the associated base camps.

Known Aboriginal sites in Maaiangal territory

There is no shortage of known Aboriginal sites in the area bounded by the south shore of Port Stephens, the Pacific Ocean, and the Hunter River estuary. Dean-Jones (1990) reported 110 new sites during her survey of the Newcastle Bight in 1990, as well as 40-50 others there was not time to record. In addition, 61 sites were already on the National Parks and Wildlife Service registry. Some of these sites are outside our area of interest, but about 200 sites are within it.

As well as these known sites, many others have been destroyed without record. The limeburning industry that operated from Corrie Island in Port Stephens through much of the 19th Century (Engel 2000: 49, 249) must have accounted for numerous shell middens. A smaller limeburning industry operated on the south side of Port Stephens, at Tanilba Point (Tanilba Historical Society information). Urban development, and commercial sand mining, will have destroyed many other sites. The southern shore of Port Stephens has never been fully surveyed for archaeological material, though the thin scatter of cockle shells in the present-day waterfront reserves suggest that there may once have been numerous middens. The landward face of the Outer Barrier dune ridges has also never been fully explored for sites. The Worimi L.A.L.C. continues to discover new sites at an appreciable rate (Lennie Anderson, pers. com. 2000 and 2004).

Thus there are some hundreds of known sites that may have been used by the occupants of Birubi in their foraging travels, and many other sites are already destroyed or have yet to be found. Most of the known sites are small scatters of shells, representing a transient visit by a few people, but others appear to have once been sites every bit as large as the Birubi one.

Which sites are contemporary?

In an environment of sand dunes the land surface keeps changing, and there have been considerable changes to the landscape along the Newcastle Bight during the last few thousand years (see Chapter 6). Aboriginal sites on mobile sand surfaces can become buried or scattered, and those close to the beach may be engulfed during shoreline regression (Dean-Jones 1990) or by tsunamis (Bryant 2001). These landscape changes may often have caused a popular camp to be abandoned after only a few human generations. It is unlikely that any campsite in these mobile landscapes has remained habitable for thousands of years.

Buried sites may be uncovered again, and doubtless many of the sites recorded along the Newcastle Bight have been through cycles of burial and exposure.

This scenario presents considerable difficulties to the archaeologist. In the first place, one must accept that many Aboriginal sites – perhaps even large ones – are currently buried. Secondly, nearly all those sites that developed close to their contemporary beach will have been engulfed during the shoreline erosion of the last 500 years. And thirdly, the brief habitability of some sites raises questions about which of the many known sites were actually in contemporary use.

This last problem is, in principle, one that can be solved by determining dates of first and last occupation at each site. However, Dean-Jones (1990) reports there are not many stratified sites available to date in this way. It will be difficult to build up a clear picture of how various ecosystems were utilized at specific times in the Aboriginal prehistory of this area.

Sites contemporary with Birubi

At the time of writing, there are few radiocarbon dates available and we therefore can connect Birubi with only a handful of the numerous sites in this locality. There is actually no site that has had both the beginning and the end of its occupation dated. I have already remarked (see Chapter 6) that dating the most recent Aboriginal occupation at Birubi is not practicable because there are European middens on the surface. This is a common problem along the Newcastle Bight (Dean-Jones 1990).

An alternative approach to radiocarbon dating of cultural material on the sites is to examine the geomorphology and estimate the date of the land surface occupied by the archaeological material. Dean-Jones (1990) has used this approach for sites on the seaward side of the Outer Barrier ridges along the Newcastle Bight. A number of these middens rested on sand surfaces she judged to be post-1200 BP; thus they must overlap at least part of the occupation span at Birubi.

The list of major sites, thought to be contemporary with Birubi, now follows. The grid references (GR) were fixed by compass bearings and dead reckoning, and carry the errors expected of such methods. These positions have not been checked by the Global Positioning System. Furthermore, many positions were fixed on First Edition Central Mapping Authority maps; thus the locations may be up to 200 metres in error with respect to maps published more recently.

The stone material I collected from all sites in Maaiangal territory is listed in **Tables 14.1** and **14.2**, with the same descriptions I used in Chapter 2. These lists are intended only to give broad impressions. Obviously the number of artefacts collected depends on the number of times I visited the sites, and on the degree of visibility of the material. I do not believe I was the only collector, and the distribution of the various tool types may therefore have been distorted. The material I collected has been lodged with The Australian Museum, except for the waste flakes, which the Museum was unable to accept.

1. **Uralla** (approx. GR 059706). This site near the ocean beach was reported by Dean-Jones (1990: 94) to have ten mounds of pipi shell, and four of these were in clear association with the post-1200 BP stable dune surface. One mound included discrete concentrations of cockle (*Anadara trapezia*) and mud whelk (*Pyrazus ebeninus*) which must have come from an estuarine source. There was no bone at the site, but there was charcoal. Some of the shell mounds included scattered stone material; the 62 items she subjected to study were made up of 40% Nobby's tuff and 56% "Birubi igneous". The tuff had been heat-treated prior to flaking. The only recognized tool was a hammerstone.

   My own survey here, made in 1975, gave similar information. The shell middens around the fishermen's huts near the old *Uralla* wreck were part of a near-continuum extending southwest as far as North Stockton and northeast to Birubi Point. Those middens around the huts were well preserved. Generally these shell heaps were 99% pipi, with cockles (*Anadara trapezia*), mud whelks (*P. ebeninus*), floating oysters (*Ostrea angasi*) and sand snails (*Conuber aulacoglossa*) making up the rest, but in several small patches the proportion of cockles rose to 20%.

   In conformity with Dean-Jones' observations, most of the shell middens were on the dune-ridge slopes facing the sea. A rather wet swale lay between this dune ridge and the beach. Some of the middens were as far as 800 metres from the present beach. There was stone material (both flaked and fire-shattered) on many of the shell heaps, occasionally in a small cluster of flakes of the same lithology. These clusters perhaps represented a single flaking event. The total amount of stone material was however small: a stretch of 7 km of these middens yielded just 186 items (see **Table 14.1**). There was also one trimmed flake of green glass. At one place there was a porphyry boulder, weighing about 18 kg, lying alongside a rounded 2-kg cobble. The function of such a hefty manuport is unknown, but it must have been important since the nearest source is nearly 10 km distant. Information given in Chapter 7 suggests this boulder may have been used for cooking whale blubber.

   One of the edge-ground axes, made of black basalt, had only a small amount of edge-grinding. A second one, made of ignimbrite, was extensively ground, but the cutting edge was broken. These two axes were found by RAAF pilots, who used the rather novel method of blasting the sand off the shell heaps with their helicopter before

landing to see what had been uncovered. The third axe, which I found myself, was made of ignimbrite and had a broken butt.
My survey found very little bone in all these shell middens. One whale vertebra, a bandicoot mandible, and a broken macropodid fibula made up the total.
In 1989, Dan and Athlene Carroll of Anna Bay showed me four leaf-shaped fishhook files, which they are reasonably sure they found near the Uralla huts. These items do not necessarily mean that fishing occurred here; in fact the absence of fish bone in the middens indicates that surf-fishing was not practised.
The overall impression I have of these shell middens is that they were generally used on a casual short-term basis; there is not enough stone-working to suggest extended stays. (Note that no flaking cores were found here). Doubtless vegetable foods were combined with the pipi shellfish. The presence of a low level of estuarine shellfish indicates connection with the estuary of Tilligerry Creek, which is only 4 to 5 km distant and therefore within daily foraging reach. Some connection with Birubi is also probable, this being the closest source of the porphyritic cobbles.

Table 14.1. Lists of stone material collected from sites close to Birubi

Item	**Uralla**	**One Mile Beach (Zone A)**	**Mac's Track**	**Freshwater Lagoons**
Elouera	-	27	19	27
Used flakes	3	69	21	31
Simple blades	1	43	-	20
Backed blades	-	318	-[A]	38
Geometrics	-	17	-	3
Cleavers/slices	6	27	1	13
Ground-edge axes	3	-	-	-
Hammerstones	3	4	2	1
Slabs/anvils	1	2	-	4
Miscellaneous	-	-	-	-
Broken backed blades	-	107	-	5
Broken tools (other)	-	11	2	7
Total tool count	**17**	**625**	**45**	**149**
Pebbles	1	27	-	2
Cobbles	8	-[B]	1	-[C]
Ochres[D]	4	16	1	3
Flaking cores	-	66	12	27
"Fabricators"[E]	-	6	-	-
Waste flakes	156	407[F]	414	-[G]

A No backed blades were collected, but 20 were counted on the ground.
B No cobbles were collected, but they were numerous.
C One boulder was present.
D All the ochres were red.
E These items appear to be scalar cores produced by bipolar flaking.
F Waste flakes were collected on only 4 of 15 visits.
G Waste flakes were present but no collection of them was made.

2. **Mac's Track** (GR Omitted). *Note that some writers have called this site "Lavis Lane".*

   This site, measuring about 250 by 80 metres, occupies a transgressive dune, 2.2 km from the present-day beach. The midden has been heavily damaged in recent decades, partly by cattle and partly by the digging of sand pits. At the time of writing (2003), there is still a small intact cap of shell at the northern end of the site, but the southern end of it has been fully deflated. A considerable amount of flaked stone is scattered across the damaged and deflated areas.

   When I visited this site in 1975 I estimated the shell to be about 99% pipi, with the balance made up of oysters, cockles, occasional mud whelks, and just one example of an Australian hornshell (*P. australis*). Dean-Jones (1990: 99) observed a similar distribution of shell species, plus a few dog cockles (*Veletuceta flammea*). During my visit, I collected some large fragments of mammalian bone, a matching pair of macropodid jaws, and two fish bones one of which was the lower jaw of a small snapper.

   Dean-Jones collected two small samples of stone at the site, and identified 13 different rock types. Waterworn cobbles of "Birubi igneous" were present. She reported no utilized stone material, and remarked on the absence of backed blades at the site. In 1975 I collected 414 waste flakes (62 % of them chert) made up of 7 lithic types, as well as the other items listed in **Table 14.1**. This collection has been reported (Dyall 1975) and lodged with The Australian Museum, under the name of Mac's Track. In 1991 I examined the site again, including a blowout area at the southern end where a house had been when I visited before. In this southern area my companion and I counted 20 bondi points, all made of chert. In contrast to the site at Williamtown Church (GR Omitted) only 2 km to the north, there were no geometrics among these backed blades.

   Dean-Jones believes this transgressive dune could be about 4500 years old, but she saw no indication of the age of the archaeological deposit. Leary (1992) has since dated the pipi shell in the cap at the northern end, and the reservoir-corrected figure is 1470 ± 80 BP. This date clearly demonstrates that occupation of this site overlapped at least part of the timespan at Birubi.

   Here at Mac's Track, pipi was obviously one of the dietary staples. Estuarine shellfish are at a very low level, which indicates that Fullerton Cove was not normally part of the daily foraging territory. It was actually too far away, being 5 km in a direct line and in practice much further, since Long Bight Swamp was in the way before Europeans drained it. The few examples of estuarine shellfish, and fish, noted on this site could have been brought here on the journey from the previous camp. This previous camp may have been on Port Stephens, or towards modern-day Stockton. We are told by Dawson (1830: 66) that the Port Stephens natives sometimes took along fish and shellfish when setting forth on a journey.

   The large amount of flaked stone at Mac's Track indicates it was a base camp, and it is hardly likely that the occupants lived exclusively on pipis. The obvious food resources available to them were from Long Bight Swamp, supplemented by game from the sandhill country. The vegetable foods from the wetlands are most unlikely to leave traces in the midden, but waterfowl and eels should. An excavation of the midden remnant could be rewarding. The location of this site, well away from saltwater fishing opportunities, suggests that here the people from Birubi had a quite different lifestyle.

3. **Newcastle Bight generally**

   Dean-Jones (1990: 16) is of the opinion that shell midden sites along the deflation basin and the outer margin of the active transgressive dunes along Newcastle Bight represent an intensive occupation over the last 1000 years, approximately. She knew of about 97 of these sites (Dean-Jones 1990: 97) but firm estimates of date could not be made (except at the Uralla huts). The sites near the beach at the end of Boyce's Track (GR Omitted) are typical. These middens are dominated by pipi, with minor amounts of mud whelk, cockle, and dog cockle. Deflation was reported as severe, and the lack of a direct link to the former stable dune surface meant no date could be assigned to these shell heaps.

I have established that shell middens extend along the outer margin of the active transgressive dunes all the way from the Uralla huts to Birubi Point (Dyall 1975). Unfortunately these middens are in an area used by the RAAF as a gunnery range during World War II, and have been heavily strafed. The remnants suggest these pipi middens were not large, and there was very little stone material present. There was another example of a massive manuport – a porphyritic boulder weighing upwards of 15 kg. There was also another whale vertebra. These shell middens may well represent "dinner-time stops" associated with foraging from the Birubi base camp.

Shell middens also extend, discontinuously, all the way from Uralla huts to North Stockton (Dyall 1975). I surveyed these middens in 1968 and 1972, mostly on foot and partly with a dune buggy driven by Col Bambach of Stockton. Those shell middens on the coast near the Mac's Track base camp (described above) may represent dinner-time stops, but many of the others are possibly short-term camps making use of the supply of pipis, as well as the fresh water in the swales. Flaking cores were not uncommon on these middens.

In summary, these few sites known to be contemporary with Birubi give a very limited view of how these Aboriginal people used the resources in their territory. There are other major sites known within this territory, which I shall now describe. But it must be borne in mind that we do not know whether or not they overlap the occupation span of the Birubi middens. Many of these other sites are so severely damaged that serious study does not seem possible.

Major sites situated close to Birubi

1. One Mile Beach

This site, about 5 km to the east of Birubi Point, extends over a large area and was undoubtedly a base camp. It is well known to collectors of stone artefacts and details of worimi cleavers from this place have been published (Thorpe 1928a; McCarthy 1947). Swan (1970) refers to other collections, made by A. J. Barrett and F. A. Davidson and now held in The Australian Museum. I made collections myself between 1966 and 1977. The earlier collectors called this place Anna Bay but this usage is no longer followed.

It is convenient to divide this large site into two zones, one (A) extending about 400 metres to the south of Middle Rock and the other (B) along behind the beach for at about 1.5 kilometres north of Middle Rock. (This northern part is locally called Samurai Beach). The two zones are separated by a high sand ridge, which extends at right angles to the beach from the base of Middle Rock.

Zone A. (GR Omitted). This zone has been deflated for as long as I have known it. Stone material, and fragments of heavily weathered shell, are scattered on the dune face about 150 metres back from the sea. Towards the southern end, wind action has concentrated microlithic material, and it was here that almost all the backed blades were found. The northern end has more shell associated with it. The sand movements caused by the 1974 cyclone, and beach vehicle traffic, uncovered a number of very small, short-lived lenses of shell, grey sand, and stone material, the latter including numerous broken hearthstones. I have never seen bone material in Zone A. I do not think these lenses represented undisturbed midden; I believe all the deposits had been reworked by wind and rain. None of the lenses remains today.

My collections over this zone, made on 15 occasions, yielded the lithic items listed in **Table 14.1**.

The dominant raw material was chert. It made up 89% of the flake-and-blade tools, 94% of the backed blades, 64% of the flaking cores, and (in sample "total collections" of 407 waste flakes) 82%. The other raw materials have not all been identified but some examples submitted to Dr. S. Warne included silcrete, ignimbrite, and quartzite. There were also occasional examples of quartz.

The range of recognizable stone tools is rather similar to that on Area F at Birubi (see **Table 2.1**). Both Zone A at One Mile Beach, and Area F at Birubi, are so severely degraded that it is unlikely they will ever be dated. I have not found any edge-ground tools at either place, but this apparent absence is unlikely to be significant since both sites have been targeted by collectors for many years.

Pipi dominated the exposed shell, except at one small area at the northern end of Zone A, where cockles (*Anadara trapezia*) did. Right across the zone there were tritons, neritas, large sand snails (*Conuber aulocoglossa*), mud whelks, cockles, limpets, and green turbans. I saw no mussels.

Zone B. (GR Omitted). I first viewed this area in 2003, having been told about it by Col Whitehead and NPWS ranger Lawrance Penman. There was a sparse scatter of hearthstones, slabs, and broken pieces of the local igneous rocks. Flaking cores, of igneous materials, were common. Although there were hundreds of chert flakes, Col Whitehead and I recognized only three implements (a fishhook file, a broken bondi point, and a broken elouera). Whitehead had earlier seen an intact leaf-shaped fishhook file there.

The occasional shell fragments were very heavily weathered. Pipi, tritons, and turban shells were identified. Two of the heavy turbans (*Turbo torquatus*) had been broken into along the spiral for some distance, which is consistent with shell fishhook manufacture without actually being proof.

The only bone was the lower jaw of a marsupial, found in a small sill of dark soil and pipi shell.

Workshop site. About 80 metres out along the rocky shore, from the north end of the beach, there is a small inlet (GR Omitted). This inlet, only 5 metres across and presumed to be formed by wave erosion of a dyke, has a bed of cobbles and boulders, comprised of assorted igneous materials. For some 50 metres either side of this inlet, the gentle slope of rock at the foot of the headland is thickly strewn with thousands of man-made flakes, exposed in a fishermen's track. Most of the flakes are ignimbrite, generally pink in colour but sometimes a grey material with flecks of black and white. These ignimbrites are found across the One Mile Beach archaeological site, and also match those found at Birubi. The flecked grey ignimbrite is distinctive. Many of the cobbles in the tiny inlet were ignimbrite, which presumably had been washed in here by wave action.

We saw no retouched flakes here, and only one flaking core. Presumably the cobbles were "trial flaked" on the spot and then taken to the sandhills for further reduction. Although this ignimbrite does not flake as evenly as chert, it is easy enough to strike flakes, and the material has been used to a significant extent. The Zone A site yielded one bondi point made of the flecked grey ignimbrite.

The small size of this source of ignimbrite is noteworthy, as also is the fact that the cobbles are only accessible at low tide. There may be other such sources along this rocky coastline, though searches by Col Whitehead and the writer in 2003 failed to find any.

At the rear of this ignimbrite source, a black soil formed a bank 15-20 cm thick at the base of the sloping rock spine of the headland. Two small patches of shell midden (composed of tritons, chitons, cartruts, limpets, and neritas) were embedded in this soil. I saw no bone there.

Middle Rock. (GR Omitted). The 1974 cyclone exposed a small midden at the landward end of Middle Rock. It appeared as a thin seam topped by two metres of clean sand. I noticed the upper jaw of a large black bream, a chip of longbone from a large mammal, the shaft of a longbone from a small mammal, and two waste flakes of chert.

Southern headland. This headland, at the southern end of One Mile Beach, has a scatter of shell (turbans, limpets, and tritons) along its spine for a distance of about 400 metres. There are only very occasional chert flakes associated with the shell.

Summary

One Mile Beach was the location of a large base camp, and the presence of estuarine shellfish indicates some association with Port Stephens. Large numbers of microlithic backed blades were discarded here, and most had been made from chert which had to be imported. The availability of ignimbrite cobbles at the northern end of the site is of special interest. Some of the ignimbrite found at Birubi may have come from this source.

Apart from the obvious exploitation of shellfish from the local rocky shore and sandy beach, there is no indication of the food resources that sustained the occupants of this base camp. The most abundant source of food was probably the extensive wetland, behind the ridge of dunes on which the artefactual material was found.

There is no firm indication of when this site was occupied.

2. Skate Bay (GR Omitted)

Heavily weathered shell is thinly scattered in vehicle tracks on a level sandy area at the western end of the boulder beach. The total area of this scatter may be as large as 2 hectares. This site has fresh water available from a swamp and two small streams. The shallow bay, with its numerous rock outcrops, would provide an abundance of reef shellfish. In 2003 Col Whitehead and I identified heavy turban, cartrut, nerita, and triton in the shell debris. Stone flakes were not common: we saw 6 of chert (one of them edge-used) and one of grey ignimbrite, plus a large flaking core of the latter material. On a visit in 1989 we noted thick scatters of shell at the western edge of this site, along with occasional flakes of chert. There were also numerous pieces of heavy turban shell, which looked like blanks for making shell fishhooks. Scattered human bones were exposed in one vehicle track. According to Dan and Athlene Carroll (pers. com. 1989), there were four burials here, and a press report (Newcastle Morning Herald, January 1989) of finding a skeleton here probably related to one of these. The Carrolls had seen these skeletons exposed a number of times, and each time covered them with sand. Their accounts varied from “2 adults and 2 children” to “3 adults and 1 child”. Dan Carroll told me this area was cleared for farming in the 1930’s, so that even those parts of the shell scatter not yet not cut into by vehicle tracks may have been disturbed.

This site does not appear to be a base camp on the scale of Birubi or One Mile Beach, but it was obviously well used. There is no indication of its age.

3. Salt Ash sites

Some of the most likely sites for base camps must be along the landward face of the Outer Barrier dunes, overlooking the estuary of Tilligerry Creek. Sites with appreciable scatters of stone flakes are known, at the “Oakfield” property (GR Omitted), at Majors Flat (GR Omitted), and along Marsh Road (see Dean-Jones 1990). Generally these sites have come into view as a result of topsoil disturbance, and the full extent of them is unknown. These sites have not been studied.

4. Bob’s Farm

There are verbal reports of numerous stone artefact finds on the Cromarty farm at Bob’s Farm. Mr. Cromarty, when interviewed by Paul Johnson in 1975, remembered his father ploughing up “numerous axes”, one of which was polished all over and had a groove for attachment of the handle. The farm has now been sandmined, and the mining supervisor told me he had seen "lots" of Aboriginal stone tools on the dredge screens, including two edge-ground axes. One of these axes was polished all over.

5. South shore of Port Stephens

A large number of sites are known, especially at Lemon Tree Passage, Feningham's Island, and Soldiers Point. These sites have yet to be described in detail, and thanks to urban development it will be difficult to put together a clear picture of them. One would expect at least some of these sites to have coexisted with Birubi.

At the time of writing (2003) there are only minor signs of Aboriginal camps along the shoreline between Soldiers Point and the entrance to Port Stephens. Whether this picture is due to base camps being elsewhere, or to the activities of the limeburners who operated from Corrie Island through most of the 19th century (Engel 2000: 49, 249) and may have demolished shell-rich sites, is not known. Dan Carroll, who drove a bulldozer in this area for many years, told me that many houses in Corlette are built on top of shell middens

Sites in the Williamtown – Stockton area

1. Freshwater Lagoons (GR 930670).

These large ponds occupy a bowl-shaped depression (open to the west) amongst bare sand dunes rising to heights of 15 to 20 metres. The ocean beach is 2 km away. When I first saw this site in 1968, the ponds supported reed beds, and there was a large population of waterfowl. Tree stumps on the dune slopes indicated that there had been a vegetative cover in the not too distant past. These sand dunes have, since that time, become highly mobile. Dean-Jones (1990: 98) states that this dune system originally formed around 4500 BP.

Flaked stone of Aboriginal origin was scattered down the dune slopes, forming denser concentrations on natural sills and at the margins of the ponds. In 1968, and again in 1975, I collected material here on behalf of The Australian Museum. The collections are listed in **Table 14.2**. A boulder, of Morna Point-type porphyry, weighed about 8 kg; it was pitted on one face and polished on the other. In 1972, a geologist showed me an edge-ground basalt axe he found here. In addition to these stone tools, I saw a considerable amount of waste flakes, as well as many heat-shattered lumps of porphyritic cobbles. The great majority of the flaked material was chert (25 out of 27 flaking cores; 133 out of 149 tools).

There had obviously been a base camp here, but thanks to the total deflation one cannot assign a date to it, or relate it to any of the other base camps nearby.

Very little shell survived here. The scattered fragments I saw were pipi.

2. Fullerton (GR Omitted)

The site, which is now largely destroyed, may once have been the largest in the Newcastle-Port Stephens area. Material from the Aboriginal occupation has shown up in a number of locations. This extensive site is close to the ocean beach, the estuarine habitats of Fullerton Cove, large wetlands, and woodlands. It is convenient to describe it in three parts.

(a) The sand blowout (centred on GR 912658)

This site extended 400 metres across a loose sand "blowout", situated 3 km from the ocean beach (to the southeast) and 2 km from the mangrove swamps along Fullerton Cove to the west. Prior to the construction of drains, the area between this site and Fullerton Cove was occupied by Long Bight Swamp. Hollows in the blowout reached down to the water table and gave access to fresh water.

In March and April 1975 this site was demolished by rutile mining. The subsequent landscaping and revegetation have substantially altered the appearance of the place.

I made four collections on the blowout, two in 1968 and two in 1971. Two of the collections took every lithic item on the surface. The net results are shown in **Table 14.2**. Chert was the dominant raw material (89% of the flake-and-blade tools, 71% of the flaking cores, 73% of the waste flakes). The other lithologies have not all been positively identified but silcrete is at a moderate level of occurrence.

The axe, which had been made on a small flat pebble, was heavily pitted on one flat face. Weathering was pronounced and positive identification would require cutting a thin section. A geologist (Imants Kavalieris) saw two other edge-ground axes on this blowout.

There was only occasional shell scattered across this blowout. Most of this shell was oyster (presumably derived from Fullerton Cove) but there were several small heaps of bleached pipis from the ocean beach.

(b) The southern margin of the blowout (GR Omitted)

In April 1975, W/Cdr Paul Johnson visited this area while topsoil was being stripped as a preliminary to rutile mining. He noticed this topsoil was a black midden, including "many elouera" and two edge-ground axes. The sand dredge had just begun operating and Johnson noticed numerous stone flakes caught on the screens, but the mining staff would not let him examine them closely.

(c) Outlying lithic scatters

There are minor lithic scatters strung out for about 4 km to the southwest of part *(b)* of this Fullerton site. Some of this material was exposed in road cuttings when the present North Stockton-Williamtown road was built. Other scatters of stone and shell can be seen on low sand hills (some only a metre above the water table) on the farms between the old and the new roads linking Stockton and Williamtown. Others are along Cox's Lane. The minor sites merge into those reported below as "Fern Bay". Nearly all these sites are on small private landholdings. I have viewed them from adjacent fencelines but not actually visited them.

In my report to The Australian Museum (Dyall 1972) I listed some collections made along the new main road and Cox's Lane (see **Table 14.2**). I am aware that other collectors have combed through the sites on private landholdings and among other items have recovered worimi cleavers.

The shell at these collection areas was nearly all estuarine (mud whelk, cockle, oyster) but I saw pipi shell along Cox's Track. Dean-Jones (1990) looked at some parts of this area and saw no pipi shell. She recorded estuarine species (oyster, mud whelk, and cockle).

Summary of the Fullerton site

Overall, the number of stone artefacts in this 4-km-long strip below the western edge of the Outer Barrier sand ridges must be enormous. This base camp may well be roughly contemporary with the other large sites at Freshwater Lagoons and Mac's Track, and appears to have a similar suite of stone tools.

The absence of the expected mass of shell midden can probably be attributed to European limeburners. According to the report of Commissioner Bigge (Bigge 1822), convict limeburners were stationed 6 miles [10 km] north of Newcastle, which places them in the sand blowout mentioned above.

3. Fern Bay (GR Omitted) (known as "North Stockton" in my earlier reports)

This shell midden, on the eastern side of the Stockton to Williamtown road, was revealed by bulldozing when the approaches to the new Stockton Bridge were widened in May 1971. The shell and other material extended up a bank (which was as high as 5 metres above the road) and then about 50 metres eastwards. This midden appeared to extend still further, under the cemetery. There is a local tradition that convicts in the early 19th century burned shells into lime at this place.

This site was only 50 metres from the Hunter estuary, and about 500 metres from the ocean beach. The shell middens extended from the psychiatric hospital northwards to Braid Road (which runs along the southern side of the rifle range). I collected on this exposure of midden 4 times between July 1968 and December 1971. The shell was incorporated into the bed of the new road in late 1971.

Table 14.2. Lists of stone material from Aboriginal sites between Williamtown and Stockton

Item	**Fullerton Cove**	**Cox's Lane**	**Fern Bay**	**Stockton Links**	**Williamtown Road**
Elouera	21	6	5	4	123
Used flakes	42	30	27	11	563
Simple blades	20	3	13	-	197
Backed blades	19	8	17	-	350
Geometrics	13	3	9	-	331
Cleavers/slices	6	-	3	1	9
Ground-edged axes	1[A]	-	-	-	2[B]
Hammerstones	-	-	3	1	7
Slabs/anvils	4	4	-	-	9
Miscellaneous	4	3	6	4	59
Broken backed blades	5	2	18	-	104
Broken tools (other)	21	14	4	-	251
Total tool count	**164**	**73**	**105**	**21**	**2005**
Pebbles	8	-	13	3	179
Cobbles	-	-	-	-	-
Ochres	18[C]	-	12	-	406[D]
Flaking cores	28	22	59	10	228
"Fabricators"	3	-	2	1	20
Waste flakes	1872	661	1621	175	28141[E]

A Two more axes were rescued from sand-mining operations.
B I have seen two more axes in a private collection.
C One ochre was yellow and the rest were red.
D 26 of these ochres were yellow.
E 59 bits of stone rubble were also collected.

The lithic material from Fern Bay is listed in **Table 14.2**. Chert was the dominant raw material (63% of the flake-and-blade tools, 71% of the cores, and 50% of the waste). Silcrete, which was identified for me by Dr. S. Warne, occurred in appreciable amounts (37% of the flake-and-blade tools, 25% of the cores, 39% of the waste), which is surprising since an abundant source of Nobby's chert lay only a few kilometres to the south. Quartz was also used, though 68 of the 75 waste flakes of quartz lay in one pile and were possibly produced in a single flaking event. There were some examples of a blue quartzite, which may have come from the quarry at GR 896742. An interesting find was a flaky piece of quartz (weighing 100g), full of cleavage planes, with a high reflectance and some flashes of colour. Another collector, Ray Northey, told me he found a similar piece of quartz here some years earlier. These so-called "magic stones" are often believed to have ritual significance.

Cockles and oysters made up most of the shell, and many of the oysters were very large. Mud whelks were also numerous, and there was a moderate amount of pipi.

<u>Bone material</u>. I found only two mammalian bones. There was no fish bone.

European contact material. In November 1971 I found a clay pipestem stamped with "McDougal of Glasgow", and next month the broken pieces of the matching bowl turned up. One cannot be sure this pipe was ever in Aboriginal possession.

4. Stockton Links (GR Omitted)

In December 1976, the Newcastle Golf Club staff cleared a strip 100 metres long and 20 metres wide along the Stockton-Williamtown Road as a preliminary to regrassing. The club manager (Barry Ward) and greenkeeper (Kevin Johnston) kindly allowed me to examine the cleared area. According to Kevin Johnston, a seam of shell extends from the golf links through to the rifle range, so that this shell scatter connects with the Fern Bay site reported above.

My search revealed that the shell scatter across the golf links extended 200 metres back from the road – it could be seen in the bunkers and on the sides of small sand hills – but I saw none closer to the ocean, and the greenkeeper agreed with my findings.

Shell. This shell occurred in seams, up to 30 cm thick, in banks of dark soil. Oyster made up 75% of the shell, cockle was the next most abundant specie, and mud whelks (both *P. ebeninus* and *P. australis*) made up virtually all the balance. There were some sand snails, but in two hours of searching I saw only one pipi shell, one tapestry shell (*Tapes watlingi*), and one topshell (*Trochidae* sp.).

Bone. I found only four bones: an incisor from a smallish macropod, two fragments of mammalian longbone, and one fish spine.

Table 14.2 lists the lithic items. Chert made up 79% of the waste flakes, all the flaking cores, and all of the flake-and-blade tools. I did not see any backed blades. The late Harry Morton had an edge-ground axe from North Stockton in his private museum at Warners Bay, but I do not know the exact find site.

Glass items. There were two heavily-used scrapers made of green glass.

Dating. The shell deposit on a low sandhill at the northwest corner of the Newcastle Golf Links (GR 871630) was dated by S. Leary (1992). This shell was predominantly large examples of *Anadara*, along with some large gastropods and oysters, and was associated with stone tools. The reservoir-corrected radiocarbon date was 3280±90 calBP, which makes this site (or at least this part of the extensive site) very much older than the Birubi middens. Leary does not specify that the shell sample was taken from the base of the shell layer, but since he was aiming to establish a minimum age for the dune surface, we can assume that he took a basal sample.

5. Williamtown sites

Two of the largest sites (as judged by number of stone artefacts) in this area are at Williamtown. The one I called Williamtown Road (Dyall 1975) was at location [Omitted], partly in a sandpit and partly alongside a church. This site was almost obliterated in 1986 when a retirement village ("Banksia Grove") was built there. Dean-Jones (1990) noted remnants of this site and called it W4. The other site, which I viewed briefly in 1975 and called Williamtown South (Dyall 1975), has been examined in more detail by Dean-Jones (1990). It was probably a large site once, but most of it was destroyed when the RAAF base was built in 1942. According to Dean-Jones, both these sites at Williamtown occupy Pleistocene dunes. It does not follow that human occupation of the dunes is as old as that.

Williamtown Road

The site was on the lower slopes of a sand ridge, which rises to an elevation of 26 m from the farming flats of the former Long Bight Swamp (<10 m elevation). Stone artefacts weathered out of a very thin seam in a bank at the head of the sand quarry. I made 14 "total collections" there between 1966 and 1972, and after each visit, a further supply weathered out.

The only shell was in the form of heavily weathered fragments. Over 95% of it was pipi; the rest was made up of cockles, mud whelks, and oysters. The foraging for shellfish was, then, more closely connected with the ocean beach (4 km away) than with the estuarine mudflats of Fullerton cove (5 km to the mangrove swamps, 6 km to the open water).

The only bone I found on the site was a fabricated point, 15 mm long.

I would expect the food resources to have been drawn heavily from the adjacent Long Bight Swamp to the south, and the extensive Tomago Sandbed heaths and swamps to the north. In the absence of surviving bone, this expectation cannot be substantiated.

This sand ridge probably has remained stable since Pleistocene times, and thus the Aboriginal occupation could have begun some thousands of years ago. The condition of the shell material suggests the site is indeed quite old. There has also been quite recent occupation, as attested by my collection of 21 used tools made of glass and crockery. Shards of a thick, very pale green glass were exposed on the collection area from time to time, and some bore the coat-of-arms and name of the firm W. R. Moore of Newcastle. According to David Wells (one-time Curator, Newcastle Regional Museum) this manufacturer began making lemonade bottles of this type of glass at Newcastle in 1876. There were also shards of bottle glass made by another, unidentified, manufacturer. Three pieces of broken clay pipestem have also turned up on this site. Whether this site had been occupied continuously from some early date up till the late 19th century is not known: the Aborigines using bottle glass here may have been displaced from some other place.

Stone material. **Table 14.2** lists the lithic items. Chert made up 75% of the flake-and-blade tools, 70% of the flaking cores, and 62% of the waste flakes. A detailed analysis of the raw materials has not been carried out, but Dr. S. Warne has identified silcrete, quartzite, quartz, sandstone, and fossilized wood amongst the small samples I have shown him. These artefacts (except for the waste flakes) have been lodged with The Australian Museum. The fossil-based evidence that some of the chert found here came from Tanilba has been discussed in Chapter 8.

The axes were subjected to macroscopic examination by geologist Imants Kavalieris. He reported that one is made of dolerite (probably from Port Stephens) and the other from an indurated sediment of Carboniferous age. I have been shown two other edge-ground axes from this site.

The Williamtown collection has a high proportion of geometric microliths. It is not clear whether this difference is real or merely the result of other collectors targeting specific items (such as bondi points) and leaving the geometrics behind.

Summary. Professional examination of large samples of the raw materials used to make stone tools would be useful. There appear to be many lithologies present. Chert (tuff) might have come from Nobby’s, Tanilba, Tomago, or all three. It is to be noted that igneous raw materials occurred on this site at only a low level.

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Overview

The above attempts to place the Birubi base camp in its proper context with other contemporary Aboriginal sites have not been overly successful. Reasons for this situation include the short lifetime of sites formed on mobile landscapes of sand, and a lack of dated sites. Many of the archaeological sites have already been destroyed by urban development or sand mining. Other sites may be currently buried under the sand.

Nevertheless, we do note there are major sites that are different in character to Birubi. Those at Mac’s track, the Freshwater Lagoons, and Williamtown are located close to the food resources of swamps and bushland, rather than to marine resources. Thus the Birubi site should not be seen as “typical”, but as one component of a spectrum of sites that were used as bases for exploiting a wide range of habitats.

CHAPTER 14: A SUMMARY OF THE BIRUBI PROJECT

Diet

Various elements of the Aboriginal diet – fish, shellfish, mammals, birds, reptiles, crustaceans – have hitherto been treated piecemeal, often in separate Chapters. It is now time to attempt an overview of all the dietary components, as revealed by our excavations and the work of other investigators.

The visual impression of a coastal midden such as Birubi is very misleading. The shellfish remains are dominant, and create a picture of numerous Aborigines feasting continuously on this source of food. Closer examination shows that this picture is unrealistic.

Bailey (1975) has analysed the very large oystershell middens on the Richmond River estuary at Ballina, in northern New South Wales. He calculated that the annual consumption of oysters would meet only 2% of the calorific requirements of 100 people living there all year round. Even if he allowed that half their calories came from other sources (such as fish and mammals), the calculations showed that these quite prolific Richmond River oyster beds could support 100 people for only 14 days a year. Alternatively, the oysters could provide half the calories for *just two people* who chose to live at the middens all year long. Bailey concluded that shellfood was not the main food resource at Ballina. He thought that fish provided better support for the Aboriginal inhabitants.

In the case of Birubi, the commonest shellfish were pipis, but Bailey's conclusion is equally applicable.

The difficulties in relating the faunal remains in a midden to the actual diet are manifold. Scavengers will have removed most of the bone discarded by the human inhabitants, and many of the faunal remains are prone to rapid decay. Virtually all the residues of vegetable food will be lost through decay, and in fact we found only one vegetable item at Birubi. Empty shells, on the other hand, are rarely taken away by scavengers, and a compacted shell mass may take thousands of years to decay. The diet-related material in a midden is, then, heavily biased towards shellfish and the archaeological record gives a very distorted picture of the diet consumed at the site. Moreover, excavation at a base camp such as Birubi gives no picture at all of the food consumed away from the camp during the daily foraging trips.

With all these uncertainties in mind, what are we to conclude about the Aboriginal diet at Birubi? Firstly, we must play down the role of shellfish. Despite their heavy dominance of the faunal remains, it is clear from Bailey's work that these shellfish would not have been the staple item in the diet. Shellfish were doubtless a regular component of diet, but they were probably largely a snack or garnish in the main meals, and a "fall back" food to be eaten on days when fishing and hunting were unsuccessful. There may even have been occasional pipi feasts. However, the main reason for Aboriginal visits to Birubi was surely to catch fish and crustaceans. I see these items as the staples in the diet there.

The contributions of the other types of meat are more difficult to estimate. Mammal bone is not a major component of the faunal remains (see Chapter 12) but that may largely be the result of scavenging. Many of the individual mammals are represented by little more than some jaw fragments and loose teeth. When these sparse remains are converted into MNI counts, the levels of mammals become significant (see **Table 12.3**). Bearing in mind that most mammals are larger than most fish, the contribution of animal flesh to the protein diet is considerable at the D-midden, though even on this basis is minor at the AB- and C-middens.

For birds and reptiles (**Table 12.3**) the MNI counts are low. However, these species are the most likely ones to have been cooked and eaten at the places where they were caught, rather than being brought back to the base camp. We should not conclude that birds and reptiles were uncommon items of diet.

The greatest single gap in our knowledge of diet is in the vegetable area. The ethnohistorical sources (see Chapter 7) mention a wide range of vegetable foods and their carbohydrate contribution to the diet must have been large. Excavation throws no light on just how large it might have been.

(The one plant item we found, in Square C2 Level 1, was part of a nutshell. It did not match *Macrozamia*. I sent it to a botanical institution for comparison with their collections, but it has since disappeared).

Based on what we see at the Birubi middens, we would declare the Aboriginal diet was largely derived from the sea. The traditional view among archaeologists has been that coastal Aborigines always lived on a marine diet, but that view was given a severe jolt by the work of Collier and Hobson (1987). They established that the ratio of carbon-13 to carbon-12 in marine foods is quite different to the ratio in terrestrial foods. The bone collagen taken from individual Aboriginal skeletons excavated from the Broadbeach cemetery in southeastern Queensland gave a ratio of these two carbon isotopes corresponding to a maximum contribution of 46% marine foods. The cemetery was very close to the coast, but obviously the people who lived in that locality did not have a predominantly marine diet.

Given these results, we must allow the likelihood that Birubi was not a typical base camp for the Maaiangal people. We have already seen (Chapter 13) that this clan had a number of other base camps, and at some of these the diet could have been quite different. If we want to have an overall picture of how these people lived, it will be necessary to study some others of their sites.

Dates

The basal dates (determined on pipi shell and corrected for the marine reservoir effect) for the AB-, C-, and D-trenches in the Birubi middens were respectively 490±90, 1340±80, and 1445±70 BP. The AB-midden is therefore the most recent, and the two older middens both started to accumulate at about the same time as each other.

This project had such a limited budget that no more radiocarbon dates were obtained. I initially assumed that the dates of abandonment of these middens were "recent" (that is, soon after Europeans settled in the area) but this may not be correct, and needs checking with further dates. It is by no means certain that the C- and D-middens were still in use when the AB-midden was first occupied.

Both the C- and D- middens exist as cappings on mobile sand dunes and it is possible that wind action has brought about sequences of collapse and reconsolidation. Stratigraphic integrity would probably be lost in that case. Additional dates are required to establish that the stratigraphy is in fact intact.

The basal dates indicate that geomorphological events determined when the middens began to accumulate. It is believed that the sand ridges underneath the C- and D-middens were built by onshore sand movements that slackened off around 1500 BP (see Chapter 6). Only then did the area consolidate and vegetate to provide a suitable site for a base camp. If there was earlier occupation at Birubi, the evidence of it has been dispersed or buried by the large-scale sand movements prior to 1500 BP.

A more dramatic scenario involves tsunamis (see Chapter 6). According to this hypothesis, large tsunamis swept this coastline in about 1450 BP and 450 BP. The evidence for these wave strikes has yet to be assembled in detail for this stretch of coastline, but the tsunami postulate deserves to be taken very seriously. On the basis of this theory, the C- and D-middens developed after the 1450 BP mega-wave and were possibly swept over by the next one in about 450 BP. The AB-midden would then be a re-establishment of the base camp, and maybe the C- and D-middens were abandoned. It is because of this scenario that the most recent levels of the C- and D-middens need dating.

Stone material

Sources of flaking stone

The published view, that the flake-and-blade tools at Birubi were made from "Merewether chert" (also known as Nobby's tuff), is an over-simplification. Some of the chert may have come from such sources as Tanilba, Tomago, and Shortland. In addition to chert, flakes and blades were struck from materials such as silcrete, ignimbrite, quartz, quartzite, rhyolite, jasper, fossilized wood, dolerite, and shale. Chert, however, was used to make the majority of the recognized stone implements.

Two sources of ignimbrite have been identified in the Maaiangal clan territory, at Mallabula on Port Stephens, and at the northeastern end of One Mile Beach. There may be other sources as well since ignimbrite occurs widely in the Port Stephens area.

It would be a major undertaking to trace the sources of the rocks brought to Birubi for making flake-and-blade tools. The people who made stone tools here obviously had access to quite a number of sources, some of which (such as Merewether) were outside their clan territory.

Boulders, cobbles, slabs, and pebbles

The AB- and C-middens contained numerous examples of these waterworn items. They were less common in the D-midden. Nearly all of these items were composed of local igneous materials, and could have been picked up at the strandline. Some of the boulders and the larger cobbles in the middens were found as clusters, probably used as work benches. Some cobbles had been used as hammers, and ten of the slabs as anvils. Surface collecting on the D-midden obtained two examples of waterworn slabs with some suggestion of use as a grinding mortar, as well as 8 examples of cobbles polished by use as mullers. I have been shown two unmistakable examples of grinding mortars from elsewhere in the Maaiangal clan area, and I believe these are the first known mortars from this coastal area.

The numerous pebbles appear to have had several functions. Attempts had been made to flake some of them. The attractive small ones had possibly been collected (like some of the unusual species of shellfish) by children. I suggest that some of the pebbles were used in making shell fishhooks. I found that the risk of breakage while filing the point on the unfinished hook is greatly reduced by holding it down on a pebble of matching curvature.

Cobbles of rough texture had in some cases been used as hearthstones. My experiments in making shell fishhooks reveal that these rough cobbles are very useful for grinding the hole in the shell "blank". Other uses may have included pounding reef shellfish to tenderise them.

Coal

Large waterworn cobbles of coal, especially in the C-midden, suggest coal was burned as fuel, though there is no direct evidence of the actual burning. This coal is presumed to have floated to Birubi from the Newcastle-Catherine Hill Bay coastline, where coal seams are exposed.

Flake and blade tools

The D-Squares had the most evidence of stone-flaking. Excavation in these Squares obtained a total of 19 flake-and-blade tools, including six well-made elouera. The AB-Squares yielded just three simple flakes with evidence of use-wear, and the C-Squares did not yield any. Flaking of chert at the D-midden produced significantly smaller waste flakes than were found at the AB- and C-middens.

No convincing example of a backed blade was excavated, but surface collections on specific areas of the deflated middens (see Chapter 2) obtained large numbers of them. It is not clear whether these backed blades belong to an older phase of occupation at Birubi, or whether people made them in more recent times at a preferred work area.

Although we excavated large numbers of flakes of the local acid volcanic rocks, we rarely recognized signs of use. The D-Squares yielded just two tools made of such materials, and the other Squares contained none. In the much larger collection of stone tools from the midden surface, examples made of igneous materials comprised only 1.6% of the total (see **Table 2.4**). These igneous materials flake less readily than chert, and the cutting edges are less durable, but they would be adequate for cutting up soft materials such as fish and fish bait. Flakes used for such purposes would generally end up lost or discarded at sea.

The overall stone tool kit

A wide range of tool types have now been collected by various people at Birubi (see Chapter 2). Most of the tools are flake-and-blade types (with a strong element of elouera) and worimi cleavers. My own surface collections (Chapter 2) confirm the tool types found in other large collections (Hall 1928; Thorpe 1928a; McCarthy 1947), with the addition of edge-ground axes and microlithic backed blades. Other collectors have had little or no interest in boulders, cobbles, slabs, and pebbles but in fact these items have served a number of purposes and are a major component of the tool kit.

At the moment, there is no universally accepted classification of Aboriginal stone tools. When one emerges, it would be useful to compare the Birubi material with the sizable collections made in the Hunter River estuary by D. F. Cooksey at Tirrikiba (now called Mayfield) and A. J. Glynne at Tighes Hill. Cooksey's collection is held in The British Museum and the Glynne collection at The Australian Museum (Moore 1981).

Implements of bone

The longbones of both birds and mammals were nearly always found smashed into slivers. This smashing may often have been done to extract the bone marrow, but in some cases the slivers had been ground into the form of unipoints and bipoints. These implements are generally thought to have been used as barbs and points on spears and perhaps (in earlier times) as gorges on fishing lines. My impression is that making bone points was a significant industry.

We have three instances of a macropodid fibula being ground on one end to make a sharp-pointed awl.

Implements of shell

Fishhooks made of shell were the most interesting class of excavated item. We found 181 of these items, nearly all of them broken or incomplete. The 9 complete hooks were truly beautiful objects. The hooks were of two types, C-shaped and J-shaped. We have 91 J-hooks and 19 C-hooks (the rest of the items being indeterminate fragments). This ratio of the two types is the reverse of that found on the coast south of Sydney. Birubi is the most northerly place on the coast of New South Wales where these shell hooks have been found.

The hooks were made of the heavy turban shell (*Turbo torquatus*) though in a few instances the green turban shell (*T. undulatus*) may have been used. Examples of hooks broken or abandoned or lost during fabrication allow us to reconstruct most of the stages in making a shell fishhook. I have been able to fill in the missing stages by experiment (see Chapter 9) but there is no guarantee that my methods are exactly those the Aborigines used. Ethnohistorical sources tell us that it was the women who made these hooks.

All the shell fishhooks came from the AB-Squares. Probable "blanks" were found in two of the four C-Squares, but in the absence of items from later stages in hook manufacture we cannot be sure that hooks were actually made there.

We excavated two examples of large crescents made out of heavy turban shell. It is not known whether these crescents were ornaments or fishing lures.

Shells were also used as scrapers. From all three areas of the middens we excavated numerous examples of pipi shells with use on the edge. There were also some likely examples of used turban shell pieces from the AB-Squares.

Men's camps and women's camps

As mentioned earlier, we have an unresolved problem concerning the relationships in time of the AB-, C-, and D-middens. The basal dates suggest that the C- and D-middens were contemporary, but when we come to compare them, there are many striking differences (see **Table 14.1**).

The people using the C-midden had more connection with the sea, diving for reef shellfish and crayfish and eating many more fish, while those at the D-midden ate a higher proportion of mammals and discarded recognizable flake-and-blade tools. A simple explanation for these differences would identify the D-midden as the men's camp and the C-midden as the women's camp. The AB-midden, with its emphasis on fishing and making shell fishhooks, would likewise be identified as a women's camp.

The identifications must however remain tentative, because there is some conflicting evidence. Mulvaney and Kamminga (1999: 253) suggest, on the basis of use-wear studies, that elouera were used to obtain or process food plants that had woody or strongly fibrous tissues, perhaps cumbungi and bracken fern. These functions are not firmly established, but if correct, the presence of six elouera in our D-trenches suggests women's work on the men's campsite.

Table 14.1. Differences in excavated material between the C- and D-middens

Item	**C-midden**	**D-midden**
Stone material		
Waste flake density	342 per m^3	814 per m^3
Recognized flake-and-blade tools	0	20
% Chert in waste flakes	36	58
Average waste flake weight (g)	1.41[A]	0.38[A]
Cobbles, slabs, large pebbles	58 per m^3	5 per m^3
Coal	128 g per m3	3.3 g per m^3
Ochres	6 red-orange	56 red, 78 yellow
Shells		
% Pipi	40	74
% Rocky shore species	58	18
% Estuarine	1	8
Fish		
Minimum number of individuals	252 per m^3	57 per m^3
% Kelpfish in total fish MNI	18.5	4.0
Percentages of meat sources[B] *(by MNI)*		
Fish	80	75
Crayfish	13	0
Mammals	3	17

A The flake sizes from the C-Squares show considerable variation from Square to Square; thus there is only 90 % confidence that the flakes from the C-Squares are larger in average size than those from the D-Squares.

B Shellfish are excluded from these percentages. The "missing" percentages are made up of birds and reptiles.

Fishing methods at Birubi

One of the major aims of the Birubi dig was to establish the methods used to catch fish. The outcomes of these studies are very mixed.

The AB-midden was very rich in fish bone, and the C-midden somewhat less so (see **Table 11.1**). On the other hand, eating fish was not a major activity at the D-midden.

At the AB-midden, I have identified 29 species of fish, and there are five more species not yet identified. The chief species taken, in decreasing order of percentage, were kelpfish, snapper, wrasse, groper, red rock cod, black bream, wirrah cod, and leatherjacket. These are all carnivorous fish, and probably many of the shellfish, sea urchins, and crabs found on the midden had been collected as bait. Only 1.4 % of the total MNI count of fish belonged to species preferring to eat weed.

The presence of shell fishhooks in the AB-midden proves beyond doubt that hook-and-line fishing was practised at Birubi. I have argued in Chapter 11 that this fishing was largely done from canoes, at the reefs about 200 metres off the beach. According to sketches made by European colonists, no sinkers were used on these fishing lines.

We found no unequivocal evidence of spearing fish, but there is so much ethnohistorical data on fishing that we can be quite sure spearing by the men complemented hook-and-line fishing by the women. Some species (luderick, mullet, and drummer) were almost certainly speared, but the major species listed above could have been taken by either fishing method.

Unsuccessful attempts were made to identify species only caught after the arrival of the shell fishhook 700 years ago. I support certain other archaeologists (see Chapter 11) in the view that angling was already being practised, probably using a bone or wooden gorge. The shell hook is not necessarily more effective than the gorge: the “fishing revolution” seems to have been more sociological than technological. When the shell fishhook came into use, the women adopted it and began to devote a great deal of time to fishing.

The large numbers of kelpfish - some of them very small fish indeed - in the AB- and C-middens suggest that some special technique was used to catch them. I suggest it was a baited trap. We can find no evidence either for or against the use of large nets and tidal traps.

It was hoped that this excavation at Birubi would produce evidence that at least some fish species were caught by a specific identifiable technique. Despite the very large samples of fish we excavated, very little in the way of such correlation has emerged. Future research may suggest new methods of analysing the data. In the meantime, this substantial record of Aboriginal fishing at Birubi is held at The Australian Museum and is available for further study.

Life at a mobile shoreline

Geomorphologists have established that onshore sand movements continued throughout the recent history of the Birubi landscape. These movements obviously did not make the site uninhabitable, but did affect the fishing (see Chapter 11). A statistical treatment of the species distribution in the AB-midden has revealed these effects. In the earliest Levels, kelpfish made up 36% of the total fish (counted as MNI) there. This figure decreased to only 8% in the most recent Level. The percentage of other reef-dwelling fish (wrasse and red rock cod) also diminished over the same period. These trends indicate that the rocky zones in which these species live were sanding up. In the most recent Levels of the midden we found more whiting, which is expected since this species feeds on sandy bottoms.

Water skills

Many of the dietary items found in the Birubi middens indicate that the Aborigines possessed outstanding water skills. I have already mentioned that hook-and-line fishing almost certainly involved paddling offshore in small bark canoes to fish around reefs. It is also likely that spearing fish sometimes took place from canoes. The numerous crayfish are known to have been taken by diving (see Chapter 7), and diving would also have been needed to obtain some of the reef shellfish.

Ethnohistorical sources

The wealth of detailed observations by early European observers in the Port Stephens, Newcastle, and Lake Macquarie regions has been of great value in my attempts to interpret the material excavated at Birubi. Moreover, the observations record information (such as vegetable foods, use of canoes, wooden implements, fishing lines) that one cannot hope to recover by excavation.

There may exist another especially valuable source of information. In Chapter 7 (page 57) it was mentioned that four escaped convicts lived with the Worimi tribe at Port Stephens for five years. Gionni di Gravio (archivist, University of Newcastle library) has looked into published references to this episode, and believes there is an unpublished record, probably diaries of David Collins who was the Judge Advocate at Sydney at the time. We must hope that this record will eventually be traced.

CHAPTER 15: SOME NOTES ON MIDDEN EXCAVATION

The sheer size of shell middens such as Birubi poses a difficult problem of how to sample them adequately. Emerging from this Birubi project are some thoughts and conclusions that may be useful to other archaeologists.

Sampling

Where to dig?

Frequent reference has been made throughout this Report to the local variations in the contents of the Birubi middens. We sampled the middens in three places (the AB-, C-, and D-trenches) and obtained quite different assemblages of faunal remains and stone material. Some of these assemblages reflect differences in age, and others may relate to whether the trench was dug at the men's or the women's camp. Had we dug at just one of these locations, a distorted view of the total site would have emerged. From the AB-trenches we would have identified a fishing station, whose occupants had little interest in terrestrial hunting and made no well-defined stone tools, but manufactured shell fishhooks on a large scale. The D-trenches, if taken on their own, tell a story of people with little interest in fish. These people did hunt mammals, and make elaborate stone tools, but there is no evidence that they ever made shell fishhooks. The basal dates of these two sets of trenches differ by a factor of almost three. Even if we compare sites with similar basal dates (trenches C and D) there are large differences in the material found (see **Table 14.1**).

Clearly, these shell midden sites are not homogeneous. A number of samples have to be taken if one is to obtain an overall picture. In our case, the picture presented by surface collections was invaluable. Substantial collapse along the edges of the shell mass had revealed a large amount of cultural material. It will be mentioned shortly that there are significant differences in the pictures presented by excavation and by surface collection, but the surface collecting did correctly identify the specific areas we needed to sample by trenching. The AB- and D-areas yielded quite different cultural material by surface collecting (see Chapters 2 and 3). These surface collections had also shown Area F to be different again (it contained numerous microlithic backed blades), but this part of the midden had already been scattered and excavation was not possible.

The necessity to sample the midden in a number of places does however raise its own problems. This sampling effectively creates a number of separate excavations (three in our case), which have to be related to each other. It must be said that we have not clearly related our AB-, C-, and D- excavations to one another. I hope that other archaeologists will pick up this problem and resolve it by further study of our material. The major need is funding for more radiocarbon dates.

How much to dig?

Having decided *where* to dig, the next decision is *how much* to dig at each location. Middens containing massive amounts of shell pose a special problem. If one is to obtain useful samples of flaked stone and bone material, an enormous volume of shell has to be excavated. This huge quantity of shell creates storage problems, and sorting out the sieve residues will be a great deal of work.

Some other archaeologists have elected to excavate column samples, some as small as 25 cm square (Blackwell 1982; Sullivan 1984). At Birubi, we used much larger "columns" (actually one metre square, and we have referred to them as "Squares"), and joined them into a sequence of such Squares (six for the AB-area, four at the C-area, and seven at the D-area). We often found striking variations in proportions of recovered items between adjacent Squares. Some of these individual Squares, had they been our only sample, would have given us a quite misleading picture of the total midden. I cannot accept one or two small columns as representative samples of anything except shell. For other items, there is too great a risk that the column will include atypical material (the reduction of a flaking core of unusual lithology; the remains of a catch of one of the less common fish). Moreover, the numbers of identifiable fauna (except shells) will be too small to be useful. Sullivan (1984), for the midden at Pambula Lake, excavated a 25x100 cm area and then compared three occupation levels containing just 9, 16, and 24 fish. Conclusions based on such small numbers, and without other sets of data (from other columns) to provide estimates of variability, are not at all convincing.

Similar condemnation of small samples from middens has been voiced by Edwards (1990) and Mackay and White (1987).

When deciding what volume of midden to excavate, there are three factors to consider: the limiting of destruction (for excavation is a form of destruction); recovery of sufficient items for analysis; and having enough independent samples to make statistical analysis possible.

For statistical analysis, the number of samples needs to be at least four, because otherwise the uncertainties in the analysis become unacceptably large. The variability of the data can be a large factor in deciding what is a proper number of samples. With our C-Squares, four of them proved to be an inadequate number – the conclusions reached would have been more satisfactory with at least one more sample. On the other hand, we might have excavated only five instead of six of the AB-Squares without altering the statistical picture.

A small volume of shell midden will prove adequate for study of abundant items. I see no problem in sampling shells with narrow columns, provided the number of columns is large enough to provide a measure of variability. Less abundant items, such as mammalian or fish bones, require much larger volumes to recover enough material. We found ourselves with inadequate numbers of identified fish from the D-Squares despite having excavated an area of 7 square metres of the midden. The conclusion to be drawn here is that both the total volume to be excavated, and the number of samples taken at a selected location, will be determined by the abundance of cultural items present and their variability. Neither of these factors can be evaluated until the excavated material is subjected to detailed study.

Surface collection versus excavation

The Birubi site is unusual in that it has been studied both by surface collecting and by excavation. It is of archaeological interest to compare the results of the two methods.

Obviously surface collecting on deflated middens cannot yield meaningful dates for the occupation, nor any changes in the proportions of prey species, stone tool types, or the like with the passage of time. Only excavating into a stratigraphically intact site can yield that sort of information. There are however other types of archaeological information where surface collecting can make a useful contribution.

Stone material

Both surface collections and an excavation were made on the D-midden. The surface collections yielded 153 recognizable stone implements (see **Table 2.1**), compared with 21 from the excavation (see page 73). The surface collecting recovered many more different types of stone implements. The excavation actually gave a poor impression of the range of implements present at Birubi. It even failed to obtain an example of a worimi cleaver (see **Sketch 2-2**), which appears to be one of the commonest and most characteristic implements of the Port Stephens area.

It would be unwise to do statistical analysis on stone material collected from a site as readily accessible as Birubi. Quite a number of amateur collectors had been working over this site on a regular basis.

Faunal remains

Surface collecting of shells gave a reasonably good picture of the edible shellfish species and their distribution, but the collected sample needed to be large. There was however a poor recovery of the tiny species of shellfish, in comparison with excavation.

Fish bone collections from the surface of the deflated midden areas gave rather low MNI values, and correspondingly the number of different species was low compared with the excavated material. Surface collections agreed with the excavation record in identifying the major species of fish present, but over-represented the numbers of those fish (such as snapper) whose large bones better resist weathering. Once bone is exposed on a sandhill surface by collapse of the midden matrix, it is subjected to cycles of wetting and drying and does not last long. Those fish species usually identified only from their otoliths (whiting, mullet) have a poor chance of being recognized during surface collecting.

No crayfish mandibles were found by surface collecting though these items were common in the excavated material from the AB-midden.

Less common items are more likely to be found on large areas of deflated midden than in the small area of an excavation trench. Thus we found whalebone exposed near our AB-trenches but did not excavate any.

Bone and shell implements

Only a few shell fishhooks were found on the surface of the AB-midden, and these items did not tell us anything useful about the stages in their manufacture. Excavation was very much more useful.

Bone implements were obtained in comparable numbers by surface collecting and by excavating. Although the large volume of collapsed midden may have once contained numerous bone tools, these items will, like other bone material, rapidly disintegrate when exposed to the weather.

ATTACHMENT 1: THE DIARY OF THE DIG

Excavation methods

The midden was excavated by scraping the deposit with a small bricklayer's trowel. The loosened material was then transferred into a plastic bucket, using a small flat-bottomed shovel taken from a household brush-and-pan set. The pair of excavators working in each Square had their own colour-coded buckets, and their own sieving station. By locating one sieving station at each end of the trench system, and operating only two excavation teams at any one time, we avoided mix-ups on the cramped AB-trench location. At the other two locations, there was more space around the trenches and sometimes more than two trenches were excavated at one time.

The excavators were instructed to leave a 5-cm baulk around the edges of their Square. One of the directors closely supervised the removal of these baulks (or did it personally) to ensure that the walls of the trench remained vertical. We found a builder's spirit level more convenient than a plumb bob for checking verticality.

The buckets of excavated material were emptied onto a sieve (1/16-inch mesh) at the sieving station. Stones and large shells were removed at this stage to avoid mechanical damage to other items when shaking of the sieve commenced. Fragile items (shell fishhooks, fish jaws) were also picked out of the sieve and placed in a labelled Special Finds bag. The remaining material was then sieved.

No attempt was made to sort material in the field, though the sieve residues were frequently inspected by the directors to see what was there. These residues were emptied directly into large plastic bags bearing both internal and external labels. The bags were sealed at the completion of each excavation spit, or at the end of the working day if the spit was incomplete.

"Finds" such as large stones or sizeable bones were not removed from their original location in the midden until one of the directors had inspected them *in situ* and taken appropriate action (careful brushing, photography, graphical plotting, etc).

Note that soil colours are purely subjective. We did not have a Munsell colour chart. We found that soil colours depended on moisture content. Colours changed very considerably from day to day, and sometimes even from hour to hour.

Diary of the Dig – First Phase

These records are transcribed from the field notebook. The only changes have been to reorganize the field notes so that all data for a given excavation Square are gathered together, and to delete lists of "finds bags" now that these bags have been sorted and accounted for.

Saturday 18 November 1978

Len Dyall with Dr. Chris Brown and Marie Brown

The area of the AB midden was re-examined. The area originally selected for excavation had subsequently collapsed, but fortunately there was a residual area, partly covered with drift sand and bitou bush. There was some exposure of shell further up the dune slope, but it turned out to be very shallow (5 cm). Shell scatters such as these may be the residues left after the wind has blown the rest of the midden away.

Bone collection. Several large fragments of porous bone were collected from the crumbling face of the midden. One of these pieces lay downhill from Peg 4 of the Datum Line we set this day, and the other pieces from a spot 2 m south (near Peg 6). The original bone from which these fragments came must have been so large that I can only attribute it to a whale.

Location of the trenches. A trench outline, 5x1 metres, was selected on an almost flat area of the midden. The crumbling face of the midden (see Sketch Map 4) suggested that the depth of occupation would be 60 cm. The position of the crumbling edge was plotted with respect to the Datum Line (Field Sketch 1), and the midden was photographed from the Shelley Beach side.

Preliminary sand and scrub clearance. A cover of loose drift sand, 30 cm deep, was removed from the north end of the excavation area, together with the bitou scrub. Some of the bitou roots had penetrated into the midden, whose surface suffered some inevitable disturbance during the clearing operation.

Likewise, sand cover was removed from the south end, to a depth of 50 cm before the black surface of the midden was encountered.

All this drift sand was screened (1/16-inch mesh) and proved sterile. We used some of this sand to block off the deep trackway behind (that is, east) of the proposed trench, and the rest to cover in the crumbling west face of the midden and thereby protect it from wind erosion.

Datum Line and excavation grid. The Datum Line was initially intended to be on a north-south (magnetic) bearing. This alignment would have required cutting into a large pile of drift sand and shoring up the bank thus created, so I averted this problem by skewing the Datum Line. The magnetic bearing from the south to the north end of the Datum Line was set 25 degrees east of north. Despite the skew, I henceforth use the terms north, south, east, and west. Field Sketch 1 shows this Datum Line as it appeared on the ground.

The two datum pegs, Da (north end) and Db (south end) were set about 20 cm beyond the trench grid, and were hammered in out of sight to avoid the risk of losing them to vandals. Pegs 1 to 6 were set at 1-metre intervals, number 1 at the north end. It proved impossible to hammer them very deep – or very straight – because the soil was very hard and contained large objects such as shell and cobbles. The 1-metre intervals between pegs were measured from their mid-points. This Primary Datum Line came to be called the Front Datum.

The secondary (or Rear) Datum Line was set 1 metre east of the Primary Datum, and the 1-metre Squares of the A-trenches were defined, though not yet checked for exact square geometry. In the east-west direction, the 1-metre distance was measured between the inner faces of the pegs.

The two Datum Lines had the same heights, being set with strings across the tops of the pegs 1 to 6 and 11 to 16. The Lines were set horizontal, using a spirit level 60 cm long. Peg 1 was 21.0 cm (centre to centre) from Datum Peg Da, and its top was 185 mm above the top of Da. Peg 6 was 18.5 cm centre-to-centre from Peg Db and its top was 33 mm above Datum Peg Db. Thus, it was possible to reconstruct the Datum Lines from the buried Datum Pegs. We did not leave the strings in place overnight.

There was no room for another Square at the north end, but one could have been fitted in at the south end.

The B-trenches. No decision was taken (or needed) at this stage as to whether to locate the B-trenches alongside or transverse to the A-trenches.

Sunday 19 November

Len Dyall with Marie Brown, Angus Brown, Trevor Dyall, Gavin Dyall, and Murray Steel

Setting the excavation grid.

The Primary Datum Line (Pegs 1 to 6) was restrung and rechecked, along with the rear Datum Line (pegs 11 to 16). In this way five one-metre squares were defined (A1 at the north end to A5 at the south end), and each Square was checked for correct geometry. Diagram 1 embodies the plan of the trenches and the peg numbers.

Plotting of the midden surface

A thin cover of sand had blown onto the midden, and was removed by trowel to uncover the dark surface of the midden and its occasional broken shell. More bitou roots were also removed, which unavoidably loosened up the surface of the midden.

The position of the surface was measured (with respect to the Datum Level marked with string) by measuring at 20 cm intervals along both the Front Datum (Pegs 1 to 6) and the Rear Datum (Pegs 6 to 16). Measurements were made vertically, using a spirit level and rule. These measurements are shown in Appendix 5 and are embodied in Field Sketch 2.

The position of the surface was also measured along the cross-lines (Pegs 1 to 11, 2 to 12, 3 to 13, 4 to 14, 5-15, and 6 to 16). (See Appendix 6).

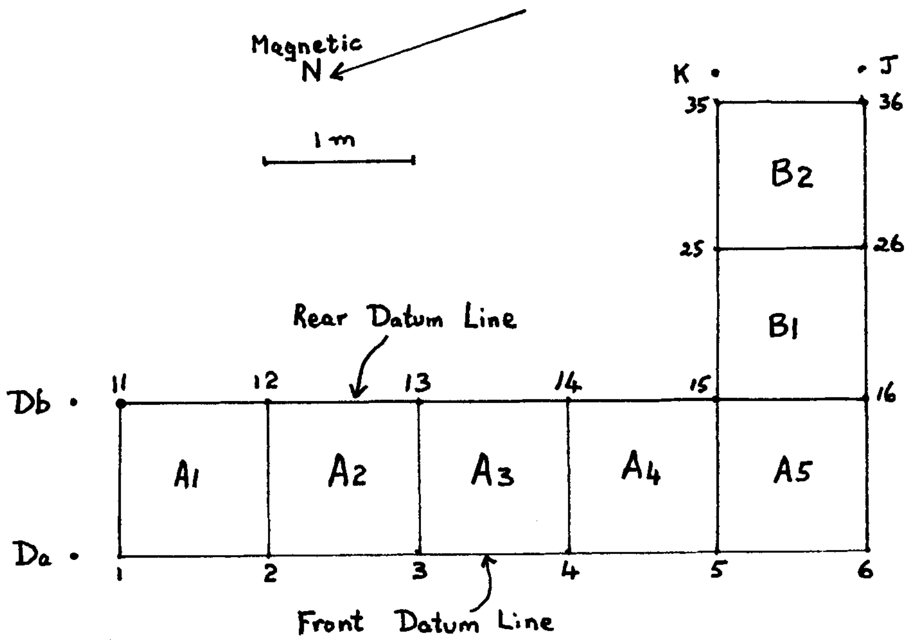


DIAGRAM 4-1. Plan of the A- and B-trenches at Birubi
(Note that Squares B1 and B2 were surveyed at later dates).

<u>Remarks on the midden surface</u>

The plotting exercise revealed the general form of the midden surface. The profiles along the Front Datum Line and the Rear Datum Line (Field Sketch 2) show that the surface bumps and hollows were quite minor (±10 mm), but there was an appreciable drop-off at the northern end (Square A1).

In the transverse direction (see Appendix 6) there was generally a small but significant slope, the midden surface along underneath the Rear Datum Line being higher than it was beneath the Front Datum. Since the midden had accumulated on the foot of a steep slope, this gentle gradient across its surface was to be expected. (The slope of the midden surface was later found to continue when Squares B-1 and B-2 were laid out (see Appendix 7)). With Squares A2 to A5, the slopes were in the range 38 to 69 mm across a span of 1 metre. Square A1 was irregular, having no slope across its common edge with Square A2 but a drop of 104 mm on its opposite edge (Peg 11 down to Peg 1).

SQUARE A2

A2/Level 0 (0-5 cm)

Sunday 19 November

Len Dyall and Marie Brown

By way of exploration, this Square was taken down to an arbitrary depth of 5 cm with respect to the surface along the Front Datum. This operation removed all the soil that had been disturbed by removal of bitou bush.

Generally loose, moist sand. The third (of the area) nearest the Front Datum Line had a lot of shell right from the start, becoming fairly compacted at full depth. The other two-thirds had little of anything at the beginning, but a reasonable amount of shell was encountered at full depth.

Fishbone throughout. One lower jaw of wrasse was noted; also several large turban shells; a few struck flakes of stone; some scattered charcoal.

A fair-sized lump of porphyritic rock protruded from the rear wall (Peg 12 to Peg 13), 60 cm along from Peg 12. This cobble was loose and was therefore removed.

The sides were trimmed and the bottom of the trench was set horizontal.

A2/Level 1 (5-15 cm)

Note that these depths are with respect to the midden surface at the Front Datum.

Same team.

Fairly dense shell, mixed with moist black soil. We saw many vague patches of coarse yellow sand, which were not concentrated in any particular portion of the Square. (Fireplaces with the charcoal blown away?). The fish bone was quite rotten. A fair bit of charcoal scattered throughout. Very little stone but several pebbles of coal.

One macropod ?collarbone at midpoint of the Rear Datum, and a rib not far under that, right at the bottom of the Level.

A sample of coarse sand was taken against Peg 12 at the bottom of this Level. The bottom was set level and the walls checked for verticality.

Noted many stinkbugs, and the shells of quite a few common garden snails. (These were later identified as sand snails).

A2/Level 2 (15-25 cm)

Same team.

A start was made on this Level, along the side adjacent to Square A1, going down to 25 cm. The dark soil, and the yellowish patches, continued.

A storm with torrential rain blew in at this stage and we covered the trench with fence palings, plastic sheet, and sand.

The rain washed a large bone out from the uphill bank of the track behind our site; it would be 4 m north of our Square A1. Labelled “Bone from rear bank of track, 19/11/78”.

Wednesday 22 November

Len Dyall

I visited the site with Carl Acheson (NPWS Ranger) to look at the dune being levelled for house construction, on the edge of Area D. It was thought I might find some undisturbed midden here. We negotiated with one of the house owners (John McKinley) for me to dig some test holes. (The outcome of that exercise is given in Appendix 2).

The wind damage from Sunday’s storm to the shell middens in Area D was unbelievable. Little of the protective cover of sand dune remained, and a lot of the midden face had collapsed.

Trench A had not been disturbed. I uncovered the trench and found only very minor bank collapse had occurred. Excavation was continued.

Midden very soft and moist, and noticeably lightening in colour as well as yielding less material per bucket. More ?macropod phalanges, mostly between Pegs 12 and 13 but one near Peg 3.

Large porphyry slab 28.0 cm out from the Front Datum, and 22.0 cm out from the 2→12 line.

Exactly at 15 cm depth, with most of it just covered when Level 1 was completed.

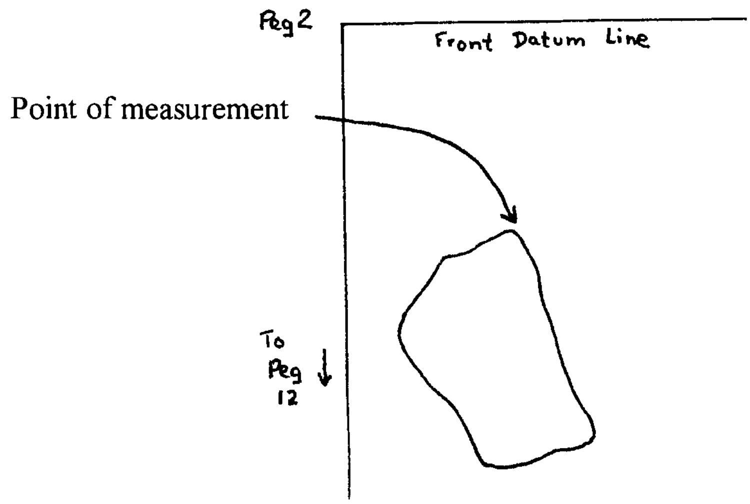


DIAGRAM 4-2. Rock slab at top of A2/Level 2.

Another phalange from the midpoint of the 2→12 line at full 25 cm depth. A large longbone came from 44 cm (along the 13→12 line, right on the Datum Line) and 15.5 cm depth.

Level completed and checked over, the bottom being set exactly horizontal.

The bottom of this Level is light brown, with a black patch at Peg 12 (where the midden had been yellow at the top of this Level). Yellow sand shows all along the Front Datum at the bottom of this Level, but there is occasional fish bone and shell showing through this sand. The following observations refer to depths from the surface (not the Datum Line).

The 3-13 wall is black and shelly to a depth of 16 to 17 cm. Thereafter the colour lightens, the stretch of 55 cm nearest to Peg 3 being yellowish.

The 3-2 wall is similar, the yellow extending for 37 cm along from Peg 3 and the shell being down to 12 or 13 cm depth from the top of the trench.

The 2-12 wall has shell extending 11 to 12 cm down into this Level. The soil is uniformly light brown, except for the last 12 cm closest to Peg 12, which is black.

The 12-13 wall is black for the first 3 cm into this Level, then uniformly brown. Shell extends 12 or 13 cm down from the surface.

A soil sample was taken from the middle of the Square at 25 cm depth.

Note: On 9 December, while I was plotting profiles, a charred phalange fell out of the Rear Datum wall, at 32 cm below the Datum Level.

Miscellaneous: From the midden scatter south of the trench, and 20 m uphill, I collected a scatter of ancient green bottle glass, including the neck. Some of these glass shards had been utilized. These pieces were scattered about 10 m down the slope. I also picked up the base of a Newcastle-made lemonade bottle from north of our trench.

On 9 December I collected four more pieces of green glass, two Hercules club shells, and two oyster shells, from the surface of the "upper middens". (This material relates to the C-trenches).

A2/Level 3 (25-35 cm)

Len Dyall

Found a porphyritic stone near Peg 12, 5.0 cm from the 2-12 line, 21.5 cm from the Rear Datum, and 27 cm below the surface. It was alongside the black patch.

The soil was generally yellow-brown with occasional shell and bone throughout. The Level was completed and the geometry was checked.
2-3 wall: Light brown.
2-12 wall: Light brown near Peg 2, steadily darkening towards Peg 12.
12-13 wall: Brown uniformly.
13-3 wall: Brown near Peg 13. Below 25 cm, a lightening in colour; yellow-brown thereafter as far as Peg 3.
Bottom: Yellow-brown with occasional rotten fish bone and shell in view. Very moist.

A soil sample was taken at the midpoint of the bottom (35 cm depth).

A2/Level 4 (35-45 cm)

Len Dyall

At 42 cm depth, below Peg 13, struck a layer of shell and fish bone, with black soil. In it were 3 lumps of stone, one of them rounded and smooth. This black patch extended 49.0 cm towards Peg 3, and 20 cm towards Peg 12.

The rest of the Square was initially yellow-brown but by no means sterile. At 7 to 8 cm depth into this Level, I struck shell and bone all over: quite a lot against Peg 3, and another dense patch 30 cm along the 2-12 line from Peg 2. This last patch had quite a scatter of burned neritas, as well as abalone and fish bone.

A large bone was found 5 cm out from the Rear Datum, 35 cm along from Peg 12, at 3 cm depth. It was bagged separately as a possible bone tool.

Special Find: a Port Jackson shark spine.

A soil sample was taken at the bottom of the Level, at the midpoint.

A2/Level 5 (45-55 cm)

Len Dyall

A flat-topped lump of porphyry was just showing at the top of this Level. The nearest corner of it was 43 cm from the 2-12 line. The same corner was 7.8 cm from the Rear Datum, and another corner of the stone was 5.0 cm from the Rear Datum.

In this Level the soil was uniformly dark brown with a lot of heavy turbans, pipi, and abalone. There were also many bitou roots, which made it difficult to trim the walls.

Made Field Sketch 3 of stones along the 2-12 side of the Square.

There were many patches of fish bone and shell. These patches are probably old hearths, but they are not well enough defined to sketch.

At the bottom of the level, the soil colour was still brown-black and the midden deposit was "going strong".

A soil sample was taken at the midpoint of the bottom of this Level.

The trench was then covered.

Saturday 25 November

Len Dyall, Boris and Sue Sokoloff; later on also Dr. Hans Tenneberg and Brigita Tenneberg

We uncovered the trench, removed some windblown sand from it, and replaced Peg 12 with a long stake.

I took a photograph from the Newcastle end of the beach, towards the site. Hans Tenneberg and Boris Sokoloff took numerous photos this day.

Gavin Dyall found a phalange (?kangaroo) and the broken upper jaw of a kelpfish on the slope above our trench site.

A2/Level 6 (55-65 cm)

Boris and Sue Sokoloff

Brown sand, with a lot of turban shells and fish bone, some ear shells (abalone), and a few flakes of porphyry.

At 44 cm from the 3-13 line, and 29 cm from the Front Datum: a yellowish patch about 10 cm across. Yellow sand and shellgrit. Sample taken.

Near the middle of the Square (40.0 cm from Peg 2 towards Peg 3, 40.0 cm from Front Datum) there was another yellow sand/shellgrit patch about 15 cm across, and a very black patch, quite small, was alongside it. The yellow patch proved very thin.

Stone flakes (two of chert) were found; one chert flake came from near Peg 2 and the other near the midpoint of the 3-13 line. There was much bone and shell, including one snail (since identified as a sand snail). Special Finds: 2 shell fishhooks.

The Level was finished. At the bottom, it had become more sandy and less brown. The colour was uniform right across the bottom. Shells protruded into the bottom from the Level below. Special Finds: 2 shell fishhooks.

A2/Level 7 (65-75 cm)

Hans Tenneberg

Dark brown throughout. Much bone, generally fish but including bird. There was a flat stone, black in colour, at the top of the Level near the Rear Datum (see Diagram **4-3**). The long axis of this stone measured 120 mm and the breadth 83 mm.

At the bottom of this Level, various stones showed through, including three close together near the 3-13 line. Plotted (Field Sketch 4A).

The 3-13 wall showed nice stratigraphy so it was trimmed and photographed with a 1-metre ranging pole. Driving sand and high winds made it a difficult operation. Note that 5 cm had been taken off the Square A3 surface before the picture was taken.

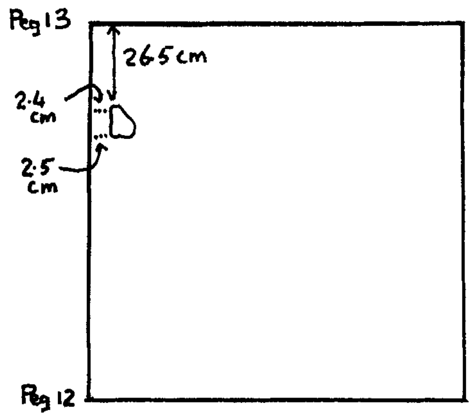


DIAGRAM 4-3. Location of a flat stone in A2/Level 7.

At the midpoint of the 3-13 wall, the profile of the whole trench is as follows. The upper 15 cm is black. Under that, the colour pales but lots of shell and bone stick out of the wall as far down as 22 cm. Thereafter the soil is brown-black down to the bottom of Level 7 at 75 cm.

It was difficult to discern the boundaries of the different strata, and I could not wait for better lighting on another day, because we had started to work on Square A3 and this Peg 3-Peg 13 wall would thereby be removed.

(Depths are measured from the original midden surface, not the Datum Line string. We actually removed this string and measured depths from the underside of a board set horizontal along the lip of the trench. This arrangement – which was followed throughout the dig whenever we had enough spare boards – gets around the problem of having strings to trip over. The board also helped to stop the lip of the trench crumbling as the soil dried out).

Other features: There are several small vague ashy places in the yellow-brown sandy layer (i.e. 22-57 cm depth), and one reasonably well defined "tongue" which comes out 32 cm from Peg 13 along the 13-3 line and is 7 cm deep. Its top is 26 cm from the surface of the midden. This tongue is grey in colour.

The dense black surface layer dips down to 18 cm at Peg 13.

Field Sketch 6A summarizes this information.

Two matching bird bones (ulna/radius) were found at 75 cm depth, and 10 cm out from the midpoint of the Front Datum Line. The matching pair of bones was found against the Front Datum Line. Both sets went into the Special Finds bag.

The Level was trimmed out and finished. A soil sample was taken at the midpoint.

NOTE: By this stage of the excavation, the upper walls of the trench had dried out, and the sand began to fall in. We had only limited supplies of planks for shoring up the walls. I decided to open the adjoining Square A3 to give the team more room to work and reduce the number of walls needing to be shored up in the interests of safety.

(It is to be noted that we did not use planks to stand upon during these excavations. Most of our team wore joggers with deep tread, which picked up items such as the bitou seeds and broken glass strewn around the neighbourhood of the trenches. Such items have turned up in our finds bags).

Sunday 26 November

A2/Level 8 (75-85 cm)

Peter Adams, Boris Sokoloff, Sue Sokoloff

Near Peg 13, uncovered more stones in an arc (a hearth?) surrounded by a black area that extended across the whole Square. Excavated to 79 cm depth and then plotted (Sketch 4B). Photographed, with 10 cm and 1-metre poles included. These are the stones already noted at the bottom of Level 7 (Field Sketch 4A).

There was a patch of limpets at 85 cm depth, on the 3-13 line, 30 cm from Peg 13.

By the bottom of this Level, the brown colour was noticeably lightening.

At the bottom, some stones remained (some standing in the next Level). They stood on the 2-12 line, and were set on edge. Plotted (Field Sketch 5). The largest stone was a rough porphyry cleaver. There was heavy shadow at the time and photography was impossible. (I had no flash).

The bottom of the Level was light brown sand, and so moist that sieving was very difficult. Fish bone still persisted.

Trimmed up and almost completed the Level. Covered the trench with the usual planks and plastic sheet. Special Finds: 1 shell fishhook and five hook fragments.

Saturday 2 December

Children had got into the trench, but had been promptly chased out by the resident Birubi ranger. The damage to Square A2 was some minor collapses of the lip of the trench; this material lay in identifiable heaps and was removed.

The residual baulks, along the Front Datum and the Square A1 side, were removed. The profiles on three sides of Square A2 were then plotted. (Field Sketches 6B and 7). Note that these Field Sketches have used depths from the Front Datum Line, not from the surface.

A2/Level 9 (85-95 cm)

George Buckton and Boris Sokoloff

Occupation material was rapidly fading out. There was a turban shell in the A1/A2 wall at depth 85 cm (15 cm in from Peg 12), and a triton in the Rear Datum wall at 93 cm depth (17 cm along from Peg 12).

A2/Level 10 (95-105 cm)

Same team.

Pale yellow sand. The sieve residues consisted of just five shell fragments. A soil sample was taken at depth 105 cm, at the midpoint.

It was seen that the midden colour faded out below 81 cm depth (A1/A2 wall), 78 cm (on the Rear Datum wall), and 78 cm (Front Datum wall). The black level (from 65 cm to 75-78 cm on the Rear Datum wall) was moist.

A2/Lower Levels

The trench was taken to a further depth of 25 cm, using a spade (for it was unsafe to kneel down and use a trowel in such a confined space with inadequate timber shoring). No occupational material was found in the sand, which extended to 118 cm depth. There was then a layer of hard dark soil (?peaty), 21 cm thick, before bedrock was encountered. A sample of the dark soil was taken at depth 120 cm. No occupational material was seen in this layer of soil. Field Sketch 6A was completed.

The trench was backfilled (using the screened material from its excavation) until it was only 65 cm deep, the common edge with Square A3 being boarded up.

SQUARE A3

Saturday 25 November

A3/Level 0 (0-5 cm)

Len Dyall, Boris Sokoloff, Sue Sokoloff, Trevor Dyall.

The surface levels were first checked over.

Generally black and sandy throughout the Level; some of the shell was fairly dense but often the soil was loose.

The Level was finished, with the depth set at 5 cm. Special Finds: mammal bone.

A3/Level 1A (5-10 cm)

Same team.

This sub-Level was intended to provide a radiocarbon date.

Considerable shell right across the Level at first, but noticeably less dense by the bottom.

A hammerstone, with battered end, lay on the bottom of the Level, and was counted as part of Level 1B. Its midpoint was 21.0 cm from the 4-14 line, 34.0 cm from the Front Datum. It lay parallel to the 4-14 line.

A minor collapse into Square A4 occurred. The piece stayed intact, and all belonged to this Level 1A, so it was lifted back and excavated with the rest.

A3/Level 1B (10-15 cm)

Same team.

Generally soft and sandy, and light brown at the bottom. There was still some shell at that depth.

There were two stones on the 3-13 line. The smooth pebble is 42 mm long.

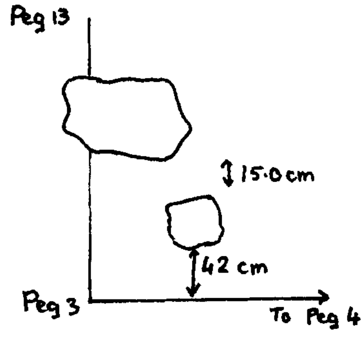


DIAGRAM 4-4. Stones in A3/Level 1B.

There was a burned phalange 82 cm along the Front Datum Line from Peg 3. A fire-shattered rock (bagged separately; 5 pieces) lay 44.0 cm along the datum direction from the 3-13 line, and 42.5 cm in from the Front Datum Line.

The Level was finished.

Part of Level 2 from this Square collapsed into the hole of Square A2. The small amount of loose material was returned to Square A3, though we bagged it separately. (In June 1995 I sorted the contents of this bag. It contained one lump of rubble; a lot of shells; some fish bone (nothing identifiable), some charcoal, pumice, and one bit of mammal bone. Because there could have been mixing of material from different Levels and Squares, I discarded it).

Sunday 26 November

The edges of the trench bottom had collapsed into the (deeper) Squares on either side, but not too badly. This material (all belonging in Level 2) was returned to Square A3.

A soil sample was taken from the bank of drift sand, 60 cm behind Peg 14 and 20 cm vertically above the Rear Datum Line. Recent wind had created a fresh surface in this bank.

There was a lot of drift sand (5 to 15 cm deep) on the site this morning. It had to be cleared back from the edges of the trenches.

A3/Level 2 (15-25 cm)

Boris and Sue Sokoloff

The levels were restrung and checked after the removal of drift sand from around the trench.

The soil was soft. The colour was black on the 4-14 line and Rear Datum Line, but patchy brown-and-yellow on the 3-13 line.

At about 20 cm in from the 4-14 line, and 30 cm in from the Front Datum Line, there was a very large earshell and a patch of charcoal and bone. A broken shell fishhook was found on the sieve, from about 20 cm depth.

At the bottom of the Level the soil was patchy yellow-brown. Noticeably more yellow on the 3-13 line.

Level finished. Special Finds: 1 shell fishhook.

A3/Level 3 (25-35 cm)

Boris and Sue Sokoloff

The brown colour of the soil became more yellow. Not much occupation material there. There were bones at 15 cm along the Rear Datum, at 33 cm depth. One bone was a phalange, the rest belonged to fish.

At the bottom of this Level, the soil was almost yellow, but we noted shell and fish bone in it (including some large fish indeed).

The Level was finished. We noted some sagging of the 13-14 wall (i.e. Rear Datum Line edge). This was probably the effect of our traffic along that edge.

Saturday 2 December

A3/Level 4 (35-45 cm)

Marie Brown, Trevor Dyall, Murray Steel

There had been two collapses from the common edge with Square A2, probably caused by children who had contrived to get under the covers. This material was recovered from the bottom of Square A2 and combined with the rest of A3 Level 4.

This Level yielded a shell fishhook, rather burned. Its shank had a notch for tying on the line, thus.

The Level was completed and tidied. Special Finds: 1 shell fishhook.

A3/Level 5 (45-55 cm)

Same team

This Level had a lot of stone and shell, and a number of shell fishhooks. Like the Level above it, it remained dark brown in colour. Several stones were encountered. The positions at depth 46-47 cm were plotted (Field Sketch 8A) and another Field Sketch (8B)was made when the bottom of the Level was reached. The stones were then lifted. One of the triangular acid volcanic stones was sitting on its end, which suggests use as a workbench.

Near this possible workbench, a blackened piece of porphyry projected from the Front Datum wall at 50 cm depth. Special Finds: 10 shell fishhooks.

Sunday 3 December

There had been no more collapses of this troublesome Square into its neighbours. Strong winds had blown a great deal of loose sand into the trenches. This sand was cleared out, and the front edge of the midden was stabilized with large rocks (from the adjacent shoreline) so that we could open Square A5 and use this front edge for foot traffic.

This day we worked in such high winds that it was difficult to keep our record sheets in place, and some of them were torn.

A3/Level 6 (55-65 cm)

Len Dyall and Marie Brown

The occupation material was becoming patchy. There was a lot of shell and bone near the A2 side but not too much over the rest of the Square. The large stones continued on down through this Level. Occasional large shells. The amount of fish bone was decreasing. There were several shell fishhooks; also an (?unfinished) leaf-shaped object made of shell. The soil was light brown by the time we reached the bottom.

I finished and trimmed the Level. Special Finds: 10 shell fishhooks, 1 shell item as above.

A3/Level 7 (65-75 cm)

Len Dyall and Frances Lambert

Soft brown soil. The two large stones near Peg 4 (see Field Sketch 11) may have been a workbench. They collapsed out of the sandy matrix before I could photograph them. There was one other large flat stone in this Level.

The stones were lifted and bagged separately. The Level was tidied up and completed.

A3/Level 8 (75-85 cm)

Len Dyall, Frances Lambert, and George Buckton.

This Level penetrated into a layer of almost clean sand, containing a little shell and bone.

Completed.

A3/Level 9 (85-95 cm)

Same team.

The soil was generally yellow. A stone protruded from the corner near Peg 13, and was left there. There were several large turban shells at the bottom.

A3/Lower Levels

Len Dyall

I used a spade to cut a hole in the centre of the Square. There was a further 10 cm of clean sand (no occupation material was found by sieving), then 15 cm of dark soil (not hard) before reaching country rock (porphyry). Right across the Square, I struck this rock, very uneven but continuous.

The trench in this Square was backfilled with spoil from our sieving stations until it was only 50 cm deep.

SQUARE A4

Saturday 25 November

A4/Level 0 (0-5 cm)

Boris and Sue Sokoloff

The surface levels were rechecked and set up with strings.

The soil was very black. There was much shell near the Front Datum and near Peg 14, but none near Peg 15. There were chert flakes from the front half.

A soil sample was taken.

This Level was tidied up and completed.

A4/Level 1 (5-15 cm)

Same team

Very black soil.

At 31.0 cm along the Front Datum from Peg 4 there were several bones: a femur, a phalange, a sliver, and a fish bone. Right on the Front Datum line, at12.8 cm depth, there was a bone point sticking up, at an angle of 30 degrees to the horizontal. It was broken at excavation. (On 26 November 1978 I glued it together with Airfix). Length 123 mm. This point had been made by grinding the end of a macropodid fibula. About two-thirds of the length showed use-polish.

A fair-sized groper jaw was noted.

The Level was trimmed up and completed. Special Finds: 1 bone point; 2 mammal bones.

A4/Level 2 (15-25 cm)

Same team

Yellow-brown sand, darker in the Peg 15 corner. There was not a great deal in it: one chert flake and sundry fish bones and shells.

Completed and trimmed.

Sunday 26 November

A4/Level 3 (25-35 cm)

Len Dyall and Peter Adams

Rechecking of levels showed that Level 2 had been set 1 to 2 cm too deep. This (minor) error was probably connected with some sagging of the Rear Datum wall. The weight of our foot traffic was doubtless the cause.

This Level 3 was very sandy, generally yellow but with darker stains and occasional material almost black. There was little occupation material in it.

There was a darker patch in the Square 5 corner, extending generally along the 5 to 15 line out to about 40 cm (the margin being quite vague).

There was a small coal cobble 4 cm down into this Level, 24 cm (to its midpoint) from Peg 14 and on the 4-14 line. It was removed from the wall and bagged with the rest.

The Level was tidied out. The colour of the bottom was much the same as the rest of this Level.

Saturday 2 December

Children had been in the trench of Square A3, knocking out Peg 14 and causing some Rear Datum wall collapse, which was not too serious. This collapsed material was thrown out. Drift sand was cleared away from the edges of the trench, and The Rear Datum wall at the junction of Squares A3 and A4 was planked up.

I took a sample of dune sand, for a pH measurement, along Gan Gan Road which leads to Anna Bay.

A4/Level 4 (35-45 cm)

John and Carol Davies

The soft soil was a sandy yellow-brown. A great deal of fish bone and a few stone flakes.

Near Peg 4 there was a flat cobble of porphyry, resting on the 38 cm level. There was also a dark area, ill-defined and quite small, as shown.

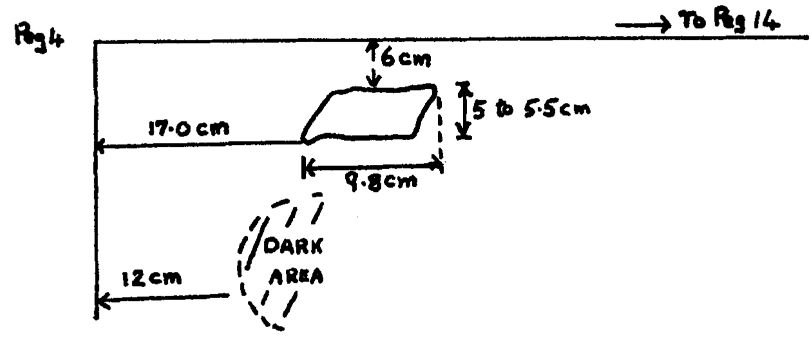


DIAGRAM 4-5. Flat cobble and ?hearth in A4/Level 4

In this same corner of the Square, at 40 cm depth, there was a shell fishhook, 17 cm from both the Front Datum and from the 4-14 line.

There was a great deal of fish bone near the flat stone; also a large red triton and a big earshell (abalone). In the A3/A4 wall there was a chert flake (42.5 cm depth, 34 cm along from Peg 4). A mammal rib was seen in the A4/A5 wall, at 45 cm depth.

The Level was completed. Its bottom was yellow-brown, with scattered bone and shell.

The Rear Datum Wall collapsed at this time. This unwanted material was shovelled out. A mammal rib was recovered from the collapsed soil.

A4/Level 5 (45-55 cm)

Same team

Almost immediately the shell was noted to get more dense, but it did not form a compacted layer.

A cluster of smooth stones was plotted (see below). (Field Sketch 14A embodies this data. The item numbers in the Sketch are given in the following Table).

This Level yielded a number of shell fishhooks, mostly near the Rear Datum but also over the rest of the Square. Special Finds bag: 13 shell fishhooks. The Level was finished.

<u>Details of stones</u>

Item Number	**Description**	**Horizontal Position**	**Depth (cm)[A]**
1	Round pebble	5 cm from Rear Datum, 33 cm from 5-15 line	53
2	Round pebble	55 cm from 5-15 line, 10 cm from Rear Datum	52
3	Round pebble	66 cm from 5-15 line, 8 from Rear Datum	51
4	Heavy slice	10 cm from 5-15 line, 29 from Front Datum	49
5	Small slab	9 from 5-15 line, 29 from Front Datum	47

6	Round pebble	51 cm from Rear Datum, 33 cm from 5-15 line	55
7	Flat slab	28 cm from Rear Datum, 25 cm from 5-15 line	48
8	Pointed stone (13.5 cm long)	On 5-15 line, 58 cm from Peg 15	47.5
9	Flat flake	28 cm from Rear Datum, 41 cm from 5-15 line	54
10	Flat flake	21 cm from Rear Datum, 20 cm from 5-15 line	54
11	Flake	17 cm from Rear Datum, 16 cm from 4-14 line	49
12	Porphyry flake	2 cm from Rear Datum, 55 cm from 5-15 line	45
13	Pebble	40 cm along the Rear Datum from Peg 14	52
14	Pebble	57 cm along the Rear Datum from Peg 14	53.5
15	Broken rock[B]	In Peg 4 corner	54
16	Big cobble	In Rear Datum wall, extending 21 to 30 cm from Peg 14	42[C]

A Depths were measured to the highest point on the top of the item.

B This rock extended 7 cm across the A3/A4 wall, and 4 cm across the Front Datum from Peg 4. Near this piece there is another one embedded in the Front Datum wall, mostly in Square A3. One end of this latter stone projects 3 cm out from the Front Datum Line into Square A4, and the other end 5 cm out into Square A3. It extends for 9 cm along the Front Datum Line.

C This big cobble extends down into Level 6.

<u>More stones</u>

There was a cluster of three stones at the Rear Datum Line (see Diagram 4-6). The distances are from Peg 14. The middle stone is at depth 49 cm, and is Item 13 in Field Sketch 14A.

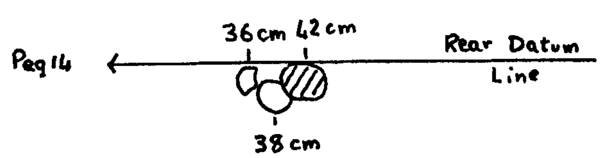


DIAGRAM 4-6. Cluster of pebbles in A4/Level 5

Saturday 9 December

A4/Level 6 (55-65 cm)

Len Dyall and Gavin Dyall. Later, Dr. Colin Keay, Myra Keay, and Susie Keay.

Generally grey-brown, with yellow patches. There was a very black patch on the midpoint of the A4/A5 wall, with two round stones in it. This patch was so thin that an attempt to tidy it up for a photograph was unsuccessful.

The round stones were at depth 57 cm (measured to their tops). One was 8 cm from the 5-15 wall, and 31 cm from the Front Datum. The other was 17 cm from the 5-15 line and 44 cm from the Front Datum.

There were stones along the Rear Datum, as follows.

Round pebble right on the rear wall: 25 cm from Peg 15 and resting on the 58 cm level.

Round pebble resting on the 59 cm level; 9 cm from the 5-15 line and 7 cm from the Rear Datum.

A slab in the Rear Datum wall, 24-33 cm from Peg 14. It goes down deeper than the bottom of this Level, and is standing on its end.

Rounded pebble in the Square A5 wall, 36 cm from Peg 15 and 63 cm depth.

Pebble, in the 5-15 wall, 18 cm from Peg 15, at the bottom of the Level (65 cm).

Another 53 cm from the 5-15 wall, 42 cm from the Rear Datum. It rested in the top of the next Level. When lifted, it was found to be flattish; the maximum dimensions were 100x55x35 mm.

Another round pebble had been lifted before its location was measured. Its location is estimated to have been 22±5 cm from Rear Datum, 65±5 cm from the 5-15 wall, and it was close to the bottom of the Level.

A shell fishhook blank was found while trimming the walls to restore verticality and squareness to complete this Level. Special Finds: 2 shell fishhooks.

Field Sketch 14B records the positions of various stones.

A4/Level 7 (65-75 cm)

Col, Myra, and Susie Keay

Generally yellow, with not much shell. There were several chunks of charcoal near the bottom of the Level; Col Keay suggests a burning stick had been thrust into the sand.

A bone point was found about 30 cm from the 5-15 line and 15 cm from the Front Datum, near the bottom of the Level. It went in the Special Finds bag.

Sunday 10 December

A4/Level 8 (75-85 cm)

Len Dyall

A baulk 10 cm wide had been left on the Square A3 side, from the top of Level 6 downwards, to hold out the loose backfill in this other Square. This backfill was shovelled out of the way and the baulk was now removed, in two stages (Levels 6 and 7) whose sieve residues were bagged separately.

In Level 8, there was light brown sand with a few shells. There was a stone 29 cm from the Front Datum, 20 cm from the 5-15 line. (Depth not recorded). When this stone was removed, another was found beneath it.

At the bottom of the Level, there was a patch of shells near the Rear Datum, 35 cm from Peg 15, as well as a stone 45 cm from the Rear Datum and 40 cm from the 4-14 line. Under the lip of the large boulder in the Rear Datum wall there was a large earshell, 14 cm from the Rear Datum and 31 cm from the 4-14 line.

This large boulder ended 8 cm above the bottom of this Level, and was now seen to have 29 cm of its height exposed. It was embedded in the Rear Datum wall and may have been taller still. Removal was not attempted.

The Level was completed. There were greyish areas amongst yellow sand on the bottom.

A4/Level 9 (85-95 cm)

Len Dyall and Boris Sokoloff

Sandy yellow. There was a yellowish stone just under the surface, 13 cm from the Front Datum and 58 cm from the 4-14 line.

Another stone lay 23.5 cm from the Front Datum and 31 cm from the 4-14 line, its upper end 2 cm below the top of this Level.

There was some shell in the upper part of this Level, but by the bottom of it, no occupation material was found on the sieve.

The Level was completed.

A4/Lower Levels

Len Dyall

I used a shovel to dig deeper, so that the peaty soil and position of the bedrock could be included in profile plots of the Front and Rear Datum walls. (See Field Sketches 16 and 17)

The bedrock was variable in nature. Towards Square A5, solid rock gave way to cobbles and shell.

The trench was backfilled.

Profile Plots

Saturday 9 December

I noted that the midden exposure in the back of the track, inshore of our Square A1, had two levels of shells matching those seen in Square A2, but both slanting downwards.

Plotted the front and rear datum walls of Squares A2 and A3. (Field Sketches 12 and 13). With great labour (there being no room to put the spoil from the bottom of the trenches) I shifted the sand around to plot the position of the rock at the bottom. This rock is comparatively level.

The wall strata were very tricky, partly because of lack of good definition (all those ashy patches in the yellow/brown sand layers!) and partly because the sand was really too wet to give sharp colour contrast.

Squares A2 and A3 were now fully backfilled.

SQUARE A5

Sunday 3 December

Boris and Sue Sokoloff

The levels of the Square were strung up, and drift sand was removed from the surface.

A5/Level 0 (0-5 cm)

The soil was loose sand, containing a little pipi shell. By the bottom of this Level, black soil and shell had been reached. The Level was finished.

A5/Level 1 (5-15 cm)

Boris and Sue Sokoloff.

The soil was brown-black, and contained a lot of shell. There was one cluster of charcoal on the Rear Datum side of the midpoint of the Square.

This Level was trimmed out and completed.

A5/Level 2 (15-25 cm)

Boris Sokoloff, Sue Sokoloff, and George Buckton.

The dark soil had lightened to brown by the bottom of this Level. It contained a lot of shell and fish bone. There was a yellow patch right against Peg 15, from 15 to 17 cm depth.

A flat stone lay 33 cm from the Front Datum and 26 cm from the 6-16 line. (Depth not recorded). Level completed. Special Finds: 1 shell fishhook.

Saturday 9 December

The heavy rain had run in under the covers and caused much damage to the trench walls, but otherwise all was well. We cleaned out the drift sand. Part of the A4/A5 wall had fallen down. It belonged to the new Level 3 of Square A5 and was restored there.

On the higher level midden (C-Area) I picked up 2 oyster shells, 1 mud whelk, and more green glass.

A5/Level 3 (25-35 cm)

Boris and Sue Sokoloff

Grey-brown soil. There was a lot of fish bone including a large groper jaw. A crumbly portion of a shell hook was found, and later an incurved shell fishhook.

The Level was completed. The bottom was dark grey, still with shell and bone. It was patchy yellow near Peg 6.

A5/Level 4 (35-45 cm)

Boris and Sue Sokoloff

Dark soil with much fish bone, including one jewfish upper jaw. Also bird bone. There were several rounded pebbles.

The Level was completed. Special Finds: 1 shell fishhook.

A5/Level 5 (45-55 cm)

Boris and Sue Sokoloff

Generally brown. At depth 48 cm (from the surface) there was a blackened stone in a patch of charcoal, 37 cm from both the Front Datum and the 5-15 line. The charcoal patch was not well enough defined to plot.

Another, yellowish, stone lay below this black patch on the bottom of the Level. There were two small fire-blackened stones on the bottom of the Level. Measured to their midpoints, one was 42 cm from the 5-15 line and 26 cm from the Rear Datum; the other was 47 cm from the 5-15 line and 29 cm from the Rear Datum. There was also, at the bottom, a "cone shell" (now thought to be a volute) 26 cm from the 5-15 line and 12 cm from the Rear Datum.

This Level also contained a hammerstone. Special Finds: two bits of pumice possibly used; 5 shell fishhooks; and 2 shell hook "blanks".

The Level was completed. The bottom was generally rather yellowish. The two stones were left in position. There was another porphyry stone resting on the bottom, 12 cm from the Rear Datum and 36 cm from the 5-15 line.

Sunday 10 December

A5/Level 6 (55-65 cm)

Boris Sokoloff, Sue Sokoloff, and Kevin McDonald.

The soil was generally brownish. A cluster of stones and large shells was exposed in the Peg 15 quadrant. It didn't look like a fireplace; there was no associated charcoal. There was a darkish patch between these stones and the 5-15 line.

The positions of the stones were plotted (Field Sketch 15).

The Level was tidied up and completed. Special Finds: 1 shell fishhook.

A5/Level 7 (65-75 cm)

Same team

The soil was sandy and yellow, with little occupation material at all.

The Level was completed.

A5/Level 8 (75-85 cm)

Same team

The soil was shaved off with a shovel.

Sieving found 4 shell fragments only. By the bottom of the Level, grey-black patches had appeared.

The Level was finished.

A5/Level 9 (85-95 cm)

Kevin McDonald

The soil was shaved off with a shovel. It was a very yellow sand, too moist to sieve. It was therefore piled onto a plastic sheet and repeatedly turned over. No shell or other occupational material was seen.

The Level was tidied up.

A5/Bottom Levels

Len Dyall

I probed with a shovel for bedrock. There was a deep layer of shell and cobbles, as in Square B1. On top of this mass of shell and cobbles (which began below 130 cm depth) there was a layer of black peaty soil (2-3 cm thick), which permeated into the layer beneath it. Many of the shells were markedly water-worn. Some of the cobbles were boulder-sized and made probing for the underlying bedrock quite difficult. It is doubtful if I reached bedrock.

Profile plots were made on the two walls (Front Datum and the 6-16 wall). (Field Sketches 16 and 18). Thanks to wet weather, the soil was very damp and the colours of the strata were therefore very ill-defined.

The Square was largely backfilled.

Note: A used cobble fell out of the inner corner between Squares A5 and B1. The depth was not recorded at the time; by memory, it came from about 25 cm depth. It was bagged separately.

SQUARE B1

Saturday 25 November

Len Dyall

The encroaching mound of drift sand was shovelled away, and the bitou scrub was cleared from the area. Square B1 was set alongside Square A5 (see Diagram **4-1**). The geometry of the new Square was checked and then Pegs 25 and 26 were set with their tops at the same height as the other Datum Level.

The position of the surface was plotted (see Appendix 7).

At the time, this Square was held in reserve. Later, as the excavation of the four A-Squares progressed, the results suggested that more Squares could be usefully opened. While we had more samples of shell and fish bone than we needed, there were only very small samples of flaked stone. Moreover, these additional Squares would doubtless yield more examples of complete and partly-finished shell fishhooks, and we hoped thereby to establish the stages of their manufacture.

The decision to run the new Squares (B2 being also contemplated) at right angles to the others was largely logistical: on our shoestring budget we could not afford the necessary timber to cover over two parallel trenchlines.

Saturday 2 December

B1/Level 0 (0-5 cm)

Arthur Munro and Bob Jakes

The Level was taken down through drift sand and loose black soil containing a little shell. A great deal of bitou root was encountered. Some stone flakes were noted.

The Level was tidied up and completed.

B1/Level 1 (5-15 cm)

Same team

Soft black sandy soil. There were a lot of pipis near Peg 25.

Noted a bird sternum, a moderate amount of fish bone, and one chert flake.

The Level was tidied up and completed.

B1/Level 2 (15-25 cm)

Same team

Soft, light brown sand. Scattered shell.

Completed.

B1/Level 3 (25-35 cm)

Same team

There was a slab of porphyry against the Rear Datum. Its nearest edge was 29.0 cm from Peg 15, its furthest edge 39 cm, and it extended out 13 cm in the 15-25 direction. The top of this slab was 25 cm from the surface.

A large ear shell was centred 34 cm along the Rear Datum from peg 15, and 10 cm out from the Datum line in the 15-25 direction.

A loose stone lay at the top of the Level between the slab and the ear shell.

There was a kangaroo pelvis, 63 cm in the 25-26 direction and 15 cm in the 15-25 direction, at 34 cm depth. It was bagged separately.

A ?rhyolite implement protruded from the 25-26 line, 67 cm along from Peg 25, at 28 cm depth. (At the sorting stage it was classified as a waste flake).

The Level was completed.

B1/Level 4 (35-45 cm)

Same team

The soil was sandy brown. Found an animal vertebra near the 25-26 line. (Special Finds bag).

The Level was completed.

B1/Level 5 (45-55 cm)

Same team

The soil was soft, sandy, and brownish.

The Level was completed and checked. Special Finds: 2 shell fishhooks.

B1/Level 6 (55-65 cm)

Same team

Yellow-brown soil.

A flat stone (123x108 mm) lay at 28 cm (to midpoint) from the Rear Datum, 20 cm from the 15-25 line. Depth not recorded.

An elongated stone in the Rear Datum wall, 29 cm from Peg 16.

Scattered throughout the Level, 3 pebbles and one lump of rock were noted, and one piece of a fish hook.

The Level was tidied up (by Len Dyall) and the trench was then covered.

Special Finds: 1 shell fishhook.

Sunday 3 December

B1/Level 7 (65-75 cm)

The field notes on a clipboard were ripped apart by a wild gust of wind. We thought we had recovered the torn sheets, and only later realized that the sheet for Level 7 was missing.

B1/Level 8 (75-85 cm)

Kevin McDonald and Helen Vaile

Generally yellow-brown sand. No fishbone. A few turbans and "sea slugs" (elephant snails).

Completed.

B1/Level 9 (85-95 cm)

Sue and Boris Sokoloff

Very yellow sand now. Scarcely any shell. By the bottom of the Level, nothing at all.

B1/Level 10 (95-105 cm)

Same team

The soil was turned over with a spade. No occupation material.

B1/Level 11 (105-115 cm)

Len Dyall

I encountered a dark brown soil then a mass of shell whose level was variously 108 to 115 cm. In with the shell were large waterworn cobbles, and smaller stones (some of them broken); all this stone was porphyry. In amongst it were the "spirals" (columellae) of large tritons, many heavy turban operculi, and a lot of shellgrit and tiny pebbles. (A sample was taken, and when examined in June 1995 was found to include pipi shell). It matches exactly the material thrown up into rock crevices along the side of Shelly Beach. The shell looks too fresh for the 120,000+ fluvial; it must represent the work of some remarkable storm prior to the present sand buildup. There was no sign of Aboriginal material.

Note that similar material is exposed along this side of the headland for the next 150 metres, on the same level.

Probing was difficult in this confined hole with so many cobbles to contend with. There was no "country rock" bedrock at 125 cm.

The wall profiles were plotted. (Field Sketch 9 for the 25-26 and 26-16 walls; Field Sketch 10 for the 15-25 wall was drawn on 10 December). Photos were taken of the 6-16 wall and the16-26 wall.

The excavation of this Square was now closed off, and the trench was backfilled with spoil until only 40 cm deep.

Note: In the rear wall of this Square (i.e. 25-26 line) there is a dark seam, variously 39 to 42 cm below the surface and 4 cm thick. It starts 27 cm in from Peg 16, runs to the Peg 15 corner, and then 27 cm back along the Peg 15-Peg 25 line. It might effectively mark the bottom of occupation. (Sorting of the sieve residues later gave a quite different picture).

Saturday 9 December

After heavy rain, the trench walls were very moist and the profiles looked quite different.

SQUARE B2

Saturday 9 December

We removed the drift sand dune, which lay 60 to 90 cm deep over the black surface of the midden. Just above the midden surface there was a large piece of dead tree root.

The Square was then set out. (See Diagram **4-1**). Pegs J and K were set 20 cm outside the Square (to guard against wall collapses), and the two corner positions were marked with steel pegs (Pegs 35 and 36). The tops of Pegs J and K were set on the same level as each other, and also to the same level as the Front Datum Line. (The Front Datum Line was just far enough above the ground there to accommodate the upward slope of the ground towards Pegs J and K).

The position of the surface along the 26-36, 35-36, and 25-35 lines was then measured (see Appendix 7). The surface along the 25-26 line had already been measured in connection with Square B1. There was only a gentle slope (a drop of 2 cm) across Square B2 in the 35→25 and 36→26 directions.

B2/Level 0 (0-5 cm)

Len Dyall and (later) Hans Tenneberg

At 4 cm depth the right mandible of a dog was uncovered. The hinge of the jaw pointed towards Peg 35. Measurements to the root of the canine were: 26 cm from the 25-35 line, 22 cm from the 35-36 line. The edge of a bone socket also came into view at the bottom of the Level.

At the same level as the mandible, there was a porphyry cobble, 33 cm from the 25-35 line and 20 cm from the 35-36 line, both measured to the midpoint. The long axis of this cobble was almost parallel to the jaw.

The mandible and cobble were photographed.

B2/Level 1 (5-15 cm)

Hans Tenneberg

This Level was very black. At the bottom it was uniformly grey-black, with not much shell. The dog jaw and (broken) cobble were lifted.

A bone lay at 9 cm depth, 44 cm from the 35-36 line and 10 cm from the 35-36 line. This bone is flat, curved, and broken; it may be a rib.

Noted the lower jaw of a small marsupial (?possum, ?bandicoot). When lifted it was noted to be broken at the hinge.

The Level was completed. Special Finds bag: dog jaw and small marsupial jaw.

B2/Level 2 (15-25 cm)

Hans Tenneberg

The soil was soft, with scattered shell. It was brownish at the bottom.

Not a great deal of occupation material, but noted one chert flake, a shell fishhook, and one large bird pelvis.

The Level was tidied up and completed. Special Finds: 1 bird pelvis.

Sunday 10 December

B2/Level 3 (25-35 cm)

Len Dyall

The Level was generally brown with yellow patches. There was little shell until the bottom of the Level, which is darker in colour.

Found a black stone at 28 cm depth, 30 cm from the 25-26 line and 41 cm from the 26-36 line.

Uncovered a hearth. It was prepared for photography with great difficulty, the soil being too wet. The soil was taken down several cm all around this hearth, leaving it upon a bench of arbitrary shape that soon dried out. (Field Sketch 19). The charcoal in this hearth was first met at 32 cm depth and bottomed at 36 cm. The stones generally rested at 35 cm depth but the large round one went down into the next Level (by 2 cm). These hearth stones were lifted and bagged separately. The lumps of charcoal were also bagged separately.

The Level was finished. Special Finds: mammal bone.

B2/Level 4 (35-45 cm)

Kevin McDonald, Boris Sokoloff, and Sue Sokoloff

The soil was very black under the former fireplace.

On the bottom of the Level there were objects as follows.

A small porphyry pebble, 46 cm from the 25-35 line and 22 cm from the 25-26 line.

A cluster of ear and triton shells, 60 cm from the 25-35 line and 19 cm from the 25-26 line.

A rather angular stone, 10 cm from the 25-35 line and 53 cm from the 25-26 line. A turban shell lay against it.

Another angular stone, 37 cm from the 25-26 line, 59 cm from the 25-35 line.

All these stones were lifted.

The soil colour was fading by the bottom of the Level.

This Level was completed.

Friday 15 December

B2/Level 5 (45-55 cm)

Same team

The soil was generally brownish with some yellowish patches.

A rounded pebble lay 4 cm below the top of this Level, 39 cm from the 25-26 line and 35 cm from the 25-35 line.

A large stone slice lay at 3 cm below the top of the Level, 22 cm from the 35-36 line and 11 cm from the 26-36 line.

A triangular cobble of porphyry rested on the bottom (55 cm depth), 12 cm from the 25-26 line and 12 cm from the 26-36 line.

Noted 1 shell fishhook and several large ribs.

The Level was finished. It was brownish at the bottom. Special Find: 1 shell fishhook.

B2/Level 6 (55-65 cm)

Same team

Light brown soil. Still some shell and bone. Occasional stone flakes.

The Level was completed. Special Finds: 2 shell fishhooks.

B2/Level 7 (65-75 cm)

Same team

Very little material at all. There was one black stain against Peg 25, 6 cm across and 2 cm deep.

The soil was yellow-brown at the bottom of the Level.

The Level was completed.

B2/Level 8 (75-85 cm)

Len Dyall and Boris Sokoloff

We used a shovel. This soil was so moist that we had to partially dry it by spreading on a plastic sheet. Even then we had to use a sieve with ¼-inch mesh to avoid clogging. We recovered a little shell near the top of the Level but the bottom was yellow and sterile.

The Level was completed.

B2/Level 9 (85-95 cm)

Len Dyall

I used a shovel. The soil was yellow sand. No occupation material was found.

The wall profiles were plotted (Field Sketches 20, 21A, 21B) and photographed. I then used a shovel to reach the dark brown peaty soil lower down, and then the stony "bottom". There was shell along the 26-36 edge; elsewhere I reached stones and quite large boulders. I was unable to shift these boulders to find the bedrock.

The whole of the AB trenchline was now backfilled.

Note 1: Beyond Square B2, a trackway exposed more black midden. It is not known how far the midden extended in the landwards (east) direction, because it was covered with a deep drift of sand. I was not able to obtain a soil auger to find what lay under this dune.

Note 2: On 29 May 1979 I picked up a broken shell fishhook, and a "blank" chipped all round the edge, near our former A-trench. I have since heard of some half-dozen hooks being found there.

SQUARE C-1

15 December 1978

We decided to sample this recently-exposed "high midden", 26 metres east of the AB trenches and some 4 metres above it. Our finds of green bottle glass nearby gave some hope of excavating material from the European contact period, and the highly compacted surface of shell and black soil looked quite different to the surface of the AB Squares. Mussels and mud whelks lay nearby. Diagram **4-7** shows the peg numbering of this 1-metre Square, and Field Sketch 22 the surrounding terrain. The sides of the Square were set out with (magnetic) north-south or east-west alignments.

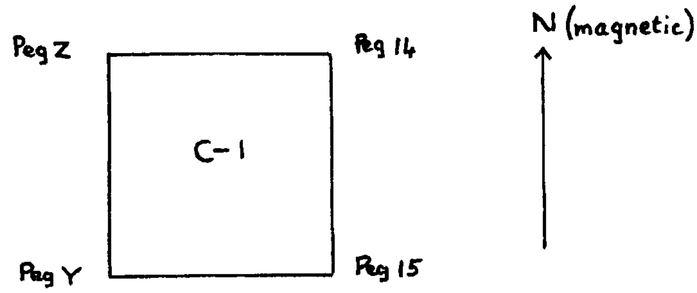


DIAGRAM 4-7. Peg designations for Square C1

The surface sloped 5 cm from Peg 15 to Peg Y, 1 cm from Peg Y to Peg Z, 3 cm from 14 to Z, and 3 cm from 15 to 14. Details are given in Field Sketch 23. Even larger slopes surrounded this Square, and probably reflected the way the midden had accumulated in sympathy with the underlying slope of the ground. We therefore set Levels that followed the slopes of the midden surface. That was done simply be measuring depths from the lip of the trench, which was marked with a string along the edge between the pegs.

C1/Level 0 (0-5 cm)

Trevor and Gavin Dyall

A lot of pipi shell, but also operculi of turban shells, and one cockle shell was noted. There were occasional yellowish patches. The soil was soft and black. The excavated material was so wet that it clogged our 1/8-inch sieves and a ¼-inch sieve had to be used. Fishbone was recovered.

The Level was finished, and Len Dyall checked it over. A soil sample was taken from the midpoint of the bottom.

C1/Level 1 (5-15 cm)

Sue Sokoloff, Trevor Dyall, Len Dyall

The soil was very black. Many large turban shells. Several stones towards the YZ side. At the bottom of the Level, a large cobble projected from the YZ edge (see Diagram 4-8).

The Level was completed.

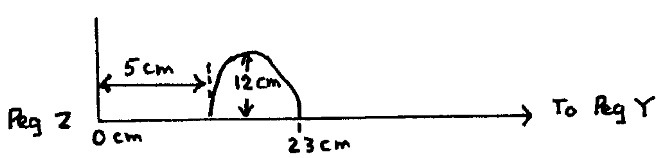


DIAGRAM 4-8. Cobble in Square C1/Level 1

C1/Level 2 (15-25 cm)

Same team

Found many tritons, turbans, and loose stones. At about 22 cm depth, went through into yellow sand, which contained a few shells.

In the Peg Z corner, a waterworn slab lay below the big boulder sketched above. This slab projected 23 cm along the Z-14 line and 12 cm outwards.

The big boulder rested at 12 cm depth. There was a mass of pipi beneath it, and then 2 flakes of porphyry.

These large stones were photographed. The Level was then finished.

C1/Level 3 (25-35 cm)

Sue Sokoloff and Trevor Dyall

The yellow-orange sand contained very little occupation material and was sterile by the bottom.

The Level was completed.

C1/Level 4 (35-45 cm)

Sue and Boris Sokoloff

This Level was turned over with a shovel. Sterile. A shovel probe to 80 cm in the Peg Y corner passed unchecked through yellow-orange sand.

Len Dyall plotted the wall profiles. (Field Sketch 23).

Boris and Sue investigated the large stones in the Peg Z corner, by digging an extension (see Diagram 4-9). One large stone was removed before this Diagram was constructed.

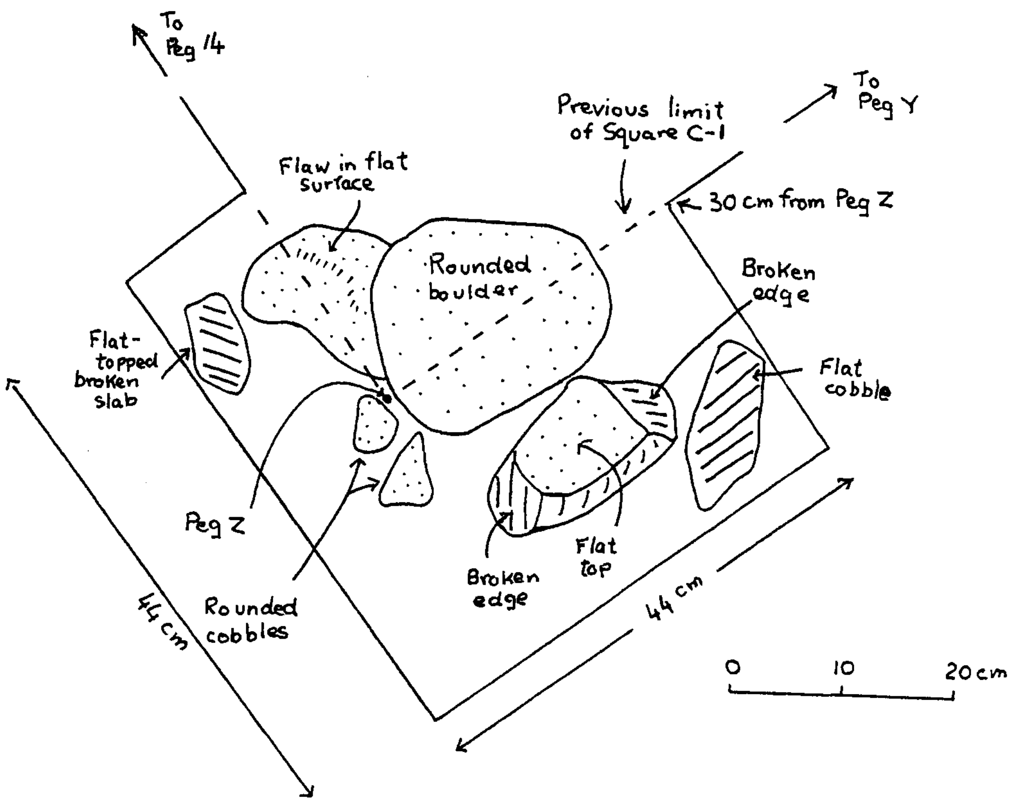


DIAGRAM 4-9. Stone arrangement in Peg Z corner of Square C1

The three largest stones lay wedged together, and the other four lay close by. The largest stone (a boulder) had a rounded top, while all the others were flat-topped. We did not plot the positions of these stones; the Diagram was constructed from a photograph and the measurements are only approximate. The stones were lifted.

Soil samples were taken from the separate Levels.

Buried pegs were left to mark the Square, and it was then backfilled.

Note: The First Phase of our fieldwork was now completed. It was time to sort some of the bags of sieve residues, so that I would have a clearer picture of what the middens contained.

Sampling of the D-middens remained for the Second Phase. I knew from my surface-collecting days that the highly reflective shell heaps would be like a furnace during the summer months, so further work was deferred till Easter.

Diary of the Dig – Second Phase

Sunday 22 April 1979

We had in the meantime excavated Area D (see later in this account), and were disappointed that so little of it remained for sampling. Therefore it was decided to take a larger sample from Area C.

Survey of C-trenches

The loose backfill in Square C1 was taken out. Only Peg Y remained in place, and the top of it was used as a Datum Level. A grid of squares was now laid out as shown in Diagram **4-10**. The "dogleg" arrangement of the Squares was dictated by the proximity of a broken edge on the south side, and a deep cover of sand (with bitou scrub cover) on the northern side (see Field Sketch 22).

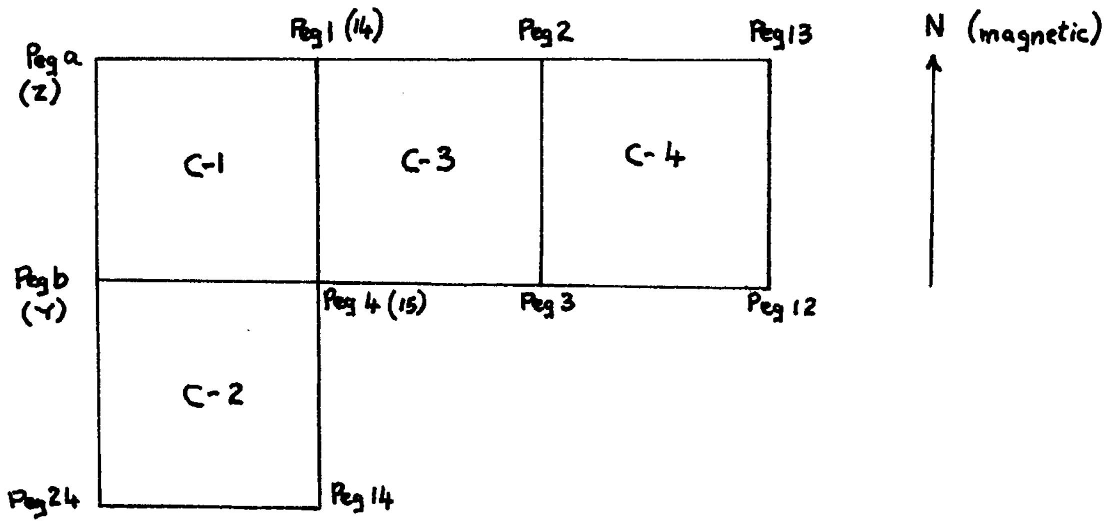


DIAGRAM 4-10. The excavation grid at the C-midden

At this date most of our painted pegs were in use on the D-Squares, and only a polyglot collection could be mustered for laying out the new grid. There is therefore no system to the numbers or letters. Constant reference to this Diagram will be necessary to follow the excavation details. Note that the peg numbers for Square C1 no longer apply: three of these pegs (including the Datum Peg) had been stolen during the intervening months. Only Peg Y remained, plus a groove in the soil where Peg 15 had been. Peg Y became the new Datum Peg and was renamed as Peg 1, so that none of the previous peg designations remained. These previous (1978) peg designations for Square C1 are shown in parentheses.

Plotting the midden surface

The position of the midden surface underneath the line between each pair of pegs was measured at intervals of 20 cm (see Appendix 8). The surface was seen to slope from north to south (dropping between 3 and 7 cm across a distance of one metre). In the transverse direction, the a→13 transect rises 3 cm from Peg a to Peg 1 and then drops 31 cm cross the horizontal distance of 2 metres from there to Peg 13. In the parallel transect (peg b to Peg 12) there is a rise of 5 cm across the first metre, and a drop of 28 cm across the next two metres. Square C3 actually had a drop of 17 cm across it in the west-to-east direction, and Square C4 not much less (14 cm). We therefore used the same approach to setting excavation Levels as we had in Square C1. That is, we followed the natural contours and measured depths from the lip of the trench, not from the Datum Level.

SQUARE C2

Sunday 22 April 1979

C2/Level 0 (0-5 cm)

Len Dyall, Janine Floyd and Jane Brisley

The soil was very dark, and full of shell, charcoal, and bone. Some broken glass was present. Mostly the deposit was loose, but parts of it were compacted. We encountered roots of the nearby bitou bushes.

The Level was completed with its bottom set to match the surface contours; thus its depth from the surface was 5 cm along all four edges.

C2/Level 1 (5-15 cm)

Janine Floyd and Jane Brisley

Very black, with much shell and several stones. Digging was made difficult by many large turban shells.

Field Sketch 24 shows the position of four cobbles. One of them rested close to the bottom, and two rested on the bottom of this Level. These three were lifted. The one on the 4-b edge was left for Level 2.

C2/Level 2 (15-25 cm)

Len Dyall and Janine Floyd

There was a mass of large turban shells (32 in all) at the top of this Level, extending from Peg 14 for 44 cm towards Peg 4, and 25 cm outwards from this line. There were more turban shells along the 4-14 line, and several others more widely scattered. When the main patch of turbans were lifted, another 11 turban shells, and a cobble, lay directly under them.

This Level also yielded one large cobble, and a thin one with possible edge use.

Brown sand appeared about 2 cm above the bottom of this Level.

The Level was completed.

C2/Level 3 (25-35 cm)

Janine Floyd and Jane Brisley

The soil was consistently yellow. There were a few shells and cobbles at the top, and nothing below that. The Level was completed.

C2/Level 4 (35-45 cm)

Len Dyall

Using a shovel, this Level was taken out. The yellow sand had two dark patches, one near Peg 14, and the other about 15 cm from Peg 24 on the diagonal from Peg 24 to Peg 4. The first of these extended down to 37 cm, the latter to nearly 45 cm. Both dark patches yielded a few fragments of shell.

The Level was completed and the profiles were plotted. (Field Sketch 26).

SQUARE C3

Sunday 22 April 1979

C3/Level 0 (0-5 cm)

Boris and Sue Sokoloff

The soil was very black, some of it loose and some of it compacted. There was much shell, a lot of fish bone, and some chert flakes.

The Level was completed, the bottom being set horizontal.

C3/Level 1 (5-15 cm)

Same team

The soil continued very black. Shell hook blanks were noted.

The excavation team found disturbed soil in the Peg 4 corner and assumed that this was where they had extended Square C1 to recover some large cobbles on 15 December 1978. This assumption is wrong; both Field Sketch 23 and our photographs make it clear that the extension was dug in the Peg "a" corner. The disturbance can be attributed to the vandals who uprooted our original Peg 15. *(In view of this disturbance, material from Square C3 should not be used for dating purposes).*

The Level was completed.

C3/Level 2 (15-25 cm)

Same team

Noted one hand cleaver (?toscanite). A heavy cobble, and a scatter of many associated stones, extended into Square C4.

The stone arrangement found at the bottom of the Level was photographed and plotted (Field Sketch 25). (Note that one of the cobbles in this Field Sketch is at a higher level than the others). The stones were then lifted and put with those from the same Level in Square C4.The Level was completed.

C3/Level 3 (25-35 cm)

Same team

The soil was uniformly yellow, and by the bottom of the Level it was sterile. A large slab was lifted; it had not extended into the wall. (This slab disappeared from our storage at the time of the 1989 Newcastle earthquake).

The Level was completed and the trench was backfilled.

SQUARE C4

Sunday 22 April 1979

C4/Level 0 (0-5 cm)

Nan and John Mitchell

The soil was very black with much loose shell. This loose shell was picked off separately before digging the Level down to a horizontal base. The two bags of sieve residues were later combined.

The Level was completed.

C4/Level 1 (5-15 cm)

Same team

The soil was very black right to the bottom.

C4/Level 2 (15-25 cm)

Same team

The soil was becoming brown towards the bottom, and there was much less shell. There was a "line" of stones down the 3-12 edge. At the bottom of the level, the sand was yellow.

The exposed stones on the floor of Level 2, across both Squares C3 and C4, were plotted and photographed. (Field Sketch 25). When lifted, these stones from C4/Level 2 were put with those from the same Level in Square C3. The Level was trimmed and completed.

C4/Level 3 (25-35 cm)

Same team

The soil was generally yellow, with one narrow patch of black near Peg 13.

A large slab was taken from the 3-12 wall. It had extended about 10 cm into this wall. A chert flake came out with it. (The slab has not been seen since our storage area was disturbed in the aftermath of the 1989 Newcastle earthquake).

The Level was completed.

Profiles

The profiles of walls 2-13, 13-12, 12-3, 3-4, and 1-2 were plotted and transferred onto Field Sketches 27 and 28.

The Field Sketch makes it clear that the layer of occupation material does follow the natural slope of the land. There was a marked thinning-out of the shell layer on passing from Square C3 to Square C4 along the Peg 1→Peg 13 line, but not along the Peg 4→12 line. The lack of any shell mass close to Peg 4 may have been caused by the vandals who dug out our survey peg.

The trenches were then all backfilled, the Datum Peg being left in position.

THE D-AREA TRENCHES

Tuesday 17 April

Len Dyall; Boris and Sue Sokoloff

<u>Selection of excavation site</u>

Wind damage to the main shell middens (Area D) in October 1978 has already been mentioned. There had been another heavy gale in January 1979, and now these middens were reduced to just four small "promontories" projecting from a low ridge of sand. We could not find any undisturbed midden under this sand ridge, and its surface was scattered with remnants of a deflated midden.

The possibility of excavating on some vacant house lots near the cul-de-sac at the end of Ocean Street had already been considered (see Appendix 2). Test holes dug there showed that the Aboriginal midden had probably been cut through by wind action in the past, so that only incoherent remnants were left. Moreover, the presence of rusty iron mixed in with the Aboriginal material indicated that the midden had been disturbed. Most probably the shell layer had collapsed after being undercut by the wind. I rejected this house lot area as a site for excavation.

At the main shell midden, we selected one of these "promontories" for excavation. It consisted of a shell cap extending for 14 metres from its crumbling seaward (south) face to the loose sand dune behind. Diagram **4-11** shows the excavation grid. Initially we laid out four Squares (D1 to D4). North of D4, the shell had been disturbed by foot traffic, so that Squares D5, D6, and D7 looked unpromising.

These D-trenches were 180 metres inland from Little Beach, and 263 metres from the AB-trench.

On the deflated midden near the excavation grid we found three mammalian carpal bones and three chert artefacts (one elouera, one used flake, and one waste flake).

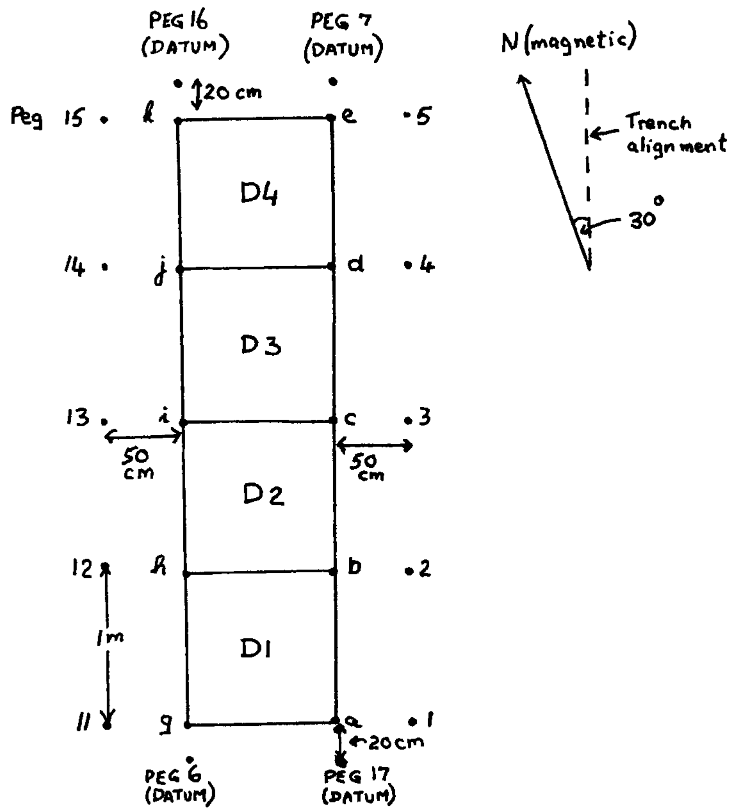


DIAGRAM 4-11. Layout of excavation Squares D1 to D4.

<u>Survey of site</u>

The Datum Pegs (6 and 17 at the south end, 16 and 7 at the north end) were set out as shown, their tops all at the same Datum Level. These pegs, and all those used for setting up the lines of survey, were placed *outside* the lines of the trenches we aimed to dig. We did this because it was very difficult to drive pegs deeply into a mass of compacted shell, and the "corner pegs" in the excavation squares were bound to come loose and fall out as digging progressed. The actual Squares were marked with short pegs bearing letters (a, b, c etc), and when some of them did fall out, it was easy to replace them in the correct positions by referring to the undisturbed pegs outside the trench.

Beyond Peg 5, a sighter peg was placed, 12 metres from Peg 1 along the 1→5 line; another was set 12 metres from Peg 11 on the 11→15 line. These sighter pegs would enable us to set out additional Squares if necessary. Such Squares had surfaces higher than the Datum Level and, if excavated, would need their own Datum Level.

The distances between pegs in the (approximate) north-south line were measured centre-to-centre. On the crosslines, the 1-metre width was set between the inner faces of the pairs of pegs (a-g, b-h, etc).

The bearing of the 11→15 and 1→5 lines was actually 30 degrees east of magnetic north, in order to keep the trench within the edges of the narrow "promontory" of compacted shell.

Conformation of the surface

The position of the midden surface was measured with respect to the Datum Level. (See Appendix 9). The surface was found to slope very slightly downhill from south to north, the drop being 11 cm across the 4 metres of horizontal distance between Pegs a and e, and 2 cm across 4 metres between Pegs g and k. There was no significant slope in the transverse direction. The surface of the midden was very close to flat.

Photographs of the site were taken. Modern-day rubbish collected from the surface included a fresh-looking sixpence (dated 1925), much broken crockery and glass, some .22 calibre rifle cartridge cases, rusty iron, and pieces of old leather shoes.

SQUARE D1

Tuesday 17 April

D1/Level 0 (0-5 cm)

Len Dyall ,Boris Sokoloff, Sue Sokoloff

The surface was loose brownish sand containing much broken pipi shell; there was also broken glass and rusty iron. Quite a lot of chert and igneous flakes. One chert elouera was noted. The Level was taken down 5 cm with respect to the surface, to a horizontal bottom.

At the bottom, there was compacted shell. The soil had a greyish tinge but there was not much charcoal in evidence.

The Level was completed.

D1/Level 1 (5-15 cm)

Same team

There was a lot of pipi shell. The sand was brown, and moist. Noted a fair number of stone flakes, and one elouera. By the bottom of the Level, there was not so much shell, and there were large patches of quite yellow sand.

Found a long bone sliver at 9 cm depth, 19 cm in from the b-h line and 41 cm along from b (towards h).

The Level was finished.

A soil sample was taken at 10 cm depth, in the midpoint of the Square. The pH was measured, by metre. After 1 minute of stirring the sample, the pH reading was 5.82, and 6.10 when stirring was stopped. After 5 minutes of stirring the reading was 6.98, and 7.15 when stirring was stopped. These disparate readings suggest that negative ions are adsorbing on the electrode, and the measurements must be regarded as inconclusive.

Saturday 21 April

D1/Level 2 (15-25 cm)

Len Dyall, Boris Sokoloff, Sue Sokoloff, Trevor Dyall

Shell sample for radiocarbon date

In the quadrant extending out from Peg g, the shell layer reached down into the top of this Level. The bottom of this seam was collected by excavating a spit between depths 15 and 17 cm. (The pipi shell in it was later used for dating).

In the rest of this Level, there was light brown sand, with very little shell. A chert elouera was found in the centre of the Square, near the top of the Level. Also noted a chert scraper. There was one rust flake. (These flakes lay all around us, and soon we realized they were sticking in the tread of our shoes and thence getting into our trenches).

By the bottom of the Level, there was just sterile yellow sand with slight brown stains.

The Level was completed.

D1/Level 3 (25-35 cm)

Len Dyall, Boris Sokoloff, Sue Sokoloff

Yellow sand, with just two pipi fragments seen near the top. Sieving obtained a little shell, especially from near Peg a. Nothing more was found down to the bottom of the Level. A soil sample was taken at 35 cm depth, in the middle.

The soil pH was 6.40 after 1 minute of stirring, and 6.49 when stirring was stopped. After 5 minutes of stirring, the value was up to 6.68, and became 6.93 when stirring was stopped. One cannot make a great deal out of readings that drift so much, but certainly the soil is more alkaline than an isolated sand dune (generally about 5.5).

D1/Lower Levels

Len Dyall

Using a shovel, I took the trench down to a depth of one metre. The yellow sand contained no occupation material.

Profile of trench walls for Square D1

The profiles of all four walls of the trench were measured with respect to the surface (see Field Sketch 29). The shell layer was seen to be irregular. While it covered nearly all the surface, there was a gap near Peg g, where it appeared at a lower level. The bottom surface of the shell layer undulated, which suggested the shells accumulated on the bumps and hollows of a sand dune.

SQUARE D2

Saturday 21 April

D2/Level 0 (0-5 cm)

Kevin McDonald

The soil was initially loose yellow sand, but compacted shell was reached near Peg b. Noted one sliver of a long bone.

The Level was completed.

D2/Level 1 (5-15 cm)

Kevin McDonald

The dense shell began to thin out; there were mixed yellow and brown patches of soil amongst it. The soil at the bottom of the Level was darker in the Peg h corner, where there was shell. Apart from this patch of shell, there was little of it by the time the bottom of the Level was reached.

Noted one wallaby maxilla. There was some fish and mammal bone.

The Level was completed.

D2/Level 2 (15-25 cm)

Kevin McDonald, Len Dyall, and Trevor Dyall

The soil was yellow-brown, and there was little shell.

The Level was finished.

D2/Level 3 (25-35 cm)

Kevin McDonald and Len Dyall

The soil was yellowish, with a few brown patches. Towards the bottom, only a few flakes of shell were seen, and by the bottom, the soil was sterile.

The Level was finished.

D2/Lower Levels

Same team

The Square was taken down to a depth of 1 metre with a shovel and the sand was thoroughly turned over. No occupation material was seen.

Note: The seam of shell seen in Square D1 continued for 60 cm across the walls (b-c and h-i) of Square D2.

SQUARE D3

Saturday 21 April

D3/Level 0 (0-5 cm)

Len Dyall and Sue Sokoloff

Loose sand with much broken shell. Noted one igneous scraper near Peg c. The shell included quite a few mud whelks, and one cockle.

At the bottom of this Level there was still quite a lot of shell, though not all of it was compacted. The soil was grey for 25 cm either side of the midpoint of the Square D2 side, but was otherwise yellow.

The Level was completed.

D3/Levels 1 and 2

These Levels (5-15 cm and 15-25 cm respectively) were dug this same day. However, this was an especially hectic day, with all three Directors working in the trenches. Apart from the labels on the Finds Bags, no record of these Levels was made.

SQUARE D4

Saturday 21 April

D4/Level 0 (0-5 cm)

Sue Sokoloff

Generally loose yellow sand, with iron objects present, and a lot of broken shell.

The Level was finished.

D4/Level 1 (5-15 cm)

Boris and Sue Sokoloff

Yellow sand with almost no occupation material. There was one dark grey ashy sand patch with a little associated shell (Field Sketch 30).

The Level was finished.

D4/Level 2 (15-25 cm)

Same team

Yellow sand, with almost no shell in it.

D4/Lower Levels

Same team

The trench was taken down to 1 metre depth with a shovel, and the sand was thoroughly turned over. No occupation material was seen.

Survey

The results of excavation in this D-area were not very satisfactory. While there were enormous amounts of shell, the recovery of stone items was quite modest, and of fish bone, quite poor indeed. We therefore decided to set out some additional Squares. The sighter pegs already in position were used to set the new Squares on the same alignment as the old ones.

Squares D5, D6, D7, and D8 had been seriously disturbed, so we resumed our trenchline at Square D9. The new Squares, and their pegs, are shown in Diagram **4-12**. The surfaces of some of these new Squares were higher than the existing Datum Line, so a new Datum Level was set, 9 cm higher than the previous one.

Details of the position of the surface, with respect to the Datum Level, are given in Appendix 10. There was just a little uphill slope from south to north (10 cm across the 4 metres from Peg r to Peg n, and 14 cm across the 4 metres from Peg l to Peg f). In the transverse direction, there was a little more slope, ranging from 2 to 6 cm in the west to east direction. (Note that the trenchline was actually set out with a bearing of 30 degrees magnetic, but it is convenient to use "north", "east", etc).

Across the whole trenchline (D1 to D12), and with allowance for the two different Datum Levels, the midden surface rose by just 14 cm across a distance of 12 metres.

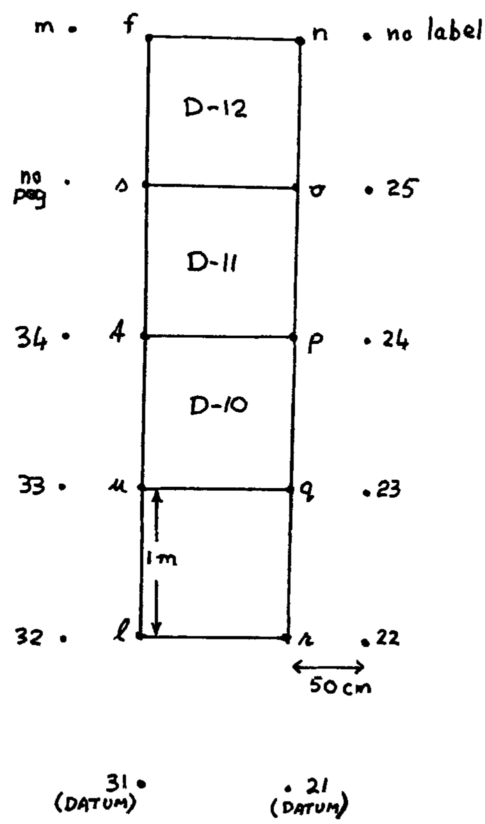


DIAGRAM 4-12. Plan of Squares D9 to D12

SQUARE D9

Saturday 21 April

D9/Level 0 (0-5 cm)

Myra Keay

Loose sand, with not much shell. The Level was completed.

D9/Level 1 (5-15 cm)

Myra Keay

There were brownish patches in the yellow sand. There was not much shell. By the bottom of the Level, there was just sterile yellow sand.

The Level was completed.

D9/Lower Levels

I dug the sand to a depth of 1 metre with a shovel, and turned it over thoroughly. No occupation material was seen.

SQUARE D10

Saturday 21 April

D10/Level 0 (0-5 cm)

Dr. Colin Keay

Loose yellow sand, containing little shell. The Level was completed.

D10/Level 1 (5-15 cm)

Colin Keay and Susie Keay

Patchy yellow and brown sand, with very little shell. By the bottom of the Level, the sand was uniformly yellow.

D10/Lower Levels

Len Dyall

I took the trench down to 1-metre depth with a shovel, turning the sand over as usual for close inspection. There was no further occupation material.

SQUARE D11

Saturday 21 April

D11/Level 0 (0-5 cm)

Sue and Boris Sokoloff

Loose sand, containing broken shell as well as bone. Level completed.

D11/Level 1 (5-15 cm)

Same team

Yellow sand. There was some shell and bone, but by the bottom of the Level it was sterile. There was a dark patch in the Peg s corner. Level completed.

D11/Level 2 (15-25 cm)

Len Dyall, Col Keay, and Myra Keay

The black patch in the Peg s corner continued through this Level (see Diagram **4-13**).

The Level was completed.

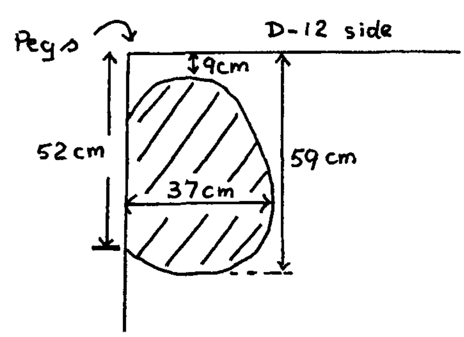


DIAGRAM 4-13. Black patch in Square D11/Level 2

D11/Ashpit

Len Dyall

I excavated only the ashpit, the rest of the Square at this depth being sterile. This ashpit was *very* black. The bottom of the pit was bowl-shaped, and reached a depth of 37 cm. The pit extended into the Peg t-Peg s wall, to a distance of 15 cm. The pit contained only a small amount of occupation material.

D11/Lower Levels

Len Dyall

With a shovel, I turned the sand over to a depth of 1 metre. There was no further occupation material.

Backfilling

There were serious doubts that these Squares D9 to D11 had contained undisturbed material. . We decided not to dig Square D12 and backfilled the entire trench.

Survey Details

Sunday 29 May 1979

I visited the site with Barry Collier (Licensed Surveyor), Sue Sokoloff, and Boris Sokoloff. The Survey benchmark outside Frank Skewes' house in Ocean Avenue was used as a reference point. The levels and locations of the following points were determined.

Peg 17 of Square D1

Datum Peg Db at the Square A5 corner

Datum Peg 1 at the Square C2 corner

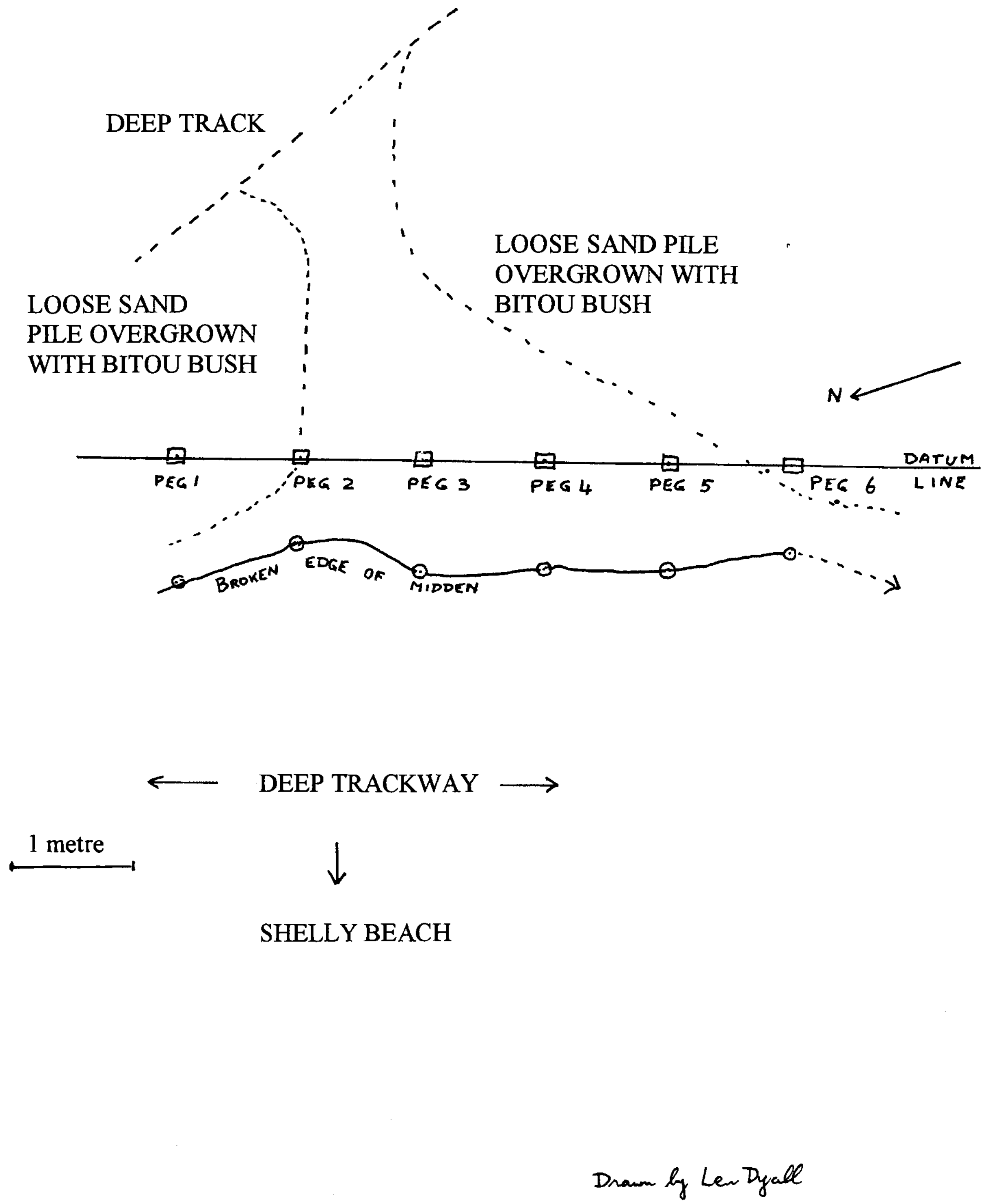
These points were not all visible from the benchmark. Therefore the small islet midden (see Map 4) was used as a common sighting point. A marker peg was driven in there (to 30 cm depth), near its right hand end as viewed from the beach. This peg was left *in situ*.

The Survey Report is attached (Appendix 11).

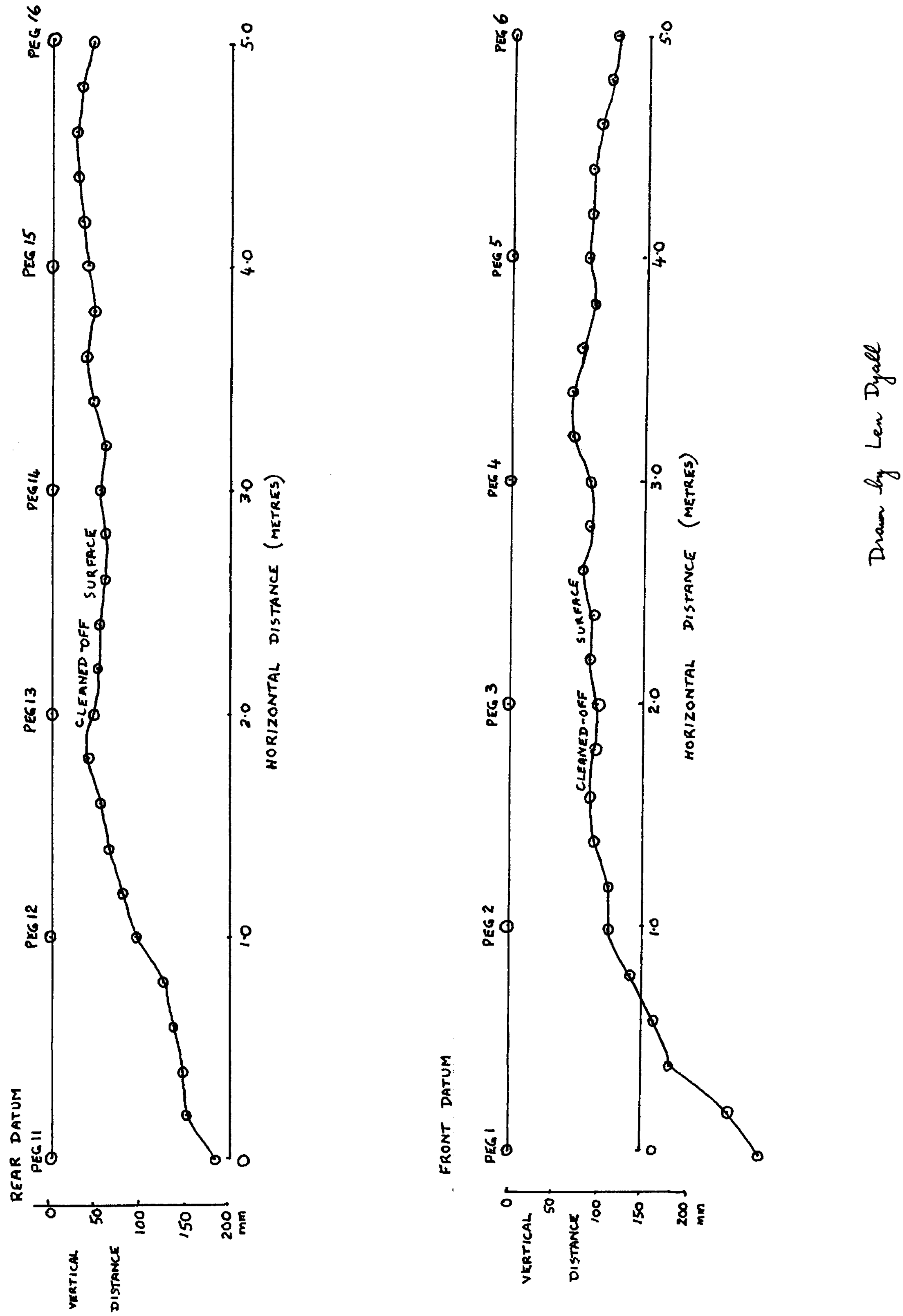
List of Field Sketches

Sketch Number	Date	Subject
1	18 Nov 78	Trench A: Plan of original surface
2	19 Nov 78	Trench A: Surface position relative to Datum Level
3	22 Nov 78	Stones in Square A2 Level 5
4A	25 Nov 78	Stones in Square A2 at 75 cm depth
4B	25 Nov 78	Stones in Square A2 at 79 cm depth
5	26 Nov 78	Stones in Square A2 Levels 7 and 8 (?workbench)
6A	26 Nov 78	Square A2: Profile of Peg 3-Peg 13 wall
6B	2 Dec 78	Square A2: Profiles of 2-3 and 2-12 walls (to 85 cm depth)
7	2 Dec 78	Square A2: Rear Datum profile
8A	2 Dec 78	Square A3: Stones resting at 46-47 cm depth
8B	2 Dec 78	Square A3: Stones at 55 cm depth
9	3 Dec 78	Square B1: Profiles of 25-26 and 26-16 walls
10	10 Dec 78	Square B1: Profile of 15-25 wall
11	3 Dec 78	Square A3: Stones at bottom of Level 7
12A	9 Dec 78	Square A2: Rear Datum wall
12B	9 Dec 78	Square A3: Rear Datum profile
13	9 Dec 78	Squares A2 and A3: Profile of Front Datum wall
14A	2 Dec 78	Square A4 Level 5: Stone scatter
14B	9 Dec 78	Square A4 Level 6: Stone scatter
15	10 Dec 78	Square A5 Level 6: Stones
16	10 Dec 78	Squares A4 and A5: Profile of Front Datum wall
17	10 Dec 78	Square A4: Rear Datum profile
18	10 Dec 78	Square A5: Profile of 6-16 wall
19	10 Dec 78	Square B2: Hearth at bottom of Level 3
20	15 Dec 78	Square B2: Profile of 36-26 wall
21A	15 Dec 78	Square B2 profile. Peg 35 to Peg36
21B	15 Dec 78	Square B2 profile. Peg 25 to Peg 35
22	15 Dec 78	Locality of Square C1
23	15 Dec 78	Square C1 profiles
24	22 April 79	Large stones in Square C2 Level 1
25	22 April 79	Stone arrangement at bottom of Level 2 in Squares C3 and C4
26	22 April 79	Wall profiles in Square C-2
27	22 April 79	Profiles in Squares C-3 and C-4
28	22 April 79	Square C4 profile (12-13 wall)
29	21 April 79	Wall profiles in Square D-1
30	21 April 79	Charcoal patch in Square D-4 Level 1 (5-15 cm)

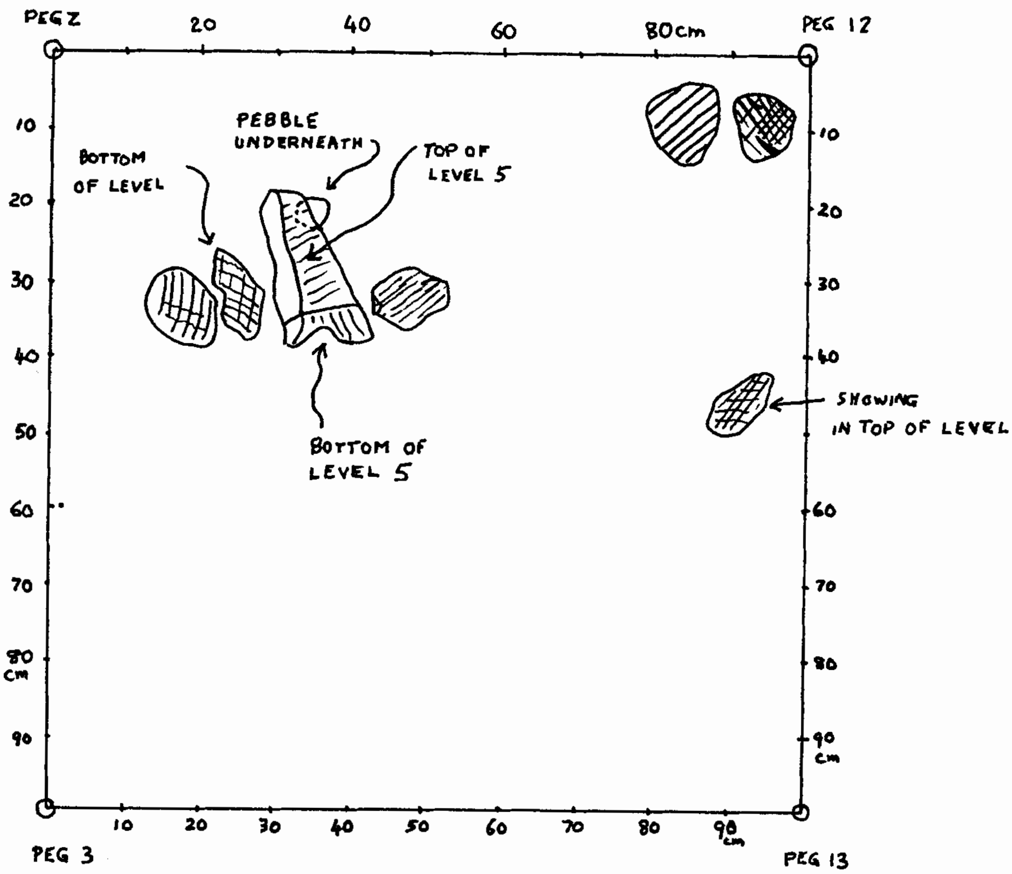
FIELD SKETCH 1: TRENCH A. PLAN OF ORIGINAL SURFACE. Dated 18/11/1978.



FIELD SKETCH 2: TRENCH A. SURFACE POSITION RELATIVE TO DATUM LEVEL. Dated 19/11/1978.
See Appendix 5 for listing of vertical distances of the surface below the Datum Line on the crosslines 1→11, 2→12, 3→13, 4→14, 5→15, and 6→16.

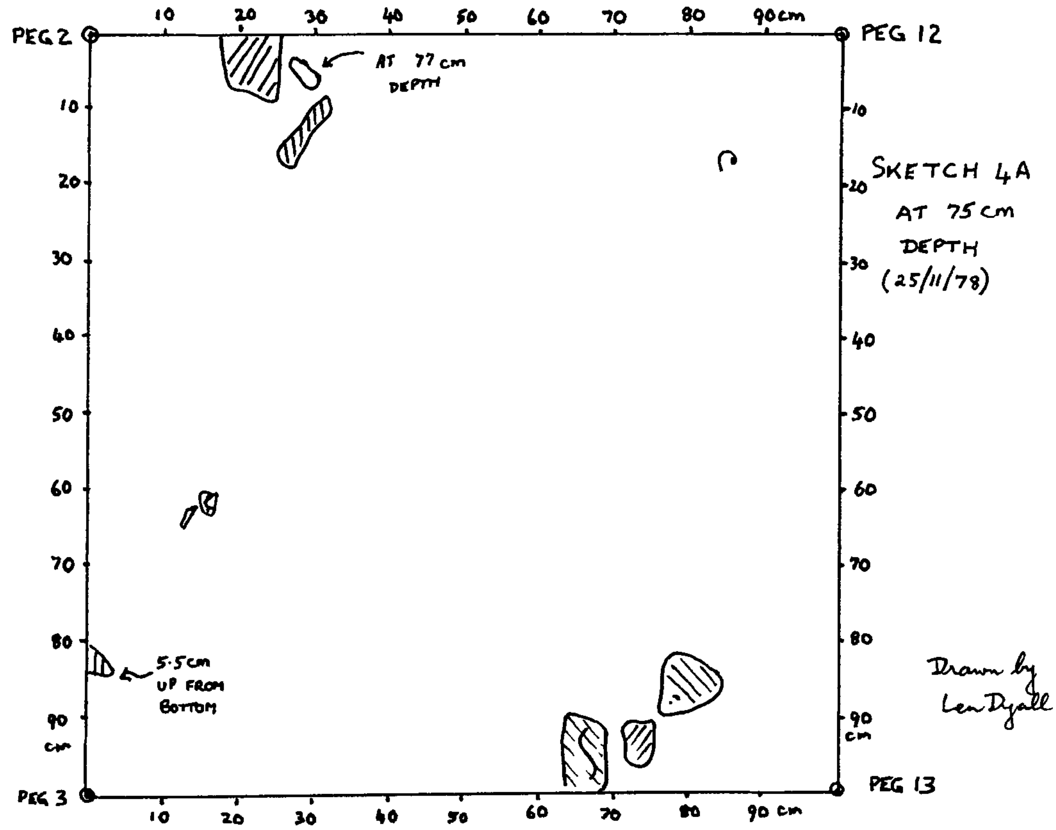


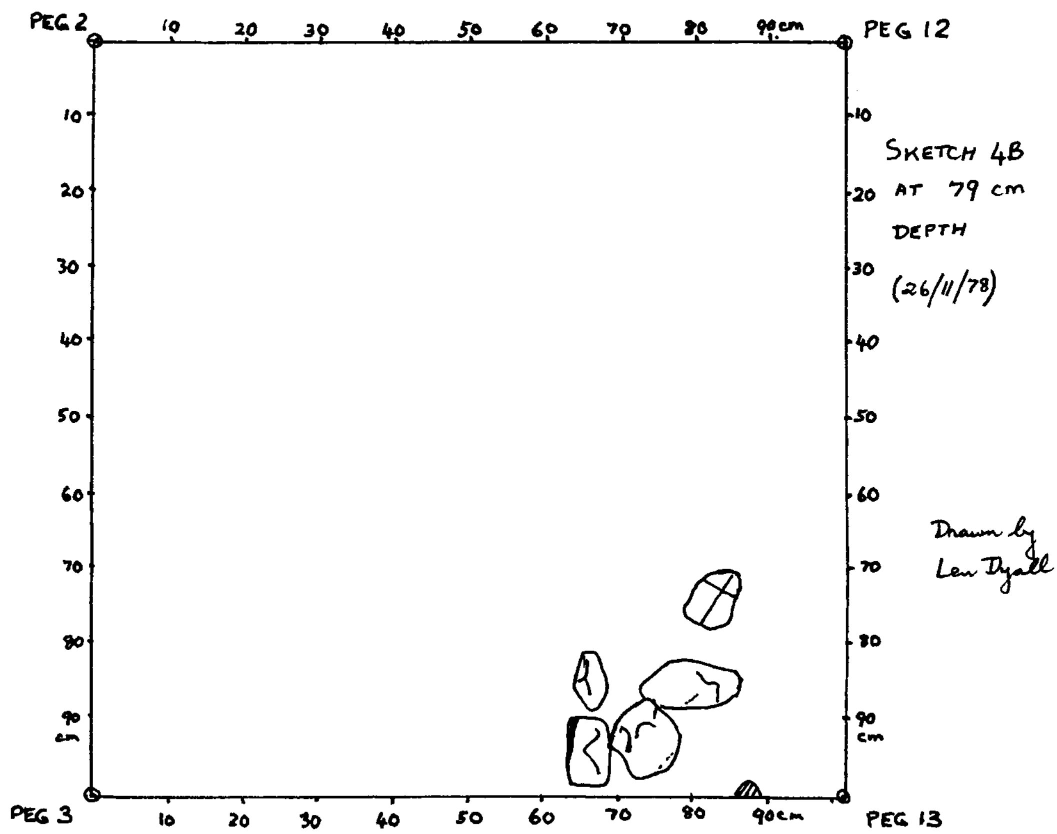
FIELD SKETCH 3: STONES IN SQUARE A2 LEVEL 5. Dated 22/11/1978.



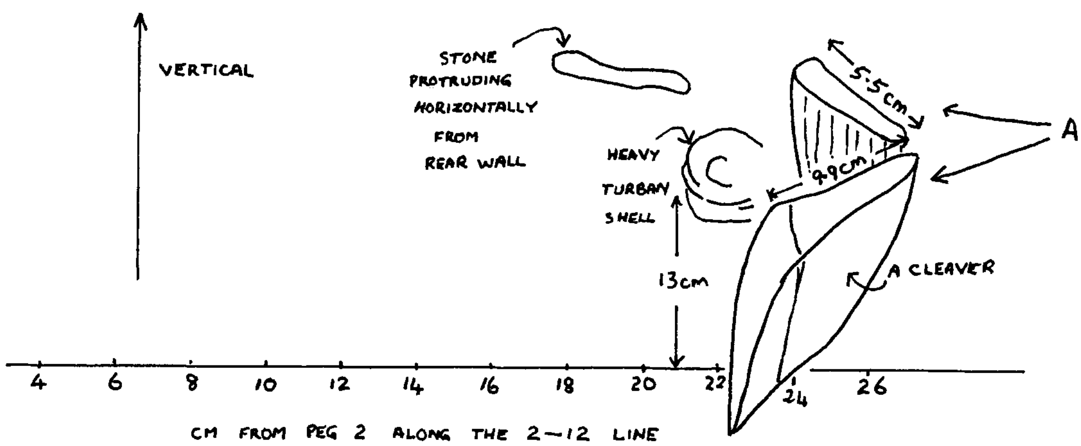
Drawn by Len Dyall

FIELD SKETCHES 4A AND 4B: STONES AT BOTTOM OF LEVEL 7 IN SQUARE A2. Dated 25/11/1978.





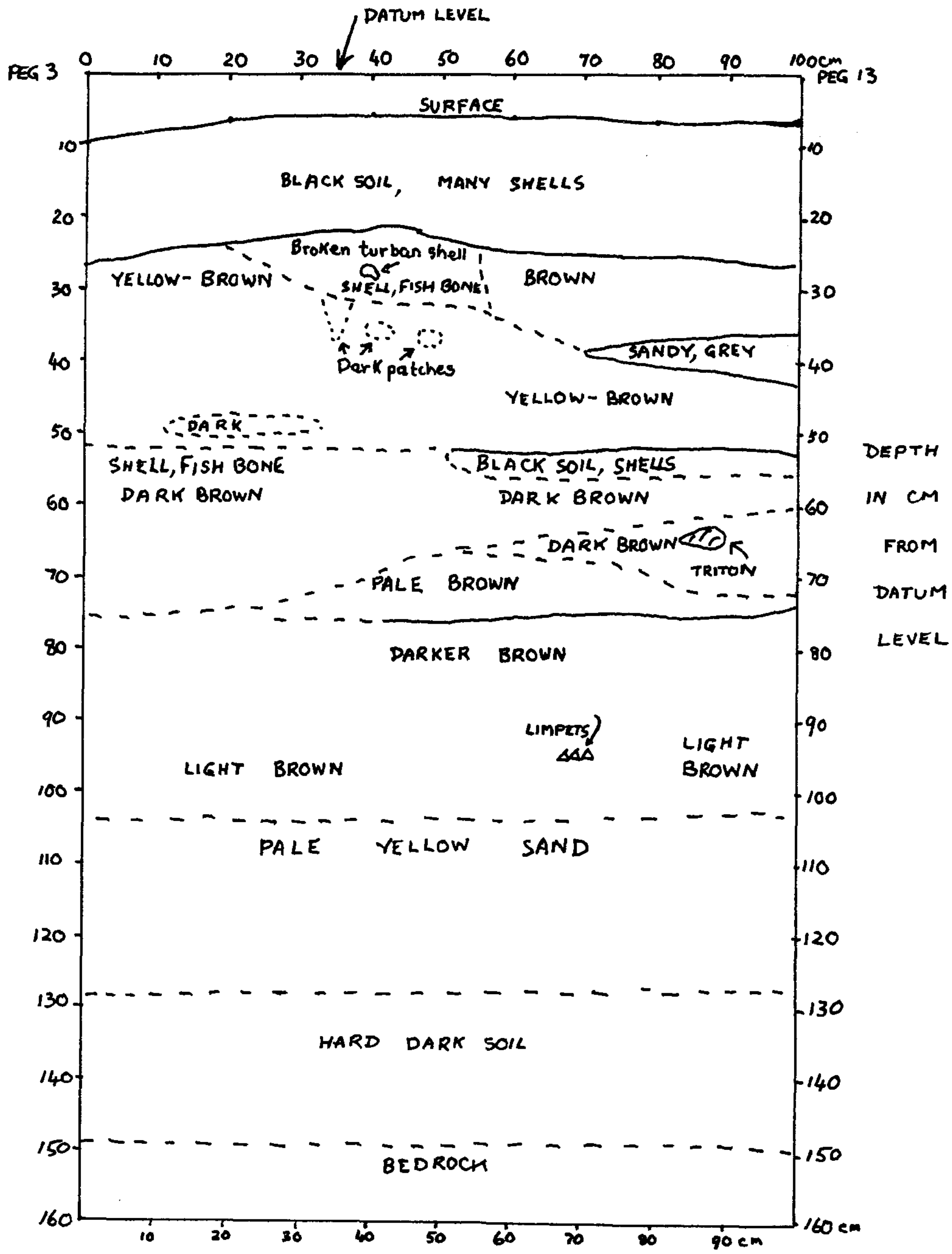
FIELD SKETCH 5: STONES IN SQUARE A2 LEVELS 7 AND 8 (?WORKBENCH). Dated 26/11/1978.



Note: The two stones labelled A were set on edge. The one further back did not reach the 85 cm level of the bottom; under it there was a small rounded pebble.

Drawn by Len Dyall

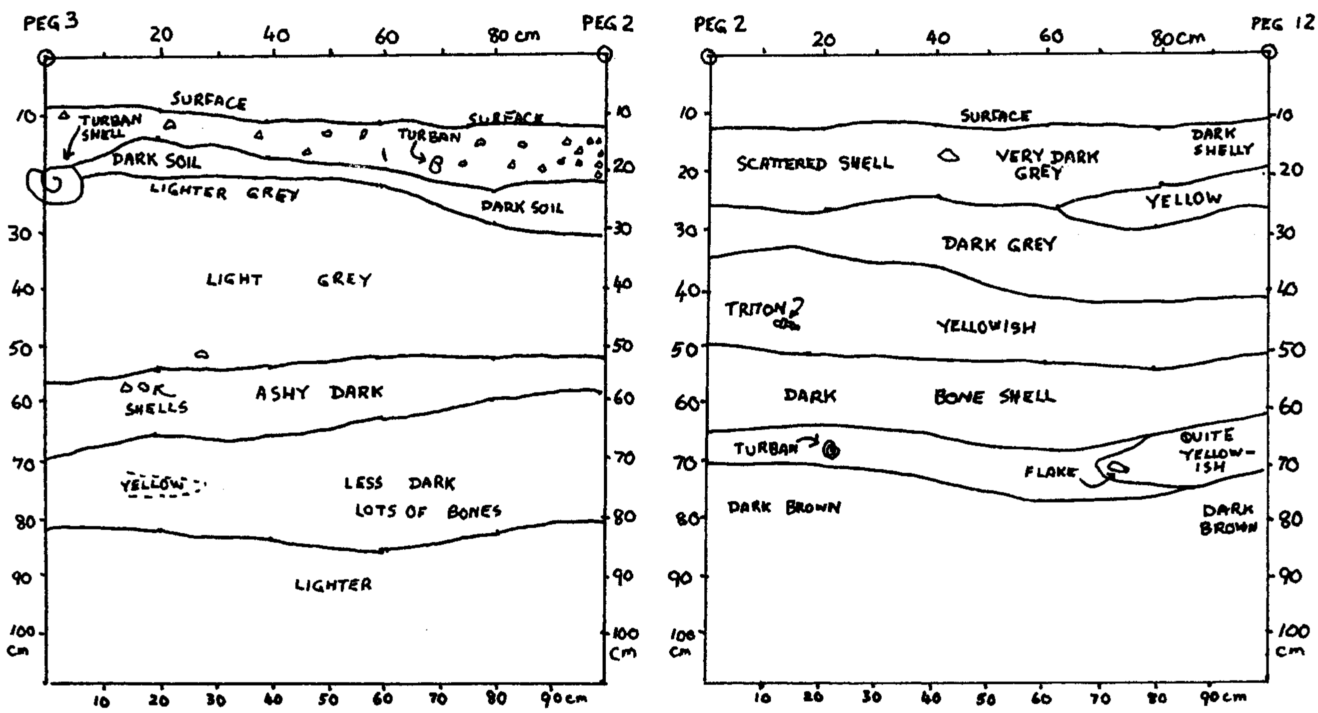
FIELD SKETCH 6A: SQUARE A2. PROFILE OF PEG 3 – PEG 13 WALL.
Dated 26/11/1978.
Depths are measured from the Datum Level. The excavation Levels were set from the surface at Peg 3 and their depths are thus 10 cm less than those shown above.
Interfaces of strata were extremely vague in most cases – these are shown with dashed lines.



Drawn by Len Dyall

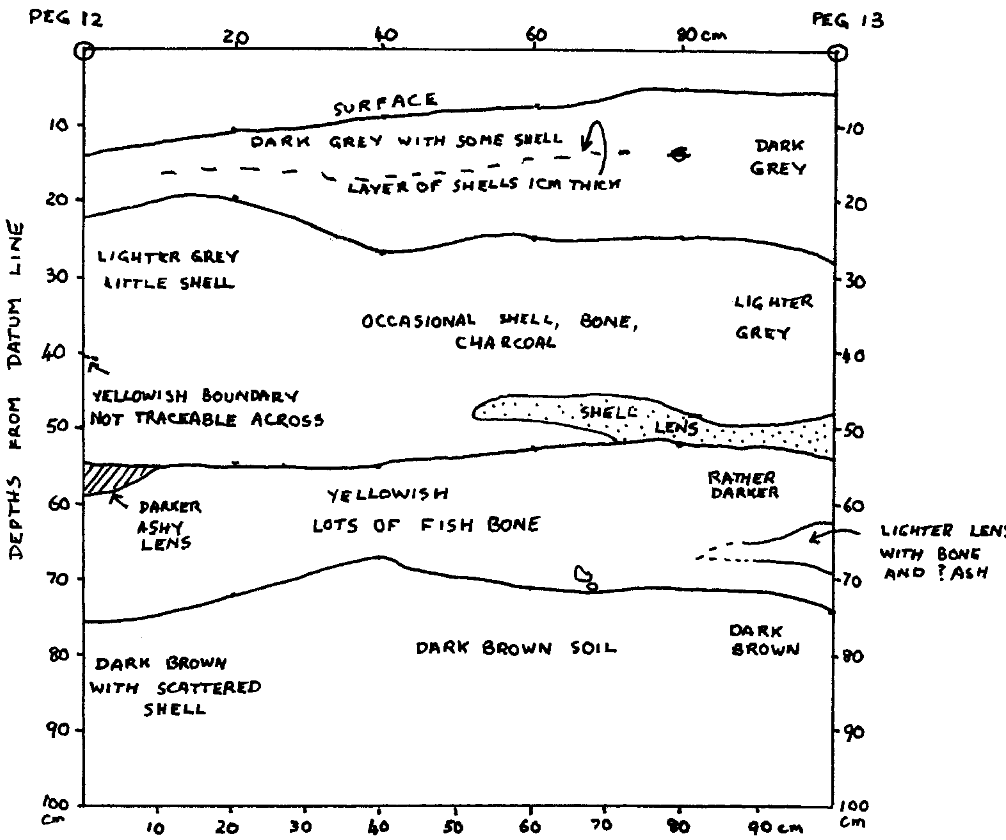
FIELD SKETCH 6B: SQUARE A2. PROFILES OF 2-3 AND 2-12 WALLS (TO 85 CM DEPTH). Dated 2/12/1978.

The mis-matches of strata recorded at Peg 2 are surprising, and may be due to drying-out of the strata between the times each sketch was made. See Field Sketch 13 dated 9/12/1978 for other versions of the strata at Pegs 2 and 3, and Field Sketch 12 for those at Peg 12.



Drawn by Len Dyall

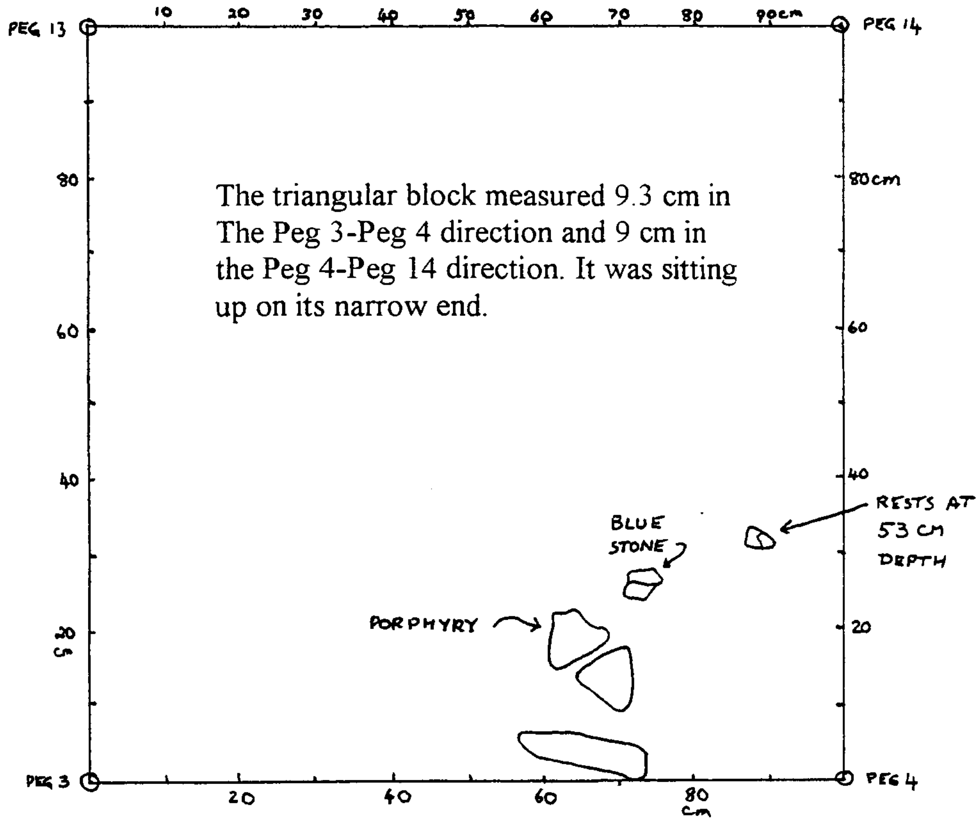
FIELD SKETCH 7: SQUARE A2. REAR DATUM PROFILE.
Dated 2/12/1978.



Drawn by Len Dyall

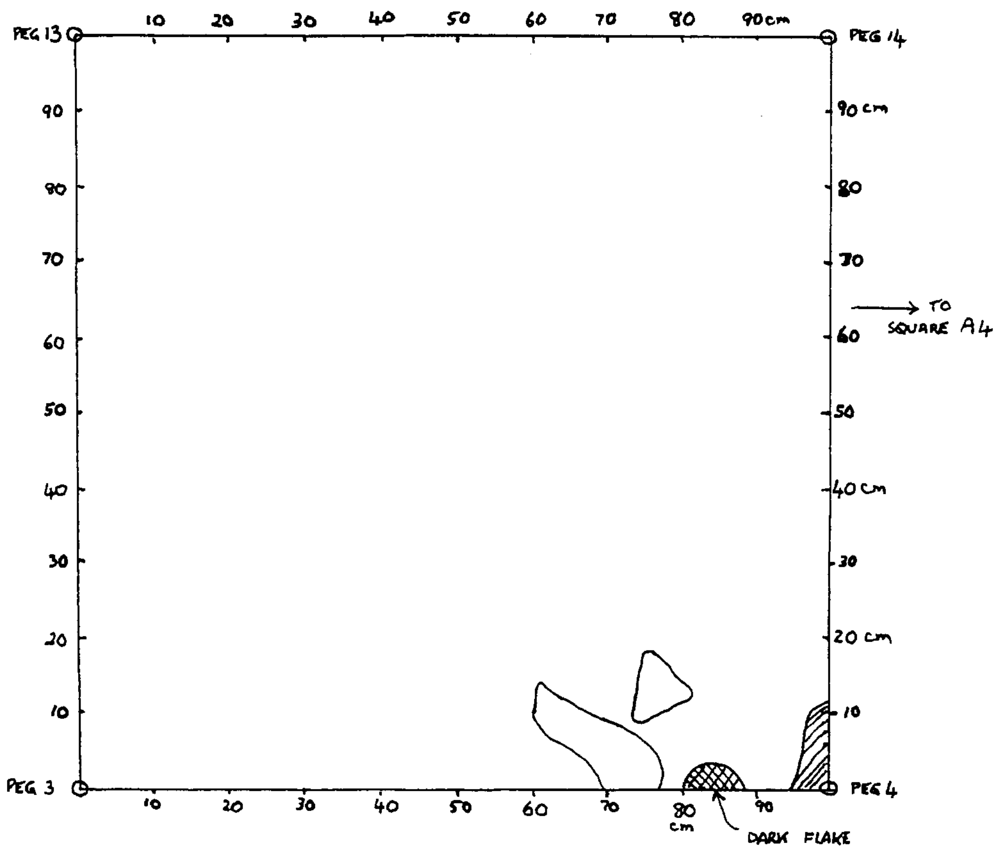
FIELD SKETCH 8A: SQUARE A3. STONES RESTING AT 46-47 CM DEPTH.
Dated 2/12/1978.

Drawn by
Len Dyall

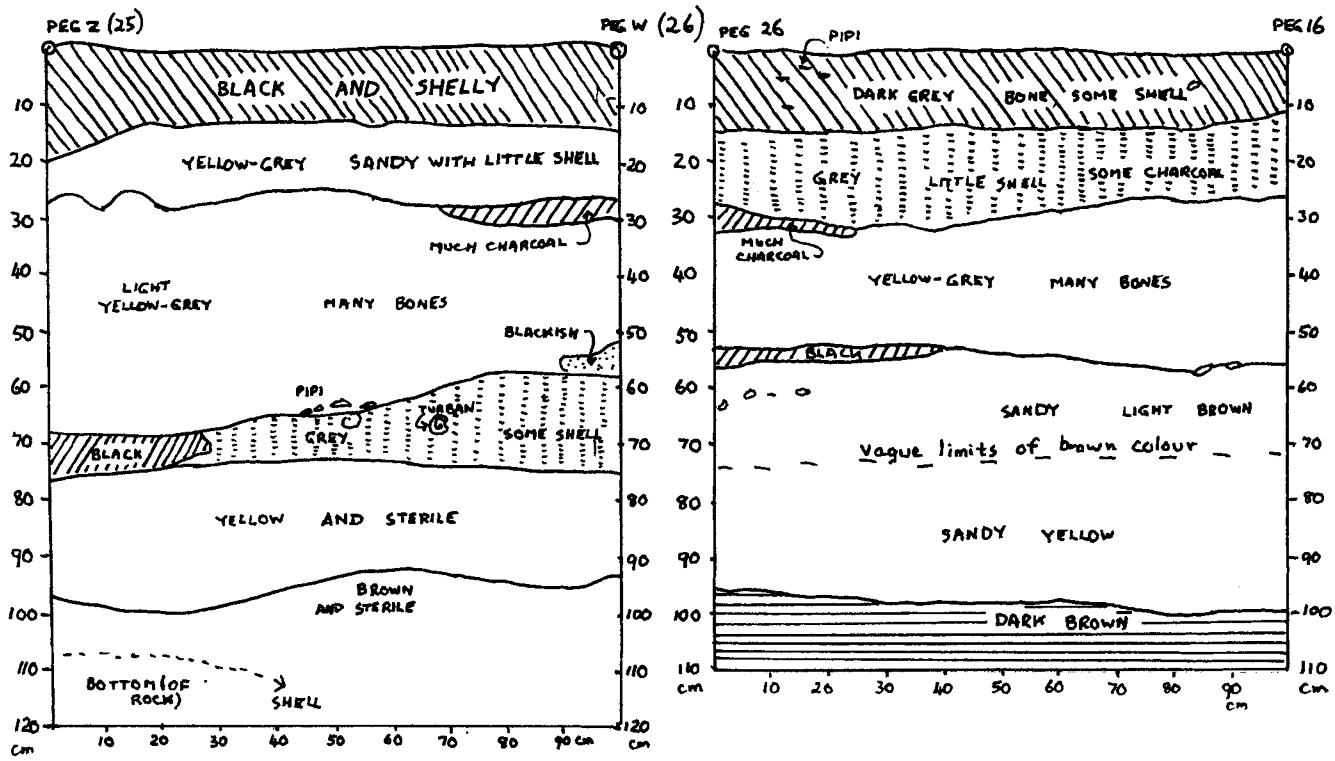


FIELD SKETCH 8B: SQUARE A3. STONES AT 55 CM DEPTH.
Dated 2/12/1978.

Drawn by
Len Dyall

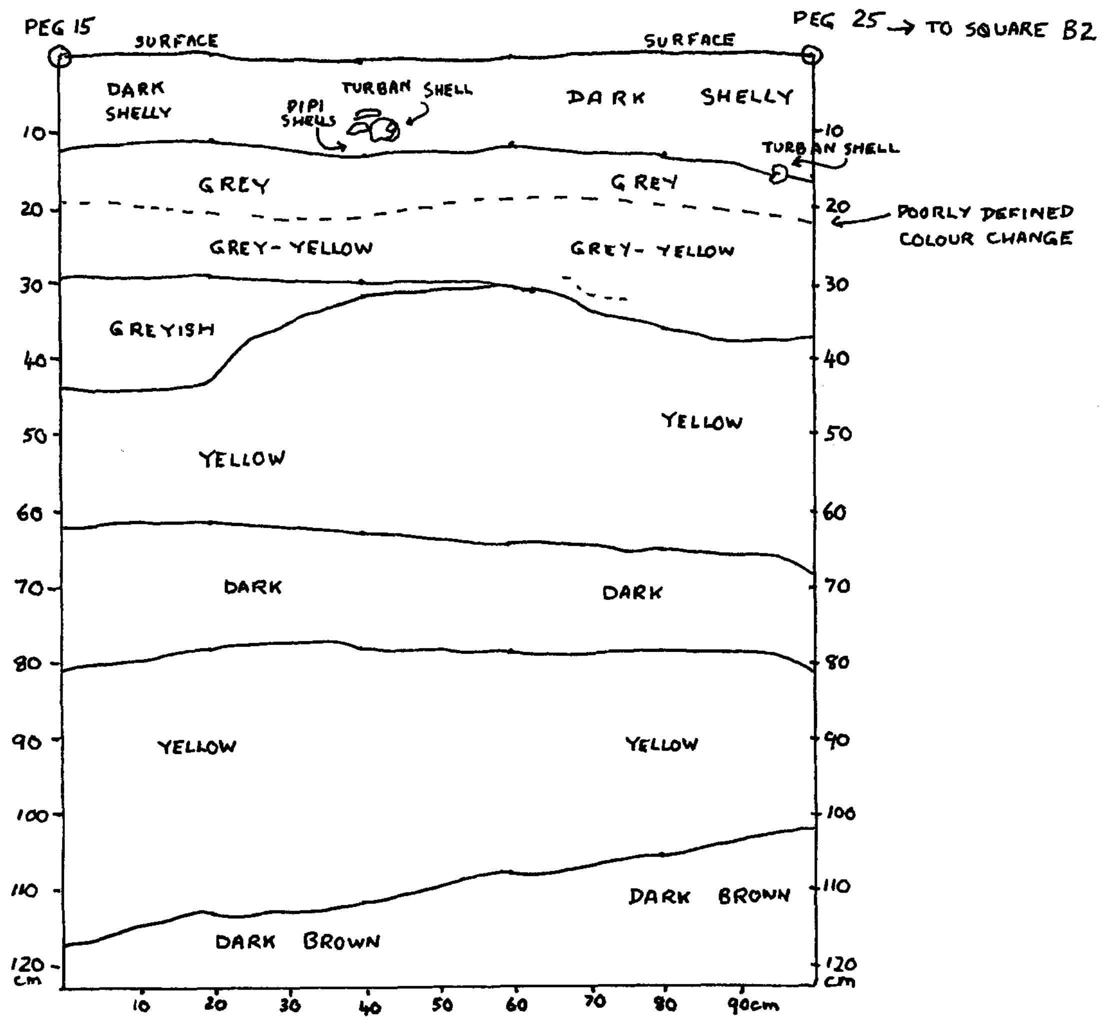


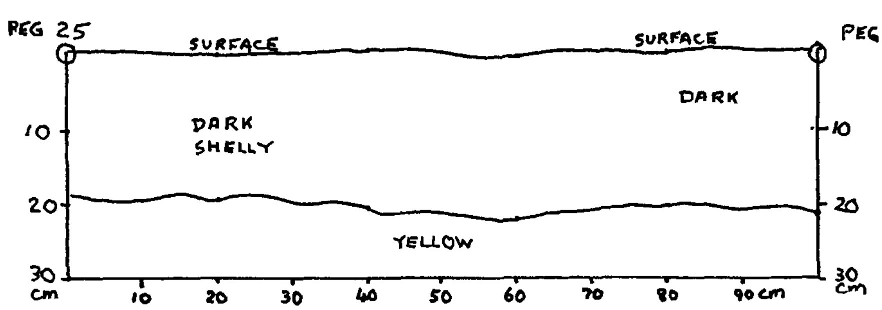
FIELD SKETCH 9: SQUARE B1. PROFILES OF 25-26 AND 26-16 WALLS.
Dated 3/12/1978.



Drawn by Len Dyall

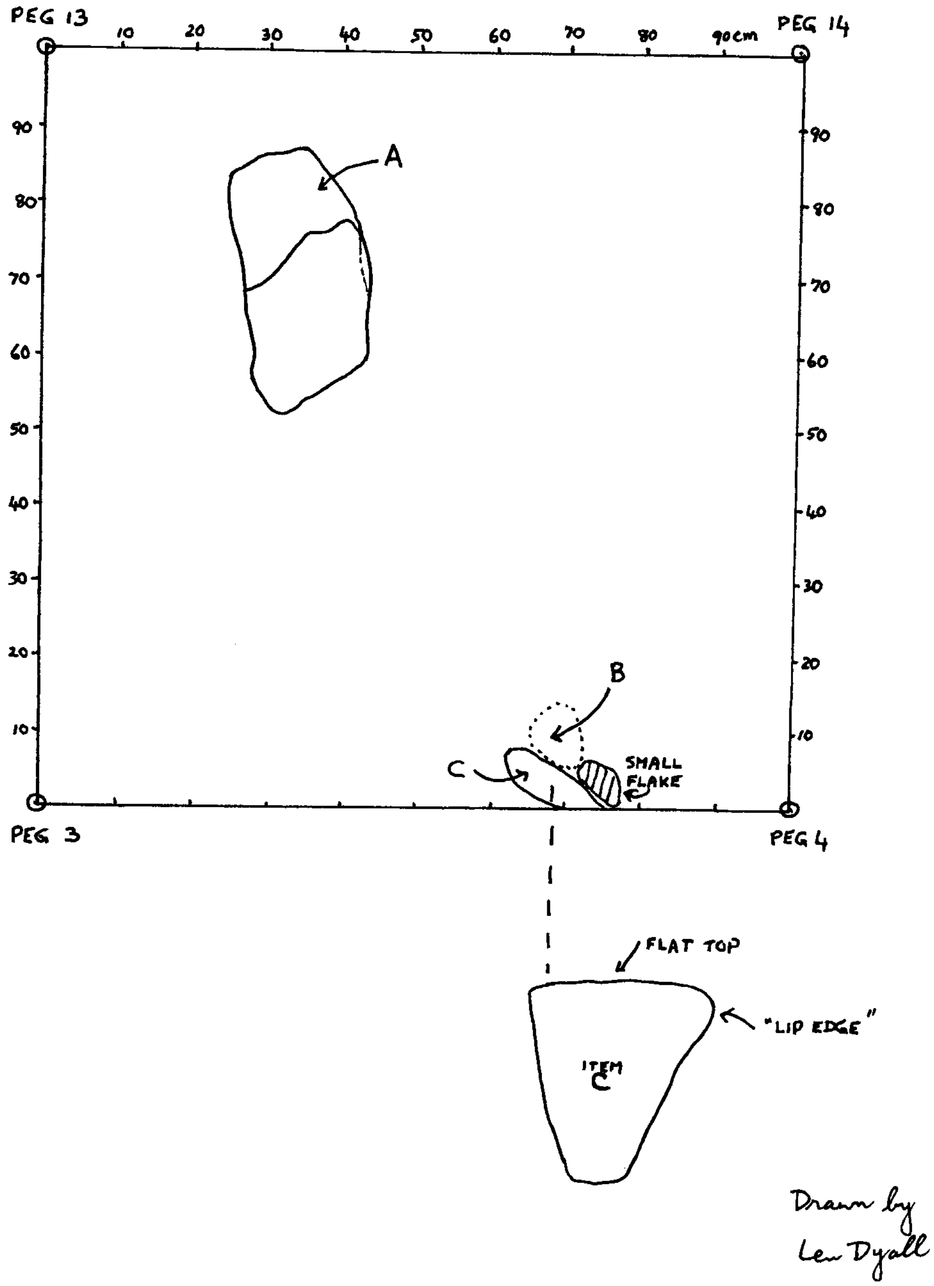
FIELD SKETCH 10: SQUARE B1. WALL PROFILE (PEG 15→Peg 25).
Includes the wall profile from Peg 25 to Peg 35 for Square B2 (which was only partly dug).
Dated 10/12/1978.





Drawn by Len Dyall

FIELD SKETCH 11: SQUARE A3. STONES AT BOTTOM OF LEVEL 7.
Dated 3/12/1978.

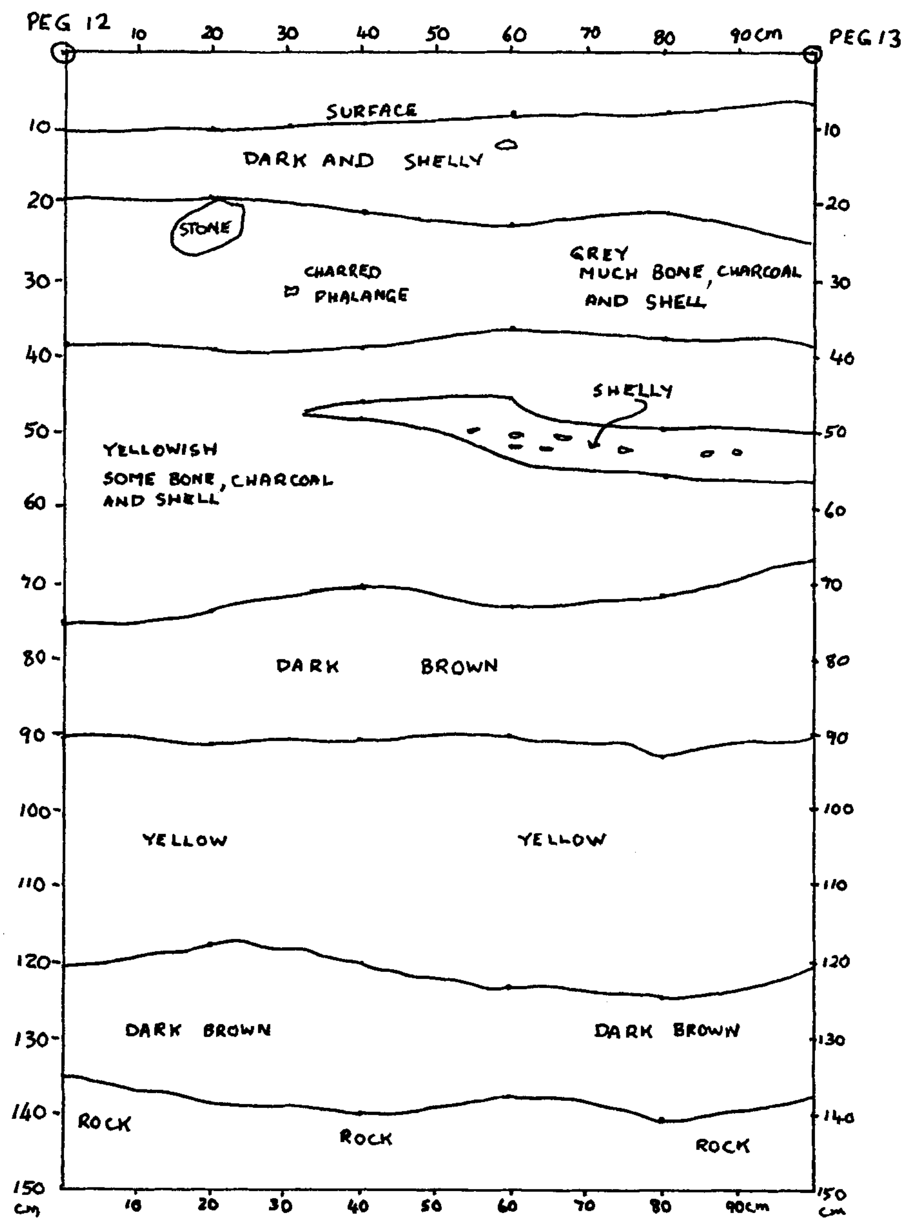


Notes

A is a thin slab resting on 71.0 cm depth (from the surface).
B is a long narrow cobble. When first uncovered, it rested on a narrow tip and presented a flat top. The tip rested at depth 69.5 cm, and the top was 4 cm above the top of the other cobble **C**. The centre of **B** was 32 cm from the Peg 4 to Peg 14 line. This cobble **B** had fallen over before this sketch was made.
C had a "lip edge" which was buried in the Datum wall. The tip of **C** rested at 67 cm depth (from the surface).

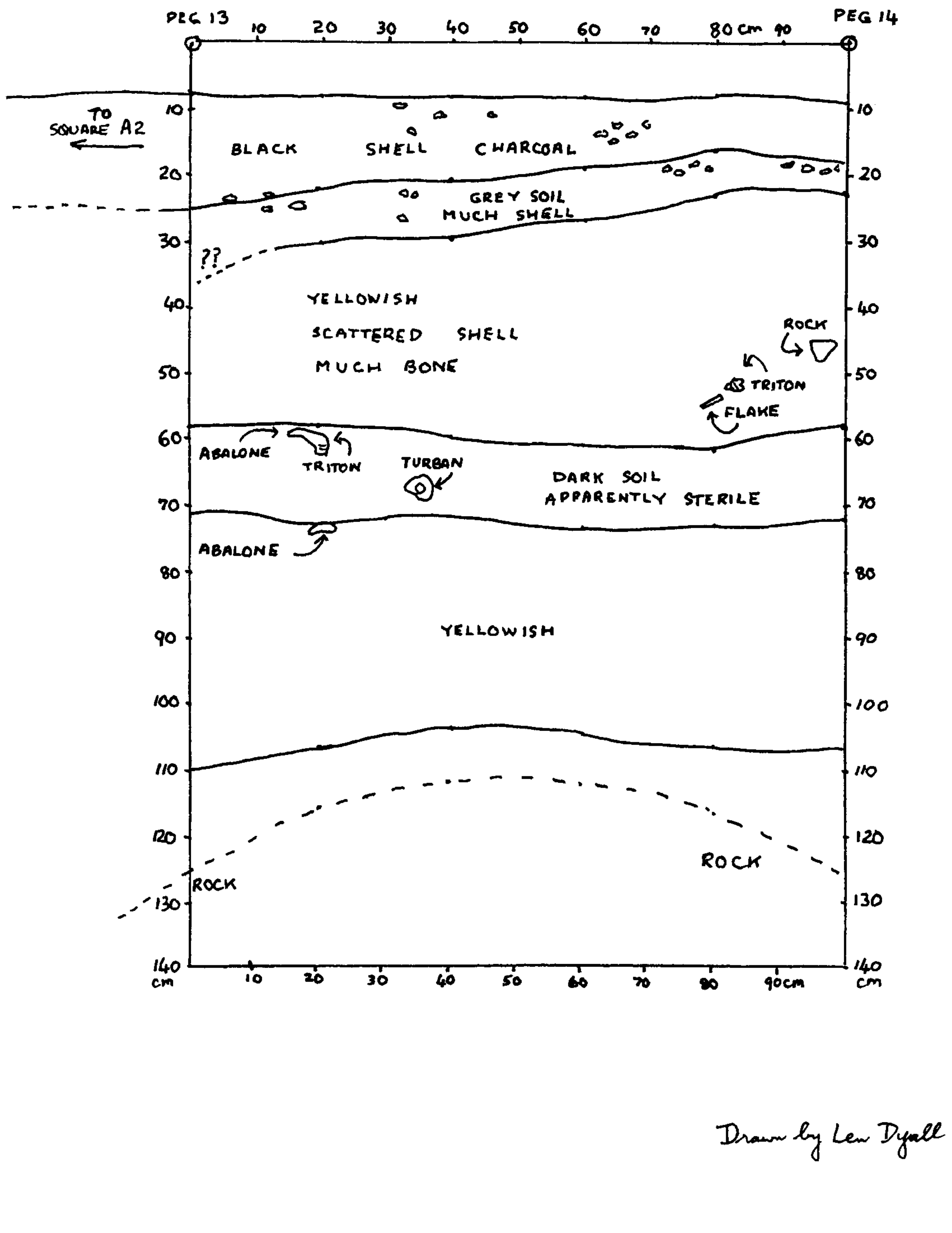
<u>Thought</u>: The pair of cobbles near Peg 4 may be a "work bench".

FIELD SKETCH 12A: SQUARE A2. REAR DATUM WALL.
Dated 9/12/1978.

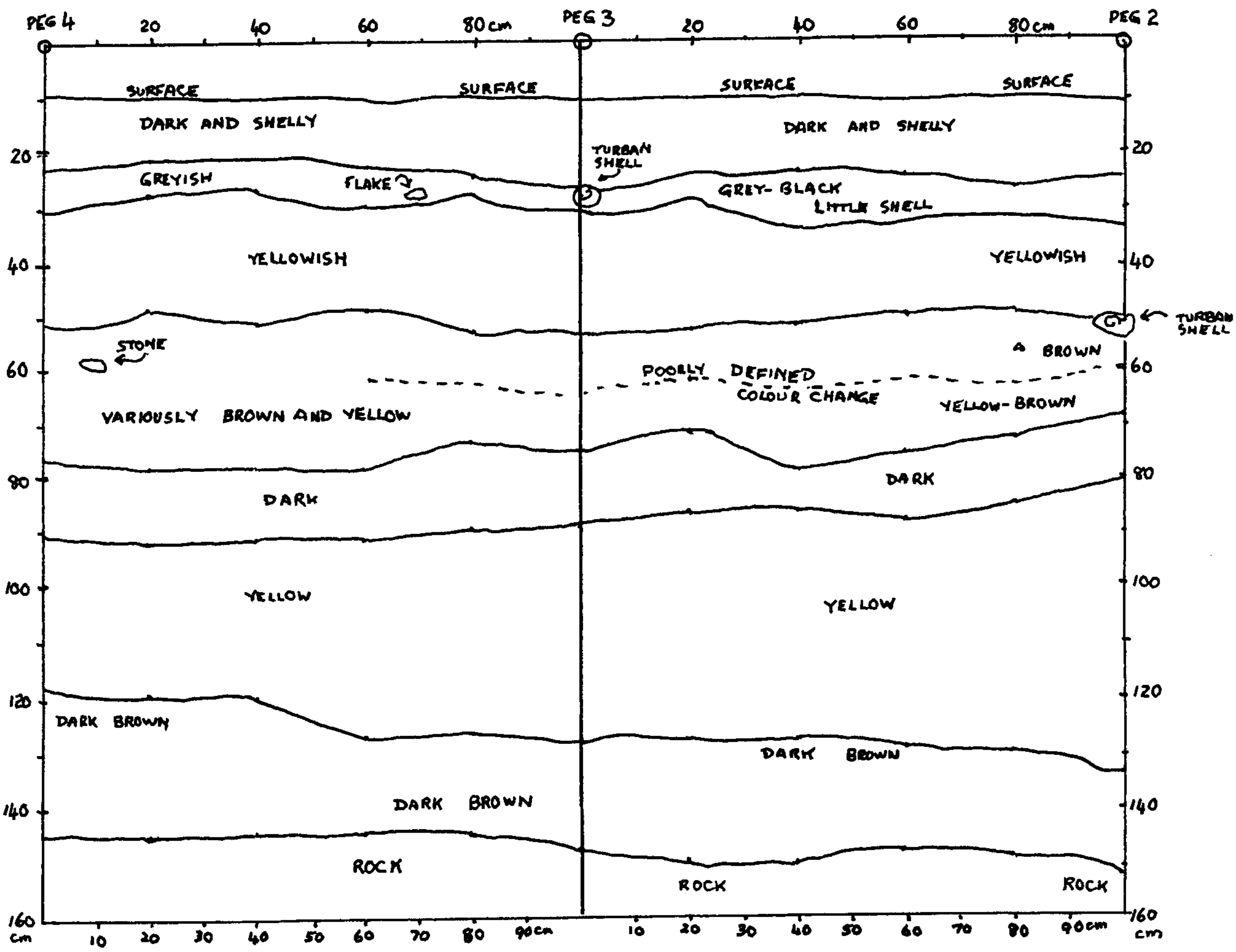


Drawn by Len Dyall

FIELD SKETCH 12B: SQUARE A3. REAR DATUM PROFILE.
Dated 9/12/1978. There was difficulty in distinguishing strata boundaries at the deeper levels. Note that the trench was too cramped for uncovering the rock bottom all at once. Depths of this bottom were obtained by probing.

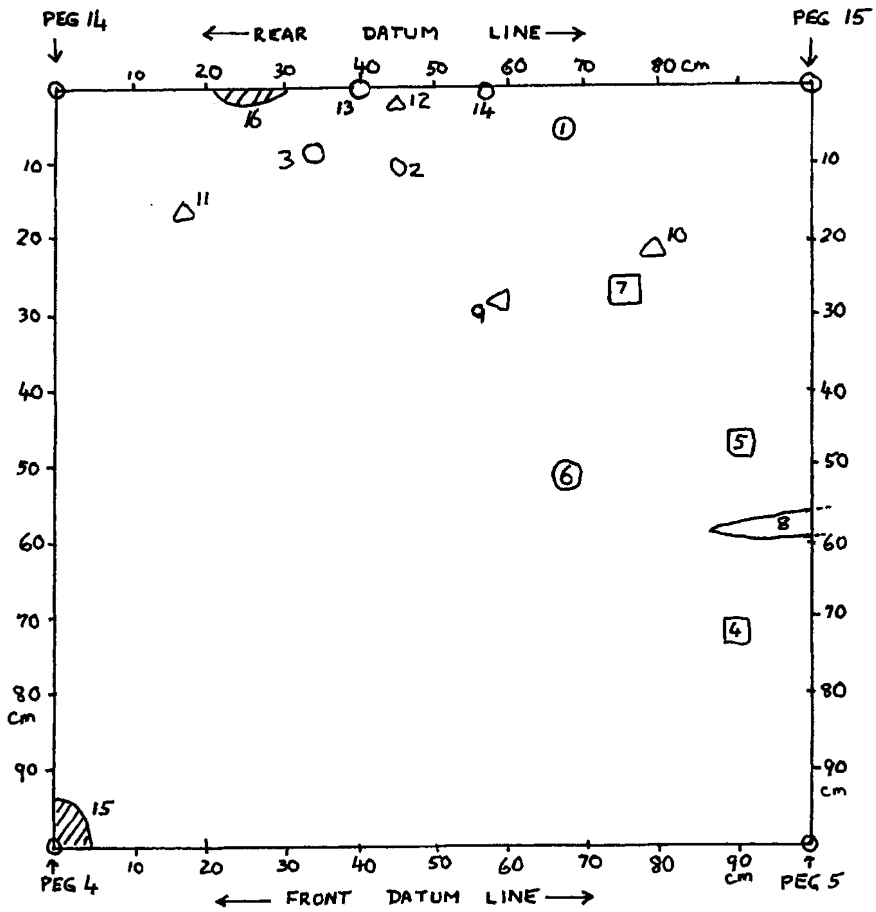


FIELD SKETCH 13: SQUARES A2 AND A3. PROFILE OF FRONT DATUM WALL.
Dated 9/12/1978. Note that the lip of the trench crumbled somewhat.
Depths are measured from the Datum Line (not the surface).



Drawn by Len Dyall

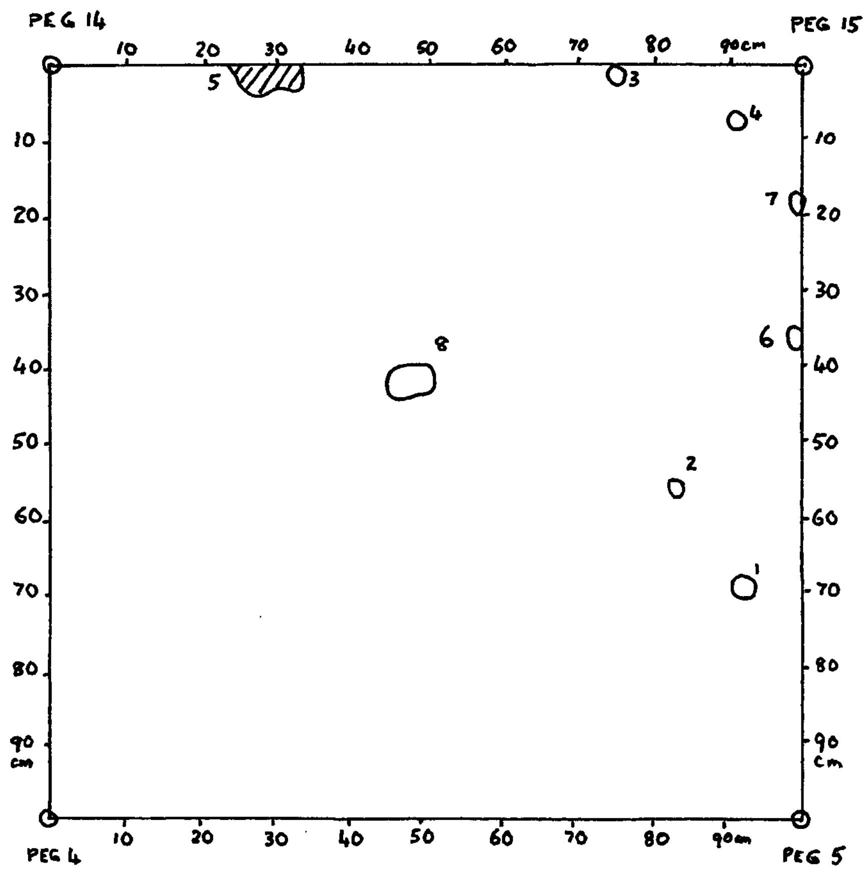
FIELD SKETCH 14A: SQUARE A4. LEVEL 5 STONE SCATTER.
Dated 2/12/1978. Drawn by John and Carol Davies.



Item number	Depth (cm)	Item number	Depth (cm)
1. Round pebble	53	9. Flat flake	54
2. Round pebble	52	10. Flat flake	54
3. Round pebble	51	11. Flake	49
4. Heavy slice	49	12. Porphyry flake	45
5. Small slab	47	13. Pebble[A]	52
6. Round pebble	55	14. Round pebble	54
7. Flat slab	48	15. Broken rock	54
8. Pointed stone[B]	47.5	16. Large cobble[C]	42

A There are two more pebbles alongside (and slightly deeper) than item 13 (see Diagram **4-6** on page 165).
B This stone was 135 mm long.
C This cobble extended below the bottom of Level 5.

FIELD SKETCH 14B: SQUARE A4 LEVEL 6. STONE SCATTER.
Dated 9/12/1978.

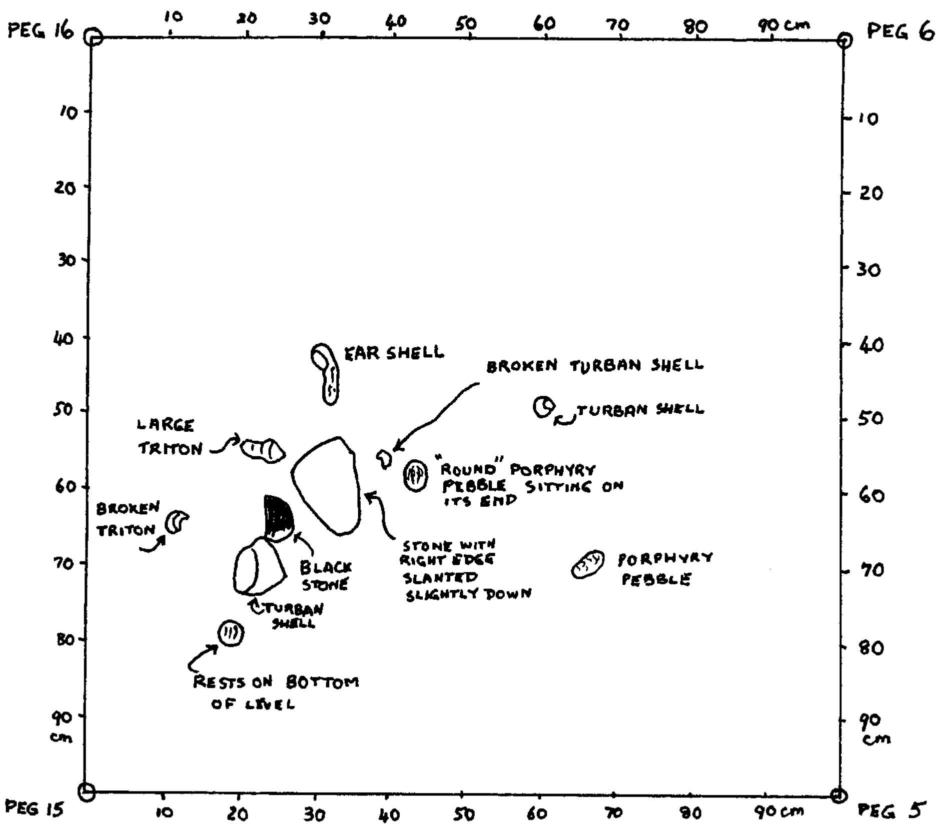


Item number	Depth (cm)	Item number	Depth (cm)
1. Round stone	57	5. Slab[A]	See footnote A
2. Round stone	57	6. Rounded pebble	63
3. Round pebble	58	7. Pebble	65
4. Round pebble	59	8. Small flattish slab	65[B]

A This slab stood on its end and extended down into the next Level.
B This slab measured 100x55x35 mm. It was treated as belonging in Level 7.

Drawn by Len Dyall

FIELD SKETCH 15: SQUARE A5. LEVEL 6 STONES.
Dated 10/12/1978.
These stones are exposed approximately 4 cm above the bottom of this Level.

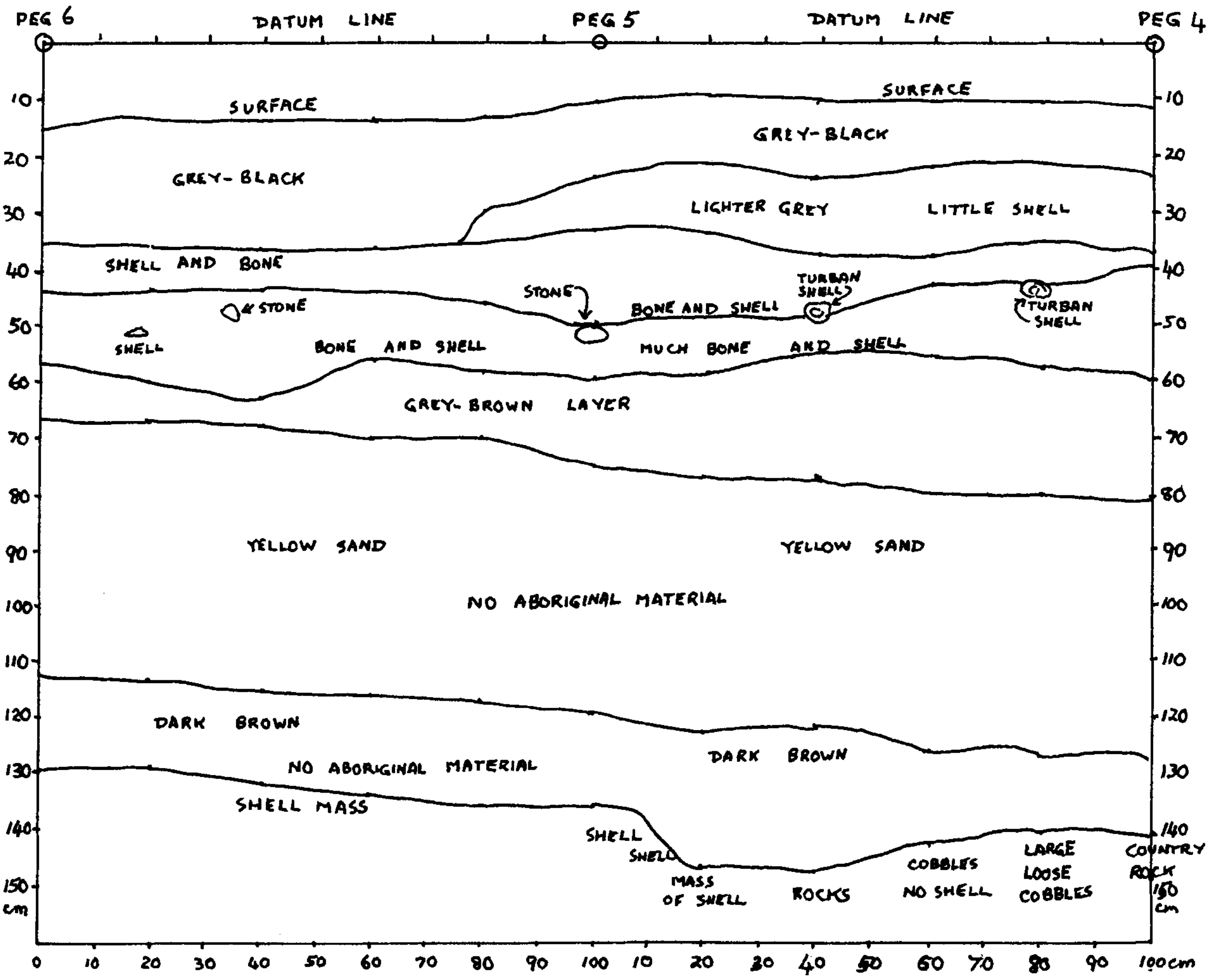


Drawn by Len Dyall

FIELD SKETCH 16: SQUARES A4 AND A5. PROFILE OF FRONT DATUM WALL.
Dated 10/12/1978.

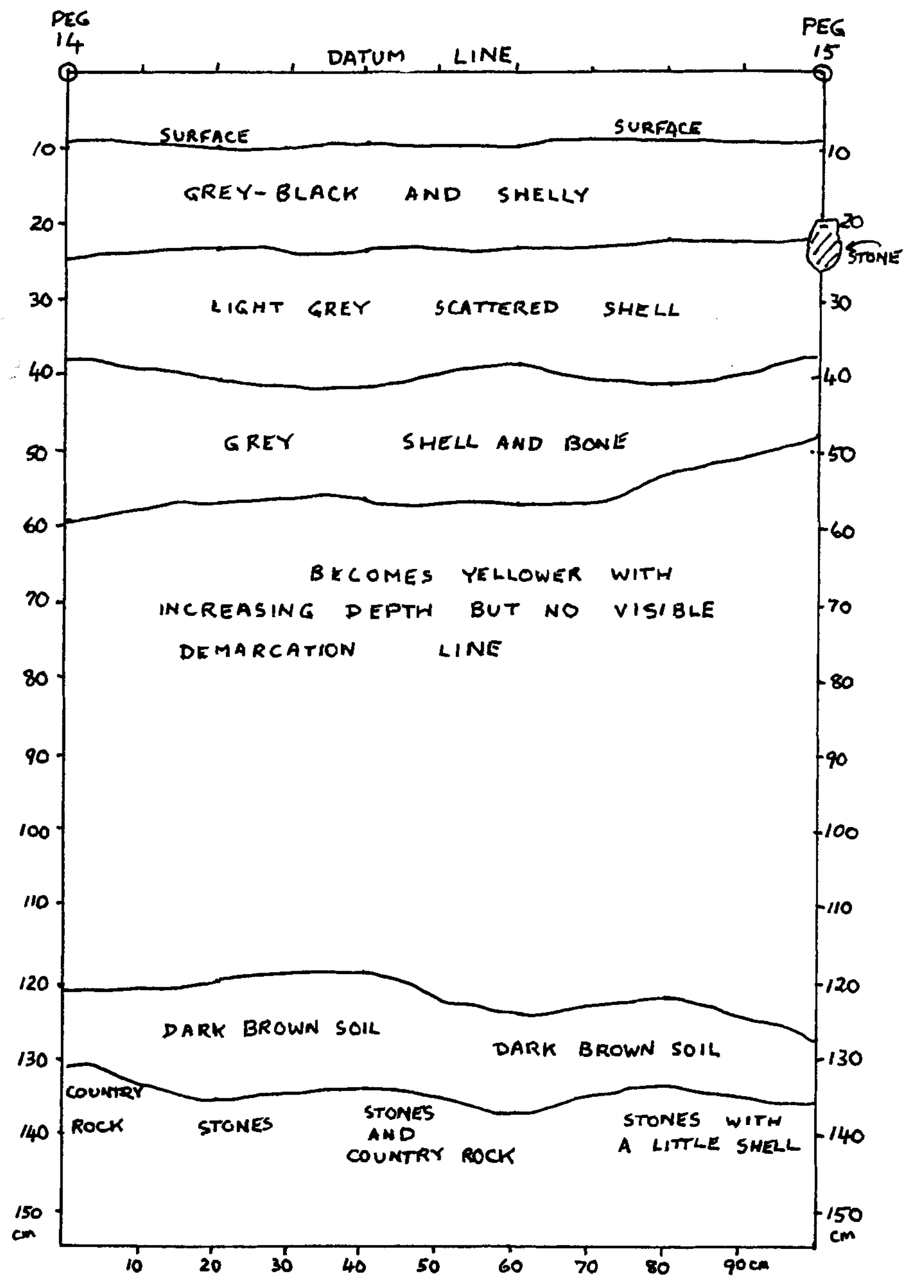
Notes.

1. The lip of the tench was by this time much broken down.
2. Due to wet weather, the colours of the strata were ill-defined.
3. The top of the shell mass/cobble layer was a black peat (2-3 cm thick) which permeated the layer below it.
4. It is doubtful if "bedrock" was reached – some of the "cobbles" were boulder-sized.



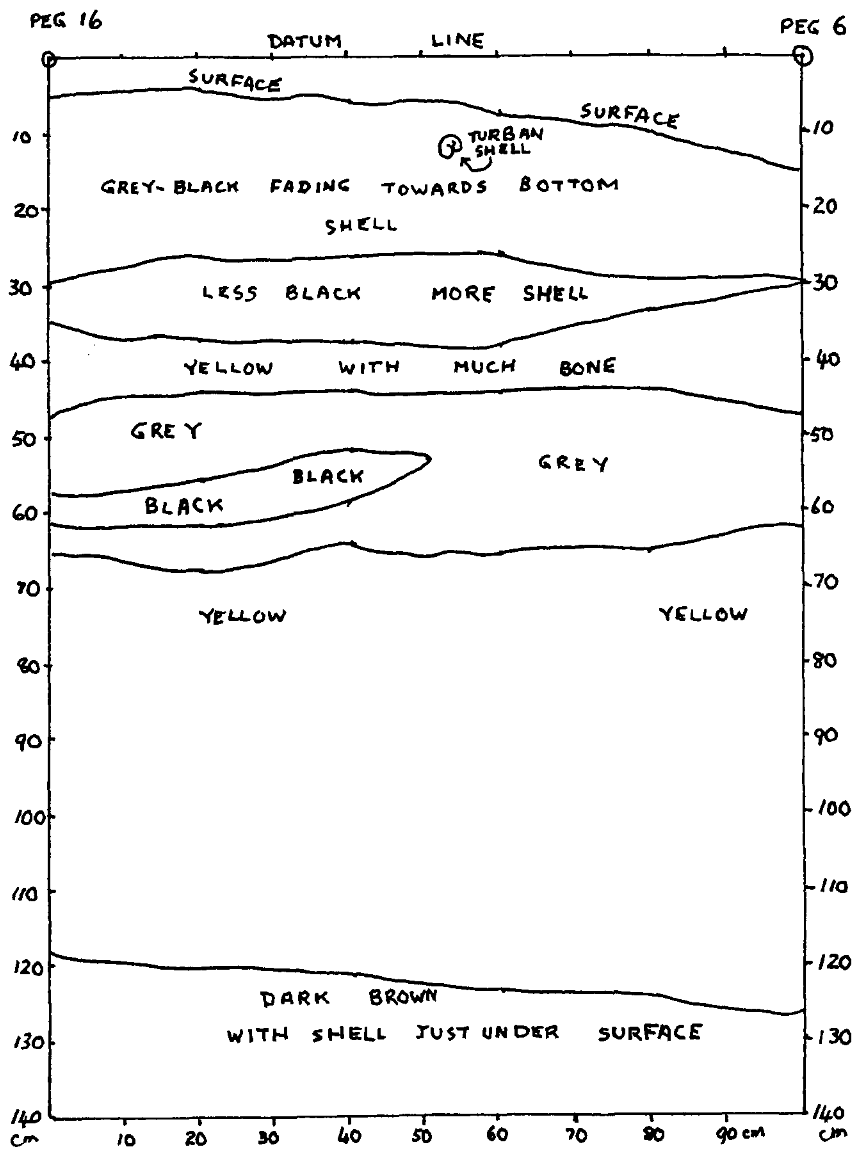
Drawn by Len Dyall

FIELD SKETCH 17: SQUARE A4. REAR DATUM PROFILE.
Dated 10/12/1978.



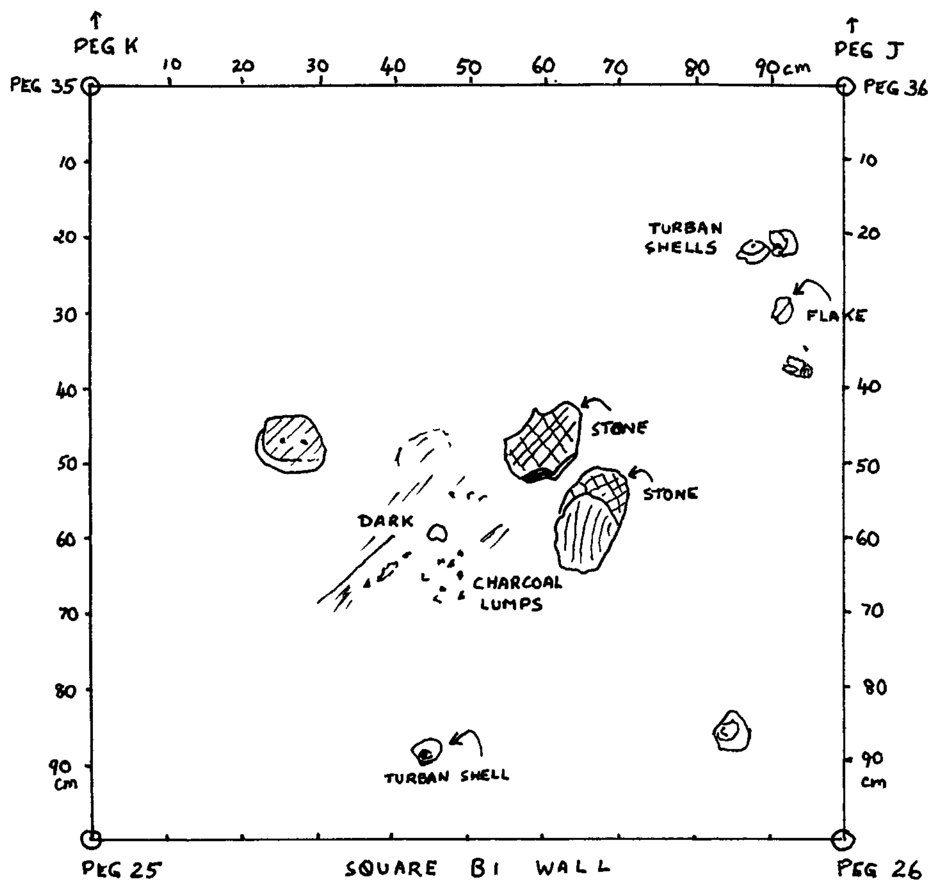
Drawn by Len Dyall

FIELD SKETCH 18: SQUARE A5. PROFILE OF 6-16 WALL.
Dated 10/12/1978.
<u>Note</u>: Due to a nearby sand stockpile it was unsafe to dig deeper for the rock bottom.



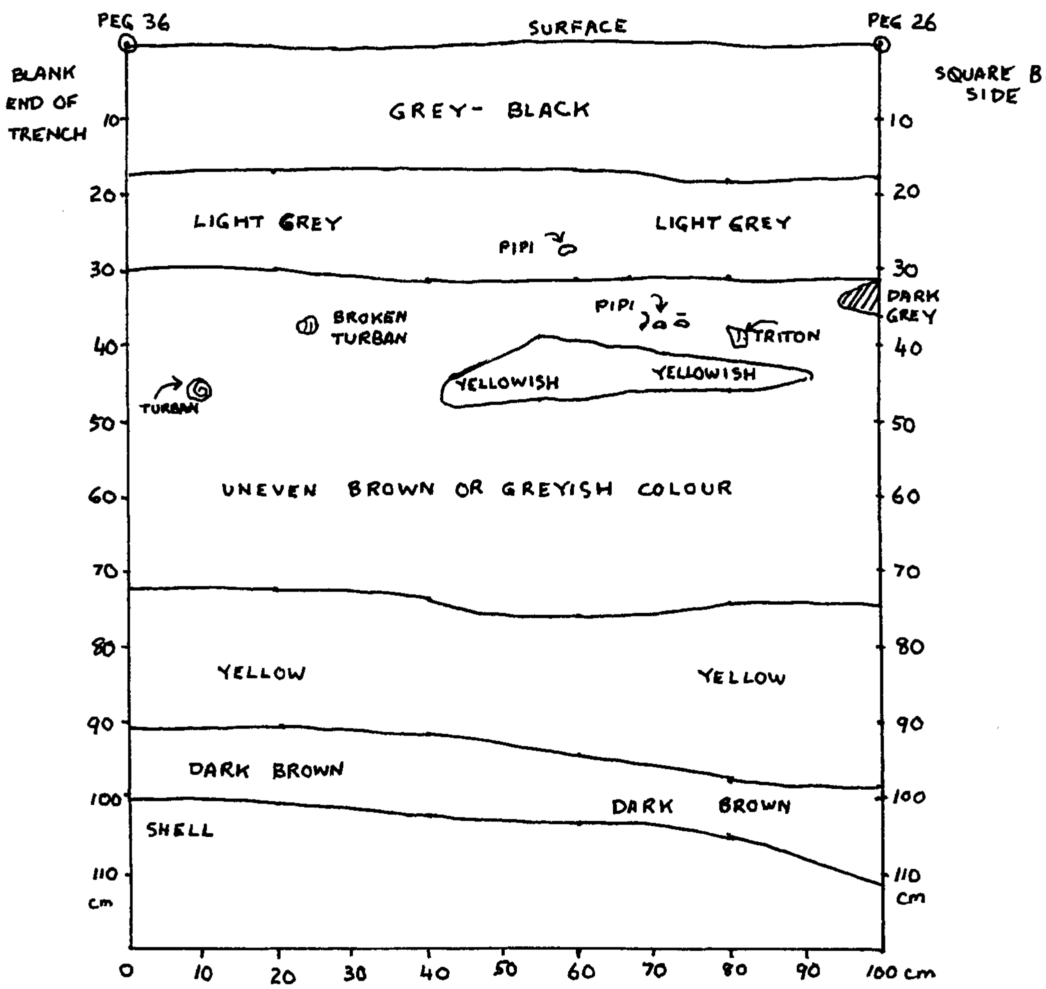
Drawn by Len Dyall

FIELD SKETCH 19: SQUARE B2. HEARTH AT BOTTOM OF LEVEL 3.
Dated 10/12/1978.



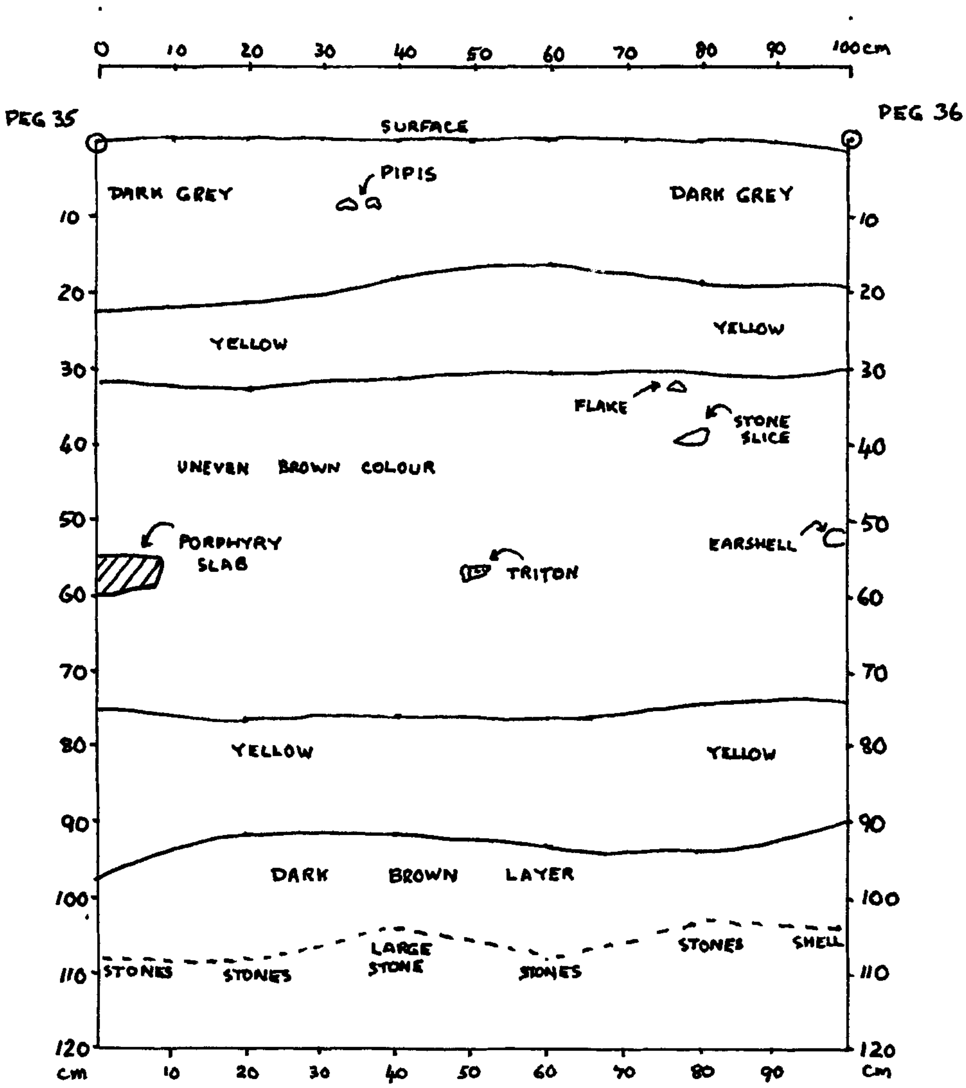
Drawn by Len Dyall

FIELD SKETCH 20: SQUARE B2. PROFILE OF 36-26 WALL.
Dated 15/12/1978.
Note: The soil was very wet and the colours were hard to pick.



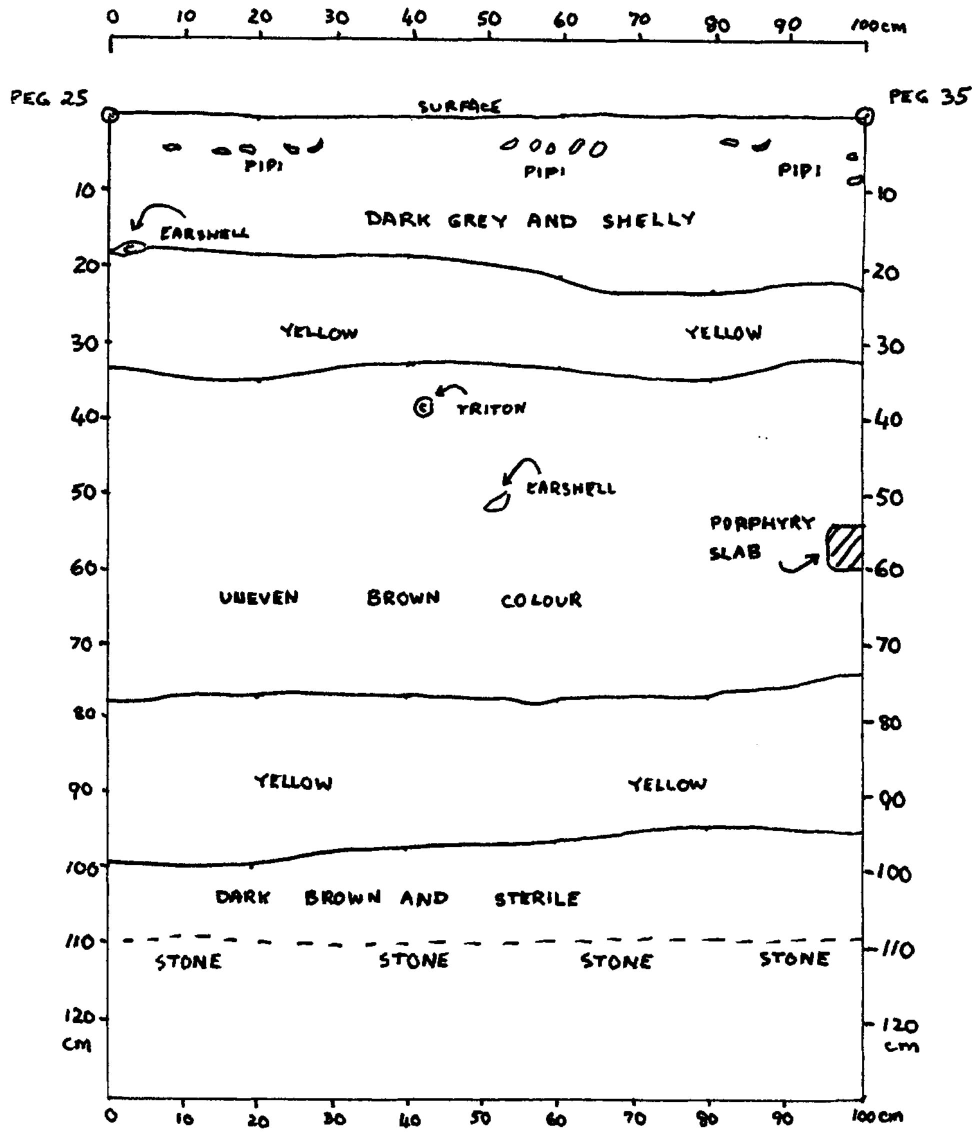
Drawn by Len Dyall

FIELD SKETCH 21A: SQUARE B2 PROFILE. PEG 35 TO PEG 36. Dated 15/12/1978.



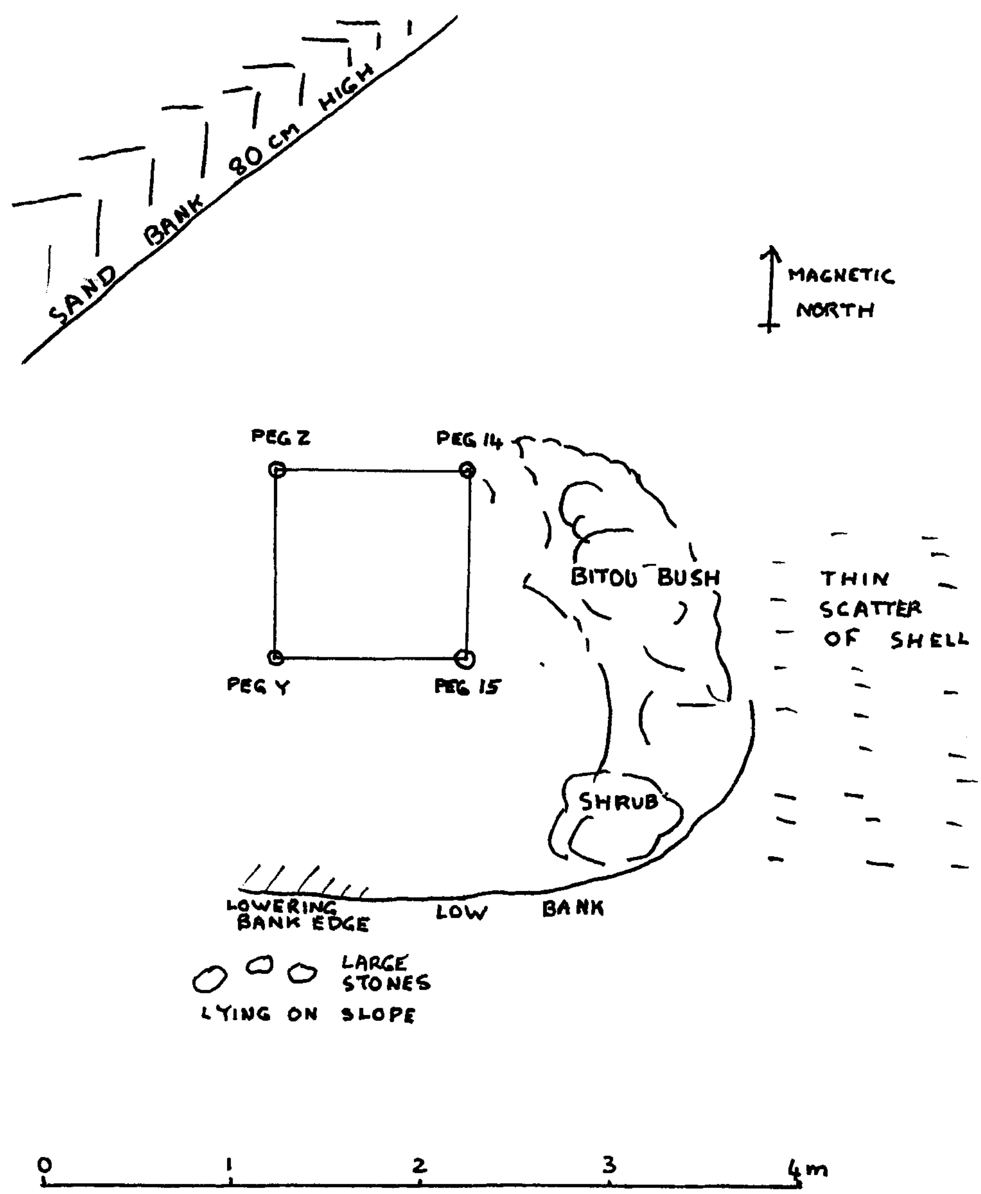
Drawn by Len Dyall

FIELD SKETCH 21B: SQUARE B2 PROFILE. PEG 25 TO PEG 35. Dated 15/12/1978.



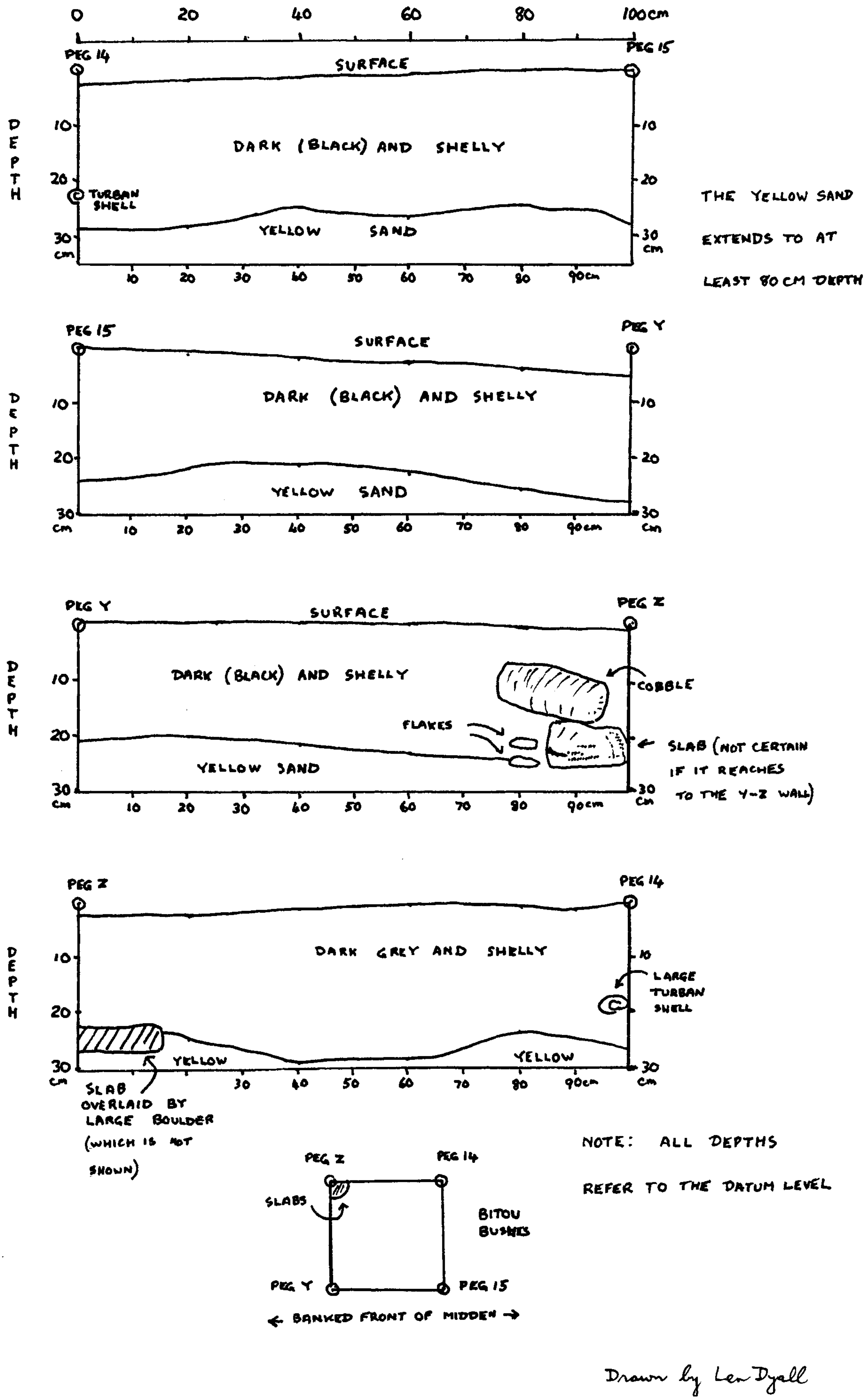
Drawn by Len Dyall

FIELD SKETCH 22: LOCALITY OF SQUARE C1. Dated 15/12/1978.

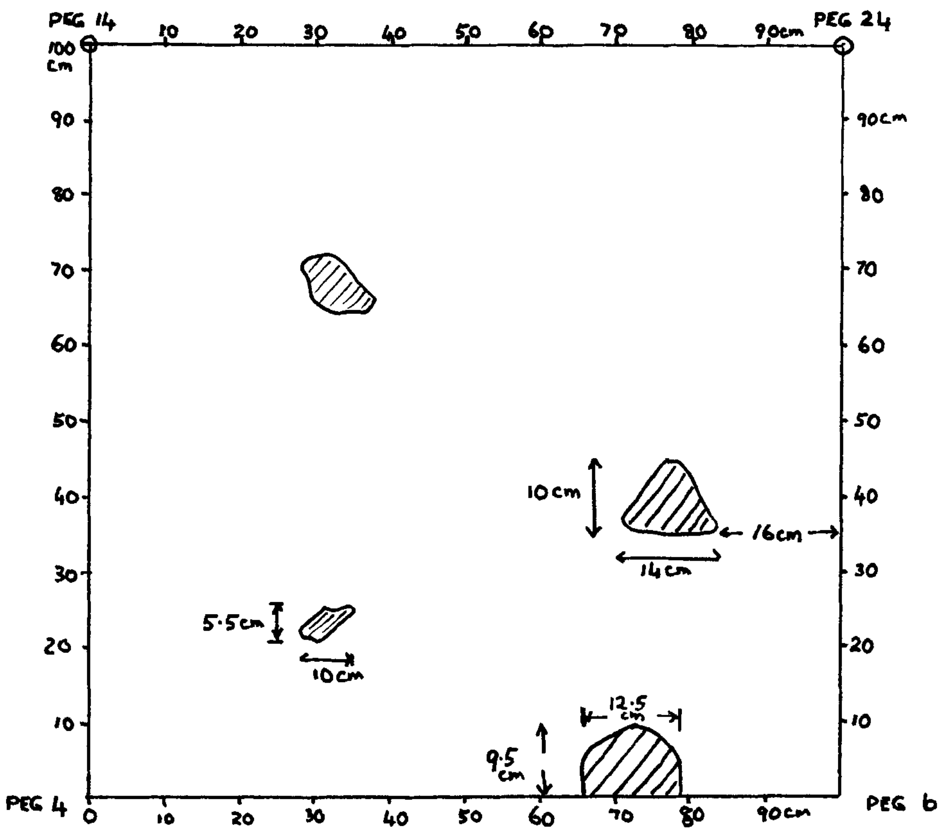


Drawn by Len Dyall

FIELD SKETCH 23: SQUARE C1 PROFILES. Dated 15/12/1978.



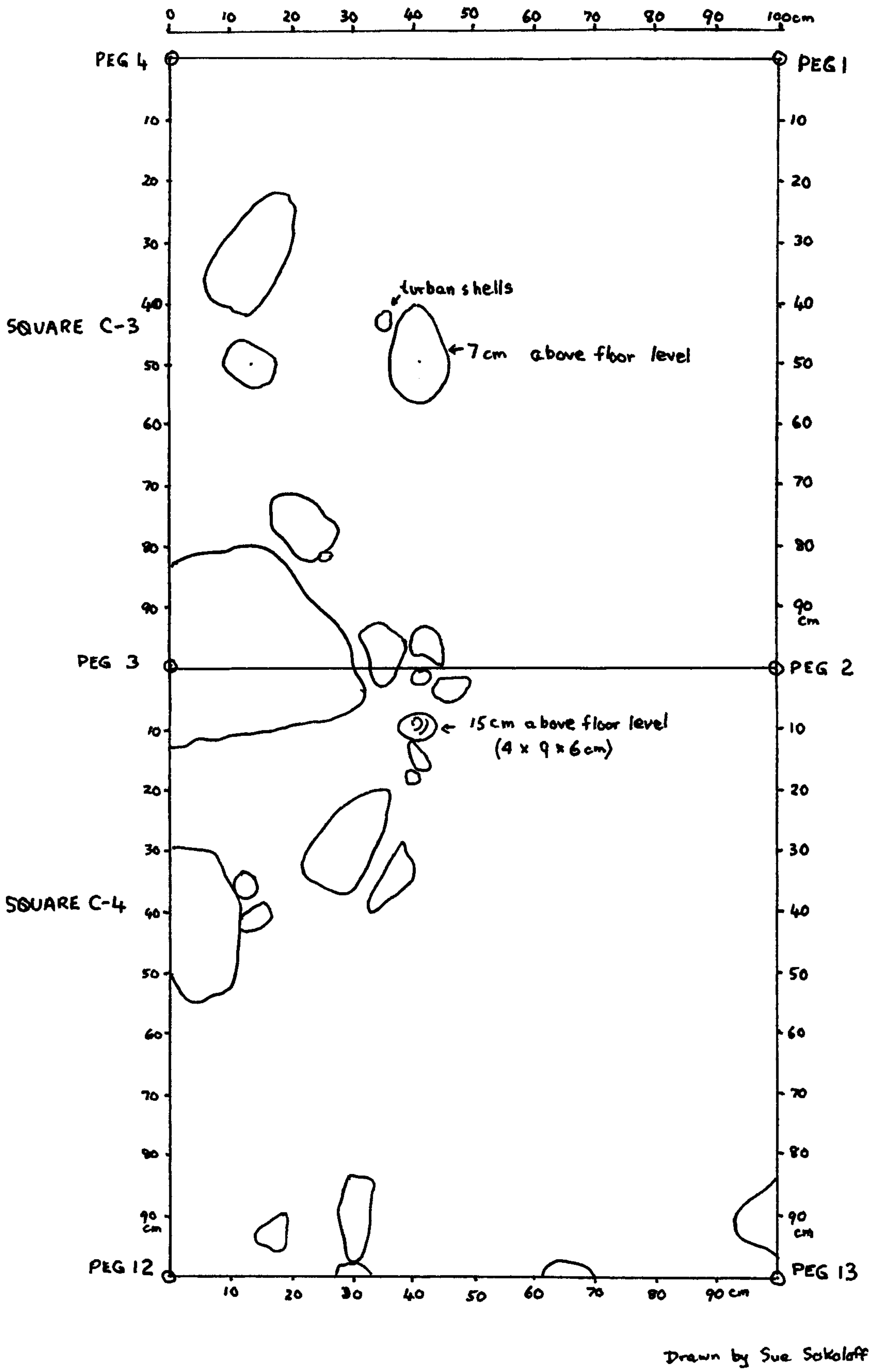
FIELD SKETCH 24: LARGE STONES IN SQUARE C2 LEVEL 1. Dated 22/4/1979.



Drawn by Janine Floyd

FIELD SKETCH 25: STONE ARRANGEMENT AT BOTTOM OF LEVEL 2 IN SQUARES C3 AND C4. Dated 22/4/1979.

Note that all the boulders and large cobbles are flat-topped.

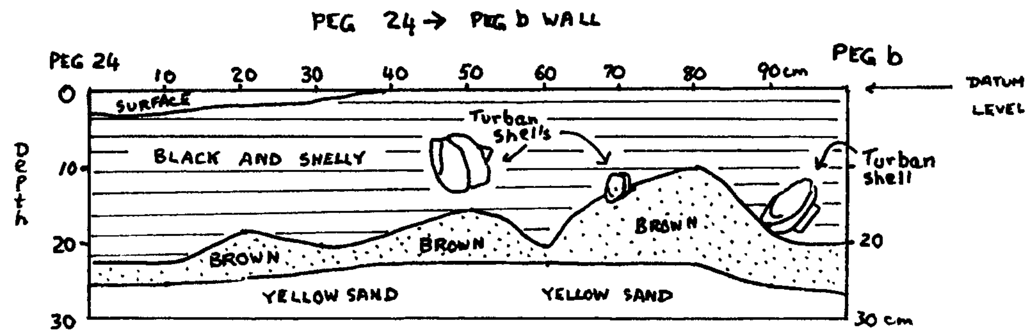


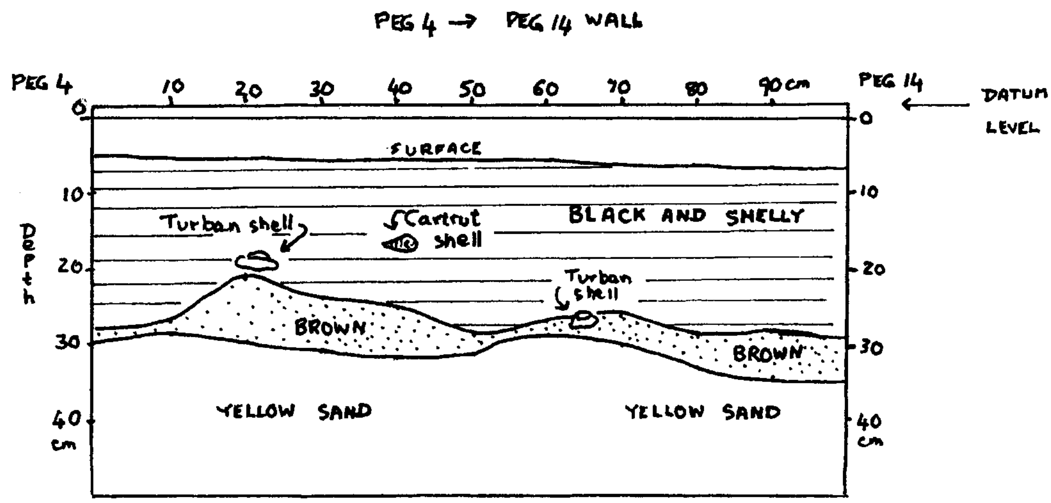
FIELD SKETCH 26: WALL PROFILES IN SQUARE C-2. Dated 22/4/1979.

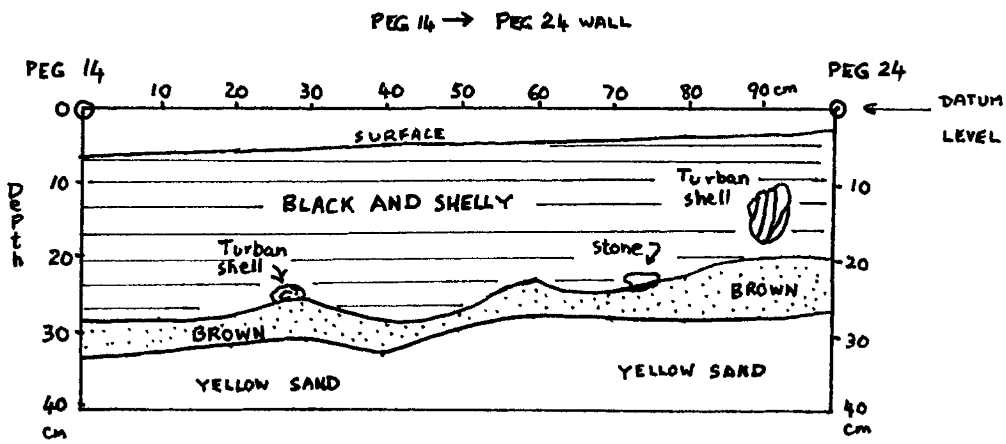
Note 1: All depths refer to the Datum Level.

Note 2: The common side with Square C-1 is the Peg b-Peg 4 one (not shown above since C-1 had already been dug). In Field Sketch 23 it is the Peg Y-Peg 15 wall, with Peg 15 in the position since relabelled as Peg 4.

Note 3: The surface has moved vertically by +5 to –5 cm since Square C-1 was laid out in December 1978. These changes could be due to stormwater wash (especially in January 1979), or to the digging done by vandals some time between December and April.

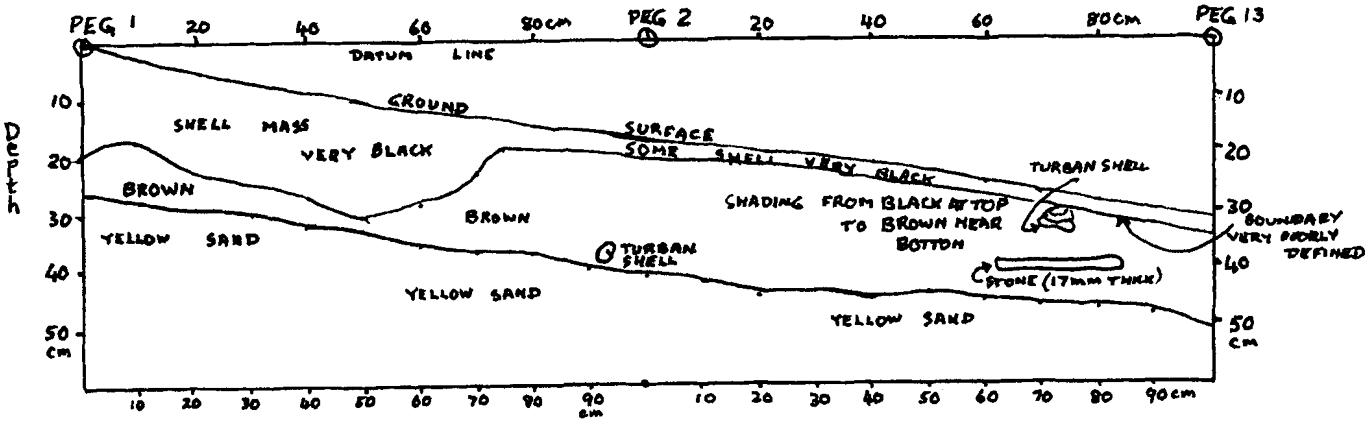


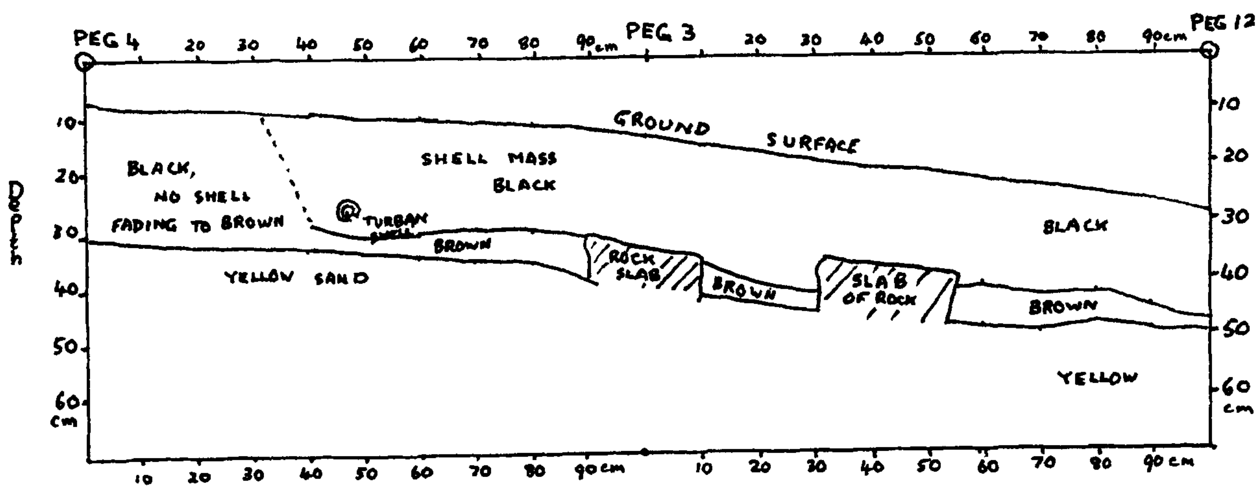




Drawn by Len Dyall

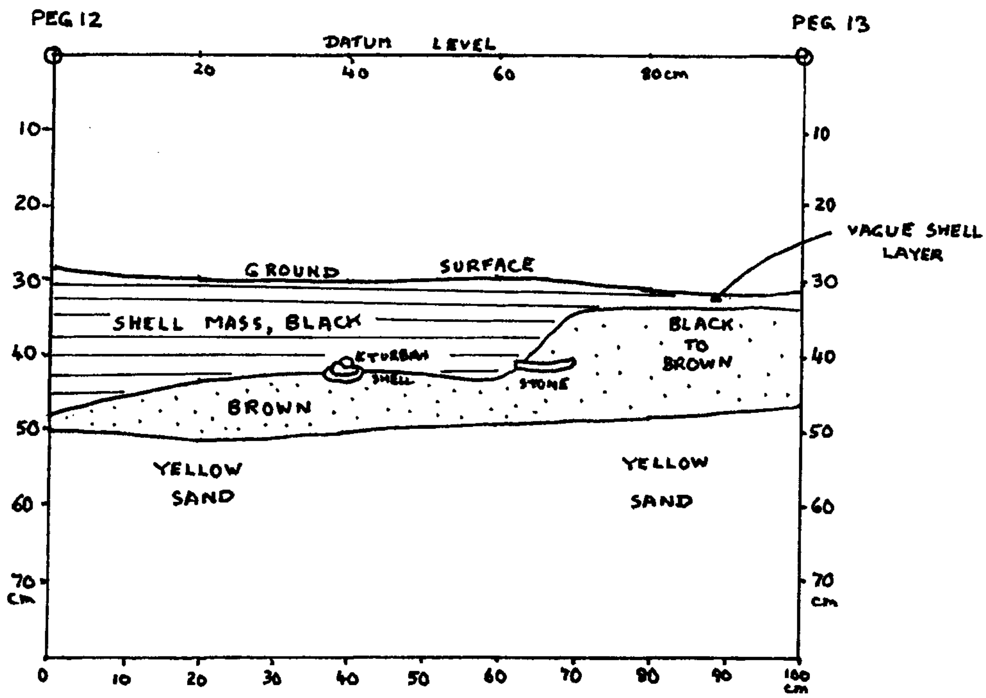
FIELD SKETCH 27: PROFILES IN SQUARES C-3 AND C-4. Dated 22 April 1979.
The depths were originally plotted with respect to the surfaces, but here they have been replotted with respect to the Datum Level (which was the top of Peg 1).





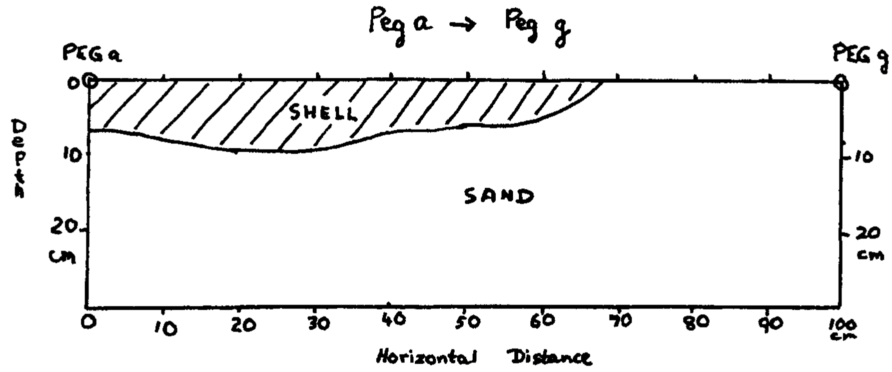
Drawn by Len Dyall

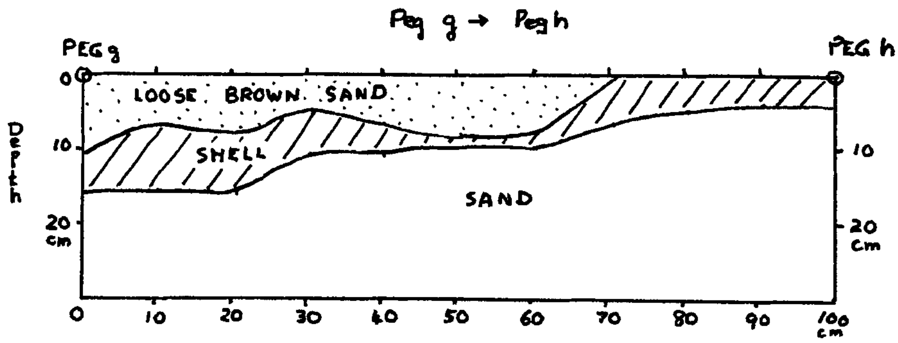
FIELD SKETCH 28: SQUARE C-4 PROFILE. Dated 22/4/1979.

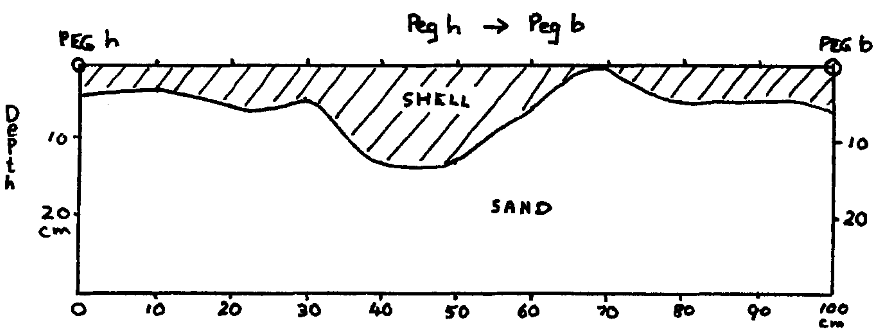


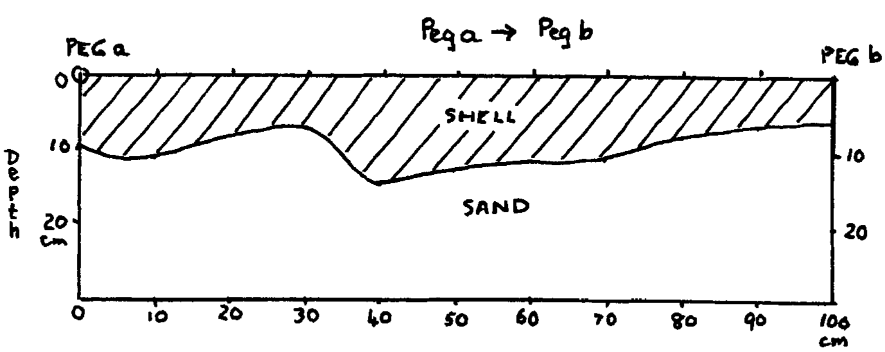
Drawn by Len Dyall

FIELD SKETCH 29: WALL PROFILES IN SQUARE D-1. Dated 21/4/1979.



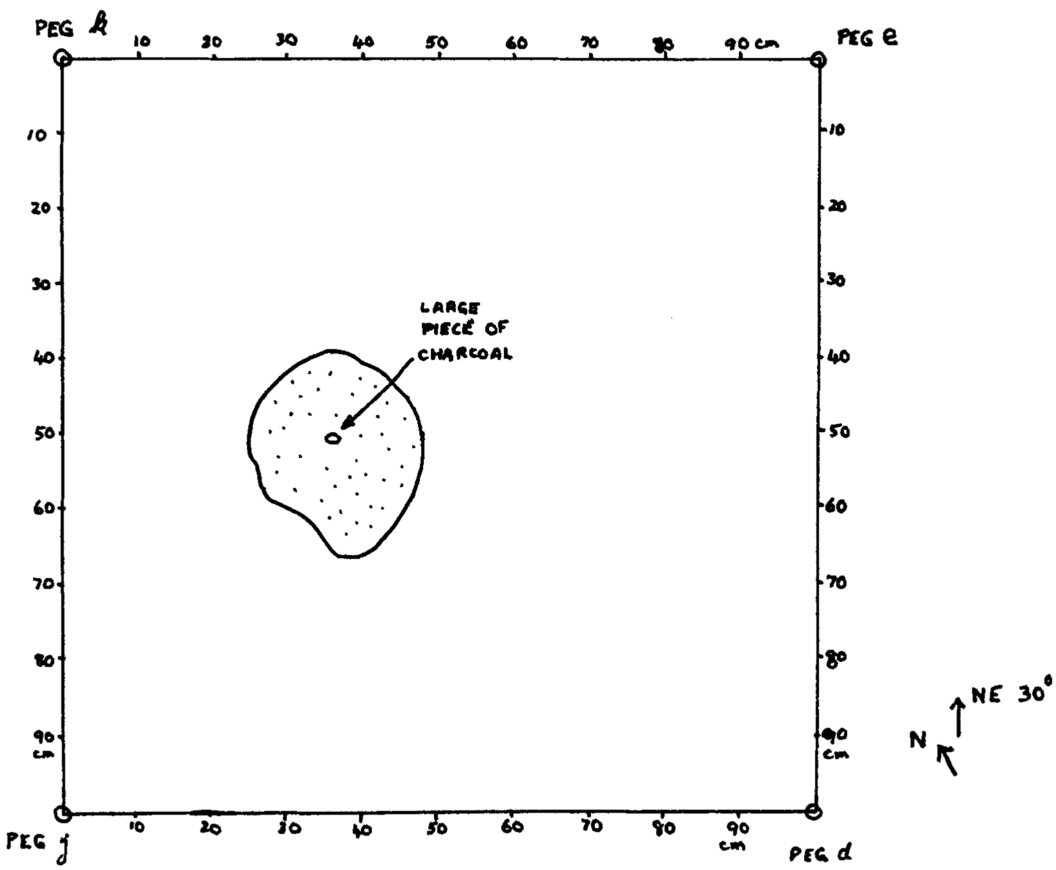






Drawn by Lew Dyall

FIELD SKETCH 30: CHARCOAL PATCH IN SQUARE D-4 LEVEL 1 (5-15 cm). Dated 21/4/1979.



Drawn by Boris and Sue Sokoloff

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Colyn Whitehead
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The excavation crew
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APPENDIX 1: BOTANY OF THE EXCAVATION SITE AT BIRUBI

By K. McDonald

Present appearance near Trench D (at 21 April 1979).

The site represents a badly eroded formerly vegetated frontal dune system. Hummocks of sand are held together by the introduced bitou bush (or South African Star Bush), *Chysanththemoides monilifera*, at present in dense flower. But for this plant the erosion of the area would probably be even worse than it is. Remnants of the indigenous coastal tea tree, *Leptospermum laevigatum* may be seen. Both plants have their root systems exposed on the seaward side and salt-spray pruning of the bushes is severe.

Two herbs also occur, both introduced:

1. Pennywort (*Hydrocotyle bonariensis*).
2. Evening primrose (*Oenothera drummondii*)

at the immediate site of the excavation.

In the more protected swales (where the water table is closer to the surface) the main plant is the sedge *Scirpus nodosa*. Pennywort is also abundant. The introduced weed, Canadian fleabane, *Erigeron canadensis*, is fairly common. Occasional small bushes of the indigenous whitebeard, *Lencopogon sp*., also occur. In places, patches of the introduced couch grass, *Cynodon dactylon* occur with the *Scirpus*-*Hydrocotyle* association.

A little further distance away (>100m) remnant stands of a characteristic frontal dune plant association occur, viz., the *Banksia integrifolia* (Coastal banksia)-*Leptospermum laevigatum* association.

The former plant community

There is sufficient evidence from remnant stands of Coastal banksia – Coastal tea tree to show that the area was once extensively covered by this plant association.

This plant association may have been interrupted by small swale communities and, on the seaward side would have graded into an association of sand Spinifex (*Spinifex hirsutus*) and such plants as the *Scaevola ramosissima*, *Lomandra longifolia* and *Hibbertia scandeus* (guinea flower).

Further landward the dune vegetation divides into two distinct communities:

(a) in the depressed areas, where the watertable is at or just below the surface, a *Melaleuca quinquenervia* forest (broad leafed paperbark).

(b) an *Angophera costata* – *Banksia serrata* association (Rusty gum – old man Banksia).

Ultimately the landward zonation climaxes in a *Eucalyptus pilularis* (blackbutt) low open forest.

Other plants occurring in the area:

Pigface (*Carpobrotus sp*.)

Sand lily (*?*)

Mullumbimby couch (*?*)

APPENDIX 2: REPORT ON BIRUBI HOUSE LOTS

Submitted to Carl Acheson, National Parks and Wildlife Service, William Street, Raymond Terrace, on 19 March 1979.

Preamble

Following discussions between Ms. Kate Sullivan* and myself in December last, I have examined three housing lots near Ocean Avenue, Birubi. Allegations had been made that building upon these lots would destroy valuable Aboriginal material, and attention was especially drawn to an exposed section of midden behind the rear fences of the existing houses at Nos. 56 and 58 in Ocean Avenue.

My own involvement arises because I hold Permit A3570 to excavate on the Aboriginal midden immediately west of the three house lots in question.

House lots were cleared and levelled at Nos. 56, 58, and 60 in Ocean Avenue some ten years ago, with demolition of a substantial section of the Aboriginal midden. Houses have since been built on these lots. The three new lots are to the north of these, and are separated from them by a scheduled roadway. One lot belongs to Mr. John McKinley (who operates the caravan park at Birubi), and he acted as spokesman for the other two owners who are not known to me.

The midden at these three house lots is covered with drift sand, which was levelled by bulldozer last November. On advice from Ranger Carl Acheson and myself, the levelling was stopped about 20 cm above the shell horizon which marks the midden. The bulldozer gained access from the scheduled roadway (Fitzroy Street), cutting into the exposed section of midden (referred to in paragraph 1) as it did so. I dug my test holes in December 1978.

In my examination of this housing area, I have considered the following questions.

1. Whether the exposed midden face behind Nos. 56 and 58 is important.

2. The extent of midden underlying the three new house lots, and whether the material in it is of special interest.

3. Whether the midden under the new house lots might have more excavation potential for our project than the area on unoccupied land immediately to the west.

METHODS The sampling method is set out in Attachment 1.

RESULTS These are appended in Attachment 2.

REPORT

This is made in terms of the three questions asked above.

1. The exposed midden face is not unique: the area to the west (where I propose to excavate shortly) contains similar material. This material† is not upon the housing lots, but will be demolished when Fitzroy Street is extended along the front of the three housing lots.
   [Should there be any proposal to extend this street still further, one will have to examine its impact upon the shell middens in that area].

2. The midden does extend under the three housing lots, but only in patchy fashion. Thus, of thirteen test holes, only four struck any midden. The Aboriginal deposit has probably been cut through by wind action in the past so that only remnants are

left. The inland edge of the area is sterile, doubtless being a quite recent product of sand dune movement.
The analysis of the samples I dug out (see Appendix 2) reveals the same types of shell, bone, and stone material as I recovered in surface collections along the face of this midden further westwards, beyond the housing lots.

3. Despite the appreciable level of faunal remains and lithic material in three of my test holes, I do not consider this part of the midden to be more suitable for excavation than the area to the west which I have already selected. The Aboriginal deposit under the house lots is so scattered that it would be hard to lay out a satisfactory excavation area. Moreover, the presence of European material (rusty iron) mixed in with the Aboriginal relics indicates that disturbance has occurred.

In summary, I am satisfied that the area to the west of these housing lots will be the most suitable for our excavation, and our trenches there will recover an equivalent sample. In view of the samples I have taken (these will be lodged with The Australian Museum), I believe that we have an adequate record of the midden remnants under these housing lots. I have no objection to the owners of these lots proceeding with house-building.

Footnotes added in 2002

* Kate Sullivan was at that time the Officer responsible for Aboriginal Relics, in the National Parks and Wildlife Service of New South Wales.

† In this new sentence the "material" is the exposed midden face in the scheduled street (Fitzroy Street) in front of the three housing lots.

ATTACHMENT 1
SAMPLING METHOD
See Figure 1

Peg 1 was placed 9 metres north (magnetic) of the property corner of No. 60 Ocean Street. While the width of the access road to go along the back of properties No. 56, 58, 60 was not defined by any survey pegs, it is likely that Peg 1 is just inside the boundary of a private house lot.

The pegs 2, 3, 4, and 5 were then laid out at 11-metre intervals. A transverse line was then laid east from Peg 3, again at 11-metre intervals. Pegs 5 and 9 were on the edge of the levelled area, which dropped away steeply to a swamp.

At each peg, a 50 cm square was cut out with a spade (see Figure 2). The loose sand overburden was put through a sieve (1/16 inch mesh) to confirm that there was no Aboriginal material present. The layer of midden (if any) was likewise sieved, and the residue was bagged for later sorting and study. A further sample was taken to 50 cm below the obvious Aboriginal deposits. These bottom samples all proved sterile.

ATTACHMENT 2
DETAILED RESULTS OF SAMPLE ANALYSIS

Peg 1 Sample There was no layer of dark midden soil, and only three fragments of pippy shell were recovered.
The ground surface was already lower than the thin pippy-shell horizon of the adjacent untouched midden. (See Figure 1). The absence of midden at Peg 1 is not due to bulldozing, but probably from the cutting of a channel by wind action. There are deep channels cut in the exposed midden immediately westwards.

Peg 2 Sample There was a dark soil layer, 8 cm thick, with scattered pippy shell. Underneath lay yellow sterile sand. Sorting yielded material as follows.
Shell 154 pippy; 3 chitons; 1 heavy turban operculum; 1 small unidentified operculum; 1 limpet; 3 cartruts; 5 fragments of large tritons. Total, 168.
Stone 19 flakes (21.9g) made up of 1 small rhyolite core, 8 waste flakes of chert, and 10 flakes of acid volcanics.
10 pieces of rubble (9.9g) and 3 pieces of pumice (0.2g).
Charcoal 17.6g.
Bone 42.5g. Identifiable bone as follows.
Bird: 1 (a broken long bone).
Mammal: 5 (one femur head of a smallish mammal, one fragment (?rib), three phalanges (two of them macropodid).
Fish: maximum number of 16 individuals, as follows.
Snapper 7 (one supra-occipital from fish about 1kg; four occipital fragments from fish ranging from 500g to 1kg; two upper jaw fragments).
Kelpfish 1 (one upper jaw).
Groper 2 (two smallish lower pharyngeal plates).
Wrasse 1 (one lower pharyngeal plate; one jaw fragment).
Labrid 3 (three fragments of pharyngeal plates).
Bream 1 (one lower jaw, about a 500g fish).
?Crayfish 1 (one mandible, not positively identified).
(In minimum numbers of fish, this sample has yielded 8, made up of 3 snapper of sizes 200g, 500g, and 1 kg; 2 small groper; 1 wrasse; 1 bream of 500g; 1 kelpfish. There is 1 probable crayfish).

Peg 3 sample There was a brown soil horizon 6 cm thick.
Shell 54 pippy; 1 chiton; 1 heavy turban operculum; 4 limpets; 1 cartrut; 2 fragments of large tritons; 1 abalone; 2 kelpshells; 1 sand snail; 1 small bonnet; 9 neritas. Total, 77.

Stone 30 flakes (16.6g) made up of thirteen flakes of chert and seventeen of acid volcanics.
1 broken slab (300g) of acid volcanic.
35 pieces of rubble (6.9g) and 3 pieces of pumice (0.35g).
Modern rubbish 18 rusty iron fragments (4.6g).
Charcoal 4.0g.
Bone 17.0g. Identifiable bone as follows.
Bird: 1 (one vertebra, probably bird).
Mammal: nil.
Fish: Maximum number of 5 individuals, as follows.
Snapper 3 (three occipital fragments, one from a largish fish, two tiny).

Kelpfish 1 (one upper jaw).
Wrasse 1 (one jaw fragment).
(In minimum numbers of fish, this sample has yielded 4 individuals (2 snapper of sizes 1 kg and 200g; 1 kelpfish, and 1 wrasse).

Pegs 4, 5, 6, 7, and 8: There were no dark soil horizons, and no material was recovered by sieving.

Peg 9 sample There was no dark soil horizon, but there was some shell on the surface, and a lot of clay pieces in the sand.

Shell 89 pippy; 2 heavy turban operculi; 2 small unidentified operculi; 3 limpets; 3 cartruts; 1 kelpshell; 8 neritas; 4 oyster operculi; 1 *Bembicium*. Total, 113.
Stone 5 flakes (3.2g), all of chert.
4 rubble (0.6g) and 1 pumice (0.1g).
4 pebbles (2.6g).
173 clay lumps (242.3g).
Modern rubbish 2 bits of rusty iron.
Charcoal 2.8g.
Bone 2.4g. None identifiable.

Probes A line of probe holes was dug with a spade to look for the Aboriginal deposit, on a line running east (magnetic) from Peg 2. (See Figure 1). The locations P1, P2, and P4 were sterile but P3 struck a black soil layer, 5 cm thick and containing much pippy shell.

Shell counting methods

Pippy shells were counted if the bivalve hinge was present on the fragment of shell. The numbers of pippy shells quoted have not been divided by two to allow for each shellfish having two halves. Other shells were counted if they were reasonably intact.

Common and scientific names

Shellfish and fish have been listed above by common name. Scientific names are appended below.

Shellfish	
Abalone	Haliotis ruber
Bonnet	Sigapatella calyptraeformis
Cartrut	Dicathais orbita
Chiton	Sipharochiton sp.
Heavy turban	Ninella torquata
Kelpshell	Bankivia fasciata
Limpet	Patellidae sp.
Nerita	Melanerita altramentosa
Oyster	Crassotrea commercialis
Pipi	Plebidonax deltoides
Sand snail	Conuba aulcoglossa
Triton	Cymatidae sp.
Fish	
Bream	Acanthopagrus australis
Groper	Achoerodus gouldii

Kelpfish	Chironemus aboriginalis
Snapper	Chrysophrys auratus
Wrasse	Labridae sp.
Crustacea	
Crayfish	Jasus sp.

Observations of a later date

The housing lot area was inspected again on 25 March 1979, soon after a heavy gale had stripped off the sand cover.

There was a lot of shell, some of it in a layer 5 to 10 cm thick, especially in the area including my test holes 1, 2, and 3. While the deposit included some Aboriginal stone material, it was certainly not undisturbed. Even though the shell layer looked to be compacted, it had embedded in it two old boots and a horseshoe.

The most likely explanation for this modern rubbish embedded in compacted shell is that the original shell midden has been undercut by wind action until the shell layer collapsed, thus mixing in any non-Aboriginal rubbish lying on the original surface. After the collapse, the shell would reconsolidate. This process must have occurred after European occupation occurred here. Where the face of the shell midden is exposed to gales, this process of undercutting, collapse, and reconsolidation might occur many times over. The seaward face of the shell middens in Area D would be especially prone to this cycle of events.

If one plots the "positive" test holes on Figure 1, it is clear that there is not much shell midden on these housing lots. There is one short tongue of midden between Pegs 2 and 3, and a larger tongue projects northwards from Nos. 56 and 58 in Ocean Street, to include my P3 hole. Between these midden remnants there is a broad gap, extending from the southwest to the northeast. (Thus P1, P2, and 6, 7, and 8 found no midden).

These tongue-shaped midden remnants, and broad gaps, seem to be characteristic of wind damage to a midden face. The same heavy gale did immense damage to all the middens in Area D, and when we came to lay out Trench D, we encountered similar gaps and remnants. The wind damage was so severe that not much midden remained. The small samples taken out of these housing lots before the gale actually became quite useful.

Addendum

At the time of the house lot survey, I collected several items on the tracks of the bulldozer where it had entered the house lots from the soon-to-be Fitzroy Street. These items were a chert flaking core, a scraper made of acid volcanic rock, several animal bones, and a small, extensively-polished axe made on a pebble of black basalt.

Note added in 2003: These items are included as part of the surface collection Area D in Chapter 2.

FIGURE 1
LAYOUT OF TEST HOLES (1 to 9) AND PROBES (P1 to P4)

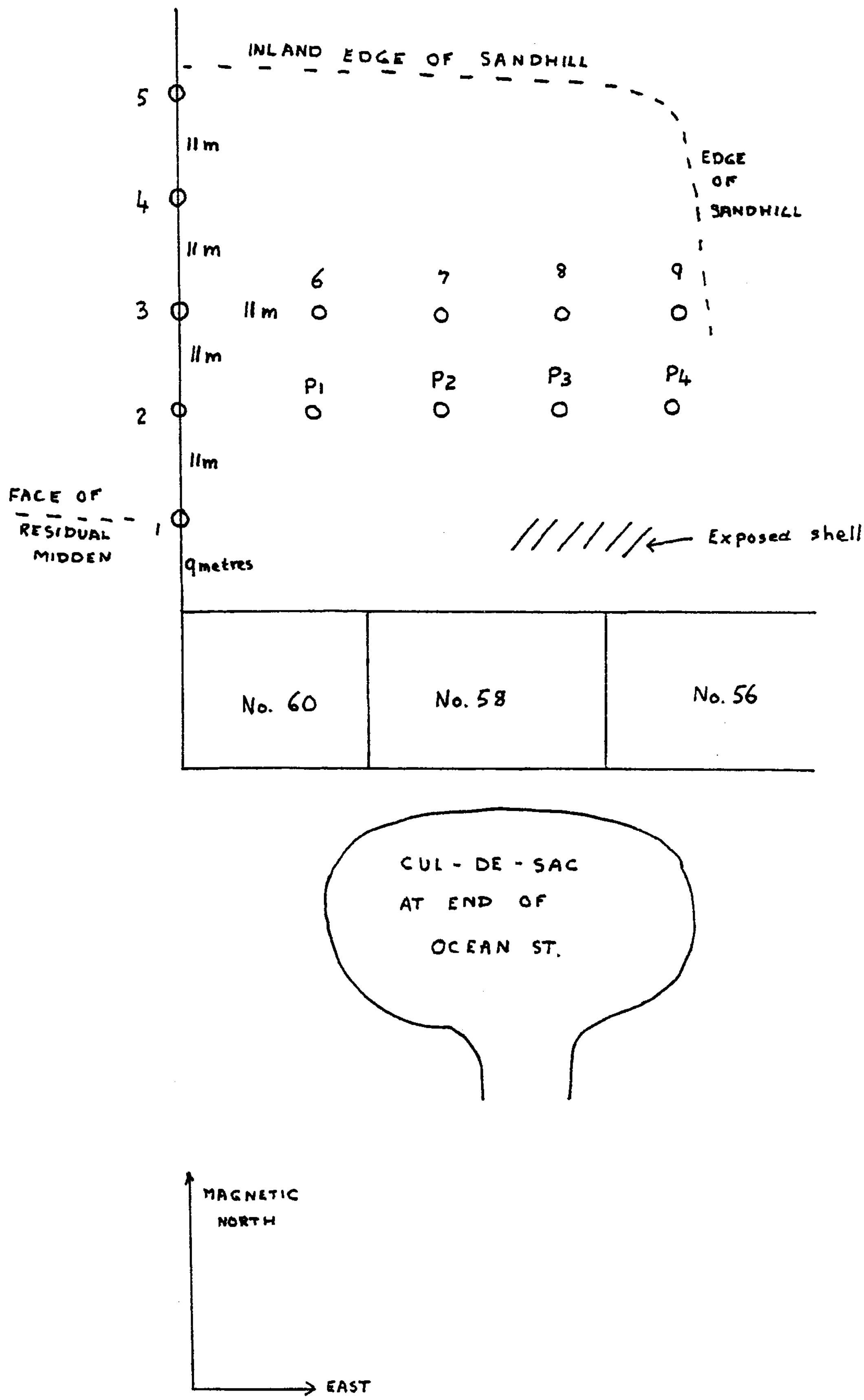
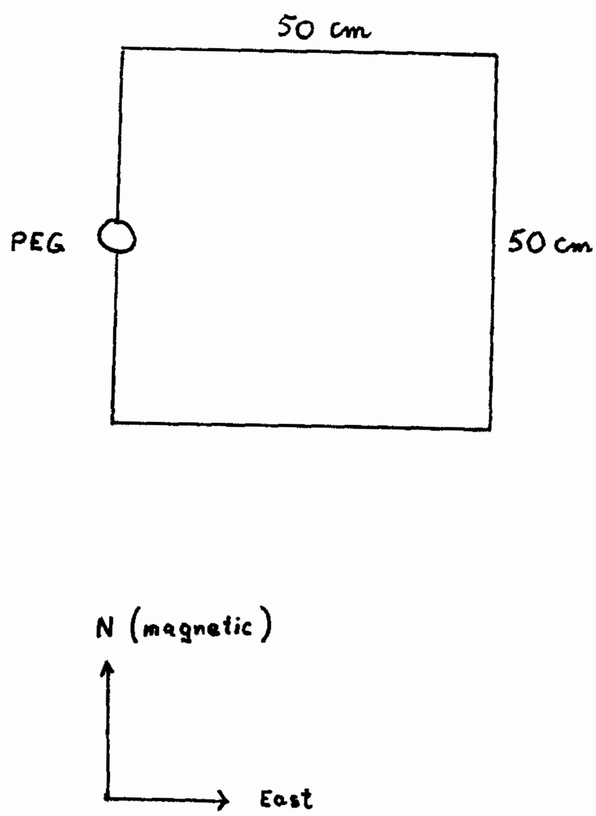


FIGURE 2
LAYOUT OF TEST HOLES



APPENDIX 3: SHELL IDENTITIES BY COMMON AND SCIENTIFIC NAMES

Common Names	Scientific Names
Abalone	Haliotis ruber
Angel's wing	Pholas australasiae
Australian horn	Velacumantus australis
Australian wentletrap	Opalia australis
Australwink (blue)	Littorina unifasciata
Barnacle[A]	Cirripedia tesseropora
Bell tent shell	Australium tentoriformis
Bonnet	Calyptraea calyptraeformis
Brooch	Neotrigonia margaritacea
Brown mitre	Mitra carbonaria
Brown trough	Austromactra rufescens
Cartrut	Thais orbita
Chiton	Chiton pelliserpentis
Cluster wink	Hinea brasiliana
Cockle (flame dog)	Veletuceta flammea
Cockle (southern)	Cardium racketti
Cockle (Sydney)	Anadara trapezia
Elegant astelena	Astelena scitula
Elephant snail	Scutus antipodes
Frilled Venus	Callanaitis disjecta
Gay fanshell	Scaeochlamys lividus
Hercules club (mud whelk)	Pyrazus ebeninus
Hollow cardita	Cardita excavata
Horsehoof	Antisabia foliacea
Kelpshell	Bankivia fasciata
Latticed platter shell	Codakia rugifera
Limpet	Patellidae sp.
	(Eight-rayed: Patellanax chapmani)
	(Keyhole: Eligidion audex)
	(Scaly: Patellanax peronii)
	(Colourful: Cellana tramoserica)
Mulberry	Morula marginalba
Mussel (edible)	Mytilus edulis
Mussel (hairy)	Trichomya hirsuta
Nerita	Nerita atramentosa
Orange jingle	Anomea descripta
Oyster (mud/floating)	Ostrea angasi
Oyster (rock)	Saccostrea cucullata
Pear helmet	Semicassus pyrum
Pipi	Donax deltoides
Ramshorn	Spirula spirula
Sand snail	Conuba aulocoglossa
Scallop	Notovola fumata
Shining wedge	Amesodesma angusta
Slipper limpet	Crepidula aculeata
Tapestry shell	Tapes watlingi
Topshell (Comtessa's)	Thaliota comtessei
Topshell (speckled)	Austrocochlea concamerata

Topshell (Zebra)	Austrocochlea constricta
Triton (red)	Charonia lampas rubicunda
Triton (Spengler's)	Cabestana spengleri
Turban (green)	Turbo undulatus
Turban (heavy)	Turbo torquatus
Violet snails	Janthina sp. Glossy: J. exigua Large: J. janthina
Volute	Amoria sp (undulata or zebra)

A Barnacles are actually crustacea, but it has been convenient to discuss them along with shellfish.

Note 1. The cemented tubules attached to some of the shells, and to waterworn cobbles, are probably *Galeolaria caespitosa*).

APPENDIX 4: COMMON AND SCIENTIFIC NAMES OF FISH

The reference collection of fish skeletons I used to identify archaeological specimens was made up of the following species. Names are taken from G. P. Whitley, "Handbook of Australian Fishes" (Jack Pollard Publishing, Sydney, 1980), and in many cases will need updating.

The *Ellerkeldia* fish was identified by Dr. John Paxton, Curator of Fishes at The Australian Museum.

My reference collection has been lodged with the Newcastle Regional Museum.

Common Name	Scientific Name
Batfish (silver)	Monodactylus argenteus
Black bream	Acanthopagrus australis
Black-spotted rock cod	Epinephelus damelii
Crayfish	Jasus verreauxii
Dart (skipjack)	Trachinotus russelii/copperingeri
Drummer (black)	Girella elevata
Drummer (silver)	Kyphosus sydneyannum/sydneyanus
Eel – conger	Conger wilsoni
Eel – freshwater	Anguilla australis
Eel – reef(moray)	Gymnothorax prasinus
Ellerkeldia (no common name)	Ellerkeldia
Estuary catfish	Tandanus tandanus
Estuary cod	Epinephelus tauvina (?suillus)
Flathead – dusky	Platycephalus fuscus
Flathead – sand	P. bassenis basensis
Flathead – tiger	Neolatylcephalus richardsoni
Flounder (commercial)	Pseudorhombus sp.
Flounder – large-toothed	Not known
Garfish	Hemirhamphidae sp.
Goatfish	Upeneus sundaicus
Groper	Achaerodus gouldii
Gurnard	Triglidae sp.
Herring – oxeye	Megalops cyrinoides
Herring – sea	Clupeidae sp.
Jewfish (mulloway)	Argyrosomus hololepidotus
John Dory	Zeus faber
Kelpfish	Chironemus marmoratus
Kingfish	Seriola grandis/ lalandi
Leatherjacket	Aluteridae sp.
Ling	Lotella damelii
Luderick	Girella tricuspidata
Moonfish	Not known
Moray eel	Gymnothorax prasinus
Morwong	Cheilodactylus spectabalis
Mullet (sea)	Mugil cephalus
Nannygai (redfish)	Centroberyx affinus
Pacific perch	Not known
Porcupine fish	Atopomycterus nichthemerus
Red rock cod	Scorpaena cardinalis
Rock cale	Crinodus lophodon
Salmon trout/Australian salmon	Arripis trutta

Shark – banjo	Not known
Shark – Port Jackson	Heterodontus portusjacksoni
Silverbiddy	Gerridae sp.
Snapper	Chrysophrys auratus
Snook	Sphyraena barracuda
Stingray	Urolopus testaceus
Sweep	Scorpis lineolatus/aequipinnus
Tailor	Pomotomidae saltatrix/saltator
Tarwhine	Rhabosargus sarba
Tereglin	Atractoscion aequidens
Toado - common	Spheroides hamiltoni
Trevally (silver)	Pseudocaranx dentex
Whiting – red spot	Not known
Whiting (sand)	Sillago ciliata
Wirrah cod	Acanthistius serratus/ocellatus
Wrasse - common	Labridae sp.
Wrasse – Maori	Ophthalmlepsis
Yellowtail – common	Carangidae sp.
Yellowtail – stripey	Carangidae sp.

There were also some archaeological specimens of teeth of Wobbegong shark (*Orectolobus maculatus*) that had been identified by Dr. John Paxton at The Australian Museum.

Note that in the cases of snapper, black bream, and tarwhine there were skeletons of fish ranging from small to very large, so that the sizes of fish could be estimated in the archaeological record.
The collection also included an octopus beak. I did not see the complete octopus and the species is thus unknown.

APPENDIX 5: Position of the A-midden surface with respect to the Datum Lines

	FRONT DATUM			REAR DATUM	
Peg Number	**Horizontal Distance (cm)**	**Vertical Distance to Surface (mm)**	**Peg Number**	**Horizontal Distance (cm)**	**Vertical Distance to Surface (mm)**
1	0	290	11	0	186
	20	260		20	153
	40	192		40	150
	60	173		60	138
	80	145		80	127
2	100	120	12	100	95
	120	120		120	80
	140	104		140	65
	160	98		160	56
	180	98		180	43
3	200	100	13	200	49
	220	90		220	53
	240	95		240	53
	260	83		260	60
	280	91		280	58
4	300	92	14	300	54
	320	70		320	60
	340	70		340	45
	360	80		360	39
	380	95		380	48
5	400	87	15	400	40
	420	90		420	32
	440	92		440	28
	460	100		460	26
	480	112		480	31
6	500	114	16	500	45

APPENDIX 6: Position of the A-midden surface with respect to datum cross-lines

Direction of Cross-line	**Horizontal Distance (cm)**	**Vertical Distance to Surface (mm)**
Peg 1 to Peg 11	0	290
	20	235
	40	240
	60	244
	80	232
	100	186
Peg 2 to Peg 12	0	120
	20	110
	40	115
	60	110
	80	118
	100	120
Peg 3 to Peg 13	0	100
	20	70
	40	60
	60	60
	80	65
	100	49
Peg 4 to Peg 14	0	92
	20	55
	40	55
	60	55
	80	50
	100	54
Peg 5 to Peg 15	0	87
	20	60
	40	52
	60	50
	80	58
	100	40
Peg 6 to Peg 16	0	114
	20	90
	40	73
	60	55
	80	50
	100	45

APPENDIX 7: Position of the B-midden surface with respect to Datum Lines
See **Diagram 4-1** in Attachment 1 for the peg numbering

Direction	**Horizontal Distance (cm)**	**Vertical Distance to Surface (mm)**	**Direction**	**Horizontal Distance (cm)**	**Vertical Distance to Surface (mm)**
15→25→35	0	22	16→26→36	0	54
	20	24		20	37
	40	31		40	38
	60	28		60	36
	80	32		80	47
(At Peg 25)	100	30	(At Peg 26)	100	10
	120	20		120	10
	140	0		140	10
	160	0		160	0
	180	0		180	10
(At Peg 35)	200	10	(At Peg 36)	200	30
15→16	0	40	25→26	0	50
	20	32		20	35
	40	28		40	39
	60	26		60	36
	80	31		80	37
(At Peg 16)	100	45	(At Peg 26)	100	45
35→36	0	10			
	20	10			
	40	0			
	60	0			
	80	0			
(At Peg 36)	100	10			

APPENDIX 8: Extended gridline in the C-midden area

See **Diagram 4-10** in Attachment 1 for peg numbers and letters

Direction	**Horizontal Distance (cm)**	**Depth (cm)**	**Direction**	**Horizontal Distance (cm)**	**Depth (cm)**
1→2→13			4→3→12		
At Peg 1	0	0	At Peg 4	0	7
	20	5		20	9
	40	9		40	9
	60	12		60	11
	80	15		80	12
At Peg 2	100	17	At Peg 3	100	14
	120	20		120	17
	140	22		140	20
	160	25		160	22
	180	28		180	25
At Peg 13	200	31	At Peg 12	200	28
Peg 1→4			Peg 2→3		
At Peg 1	0	0	At Peg 2	0	17
	20	2		20	15
	40	3		40	14
	60	4		60	14
	80	5		80	15
At Peg 4	100	7	At Peg 3	100	14
13→12			b→24		
At Peg 13	0	31	At Peg b	0	0
	20	31		20	0
	40	29		40	0
	60	30		60	0
	80	29		80	2
At Peg 12	100	28	At Peg 24	100	3
4→14			b→4		
At Peg 4	0	5	At Peg b	0	0
	20	6		20	0
	40	6		40	4
	60	6		60	3
	80	7		80	4
At Peg 14	100	7	At Peg 4	100	5
24→14					
At Peg 24	0	3			
	20	4			
	40	5			
	60	5			
	80	6			
At Peg 14	100	7			

APPENDIX 9: Surface Survey of the D-Squares
See **Diagram 4-11** in Attachment 1 for the system of peg letters

Direction	**Horizontal Distance (cm)**	**Depth (cm)**	**Direction**	**Horizontal Distance (cm)**	**Depth (cm)**
a→e			g→k		
At Peg a	0	7	At Peg g	0	8
	20	8		20	8
	40	8		40	8
	60	8		60	8
	80	7		80	8
At Peg b	100	6	At Peg h	100	7
	120	6		120	7
	140	7		140	7
	160	8		160	8
	180	9		180	9
At Peg c	200	10	At Peg i	200	9
	220	10		220	10
	240	13		240	10
	260	16		260	11
	280	16		280	10
At Peg d	300	17	At Peg j	300	10
	320	18		320	10
	340	18		340	10
	360	19		360	11
	380	18		380	11
At Peg e	400	18	At Peg k	400	10
Peg a→g			Peg b→h		
At Peg a	0	7	At Peg b	0	6
	20	8		20	7
	40	8		40	7
	60	8		60	7
	80	8		80	8
At Peg g	100	8	At Peg h	100	7

APPENDIX 10: Survey details of surface of extended D-Squares

See **Diagram 4-12** in Attachment 1 for the pattern of Pegs.

Direction	**Horizontal Distance (cm)**	**Vertical Distance (cm)**	**Direction**	**Horizontal Distance (cm)**	**Vertical Distance (cm)**
Peg 21→Peg n			Peg 31→Peg f		
At Peg r	0	12	At Peg ℓ	0	18
	20	13		20	17
	40	12		40	17
	60	9		60	16
	80	8		80	12
At Peg q	100	8	At Peg u	100	10
	120	9		120	11
	140	7		140	11
	160	6		160	9
	180	6		180	8
At Peg p	200	4	At Peg t	200	8
	220	2		220	6
	240	3		240	6
	260	3		260	7
	280	3		280	7
At Peg o	300	4	At Peg s	300	7
	320	3		320	5
	340	3		340	5
	360	3		360	5
	380	3		380	5
At Peg n	400	2	At Peg f	400	4

APPENDIX II:

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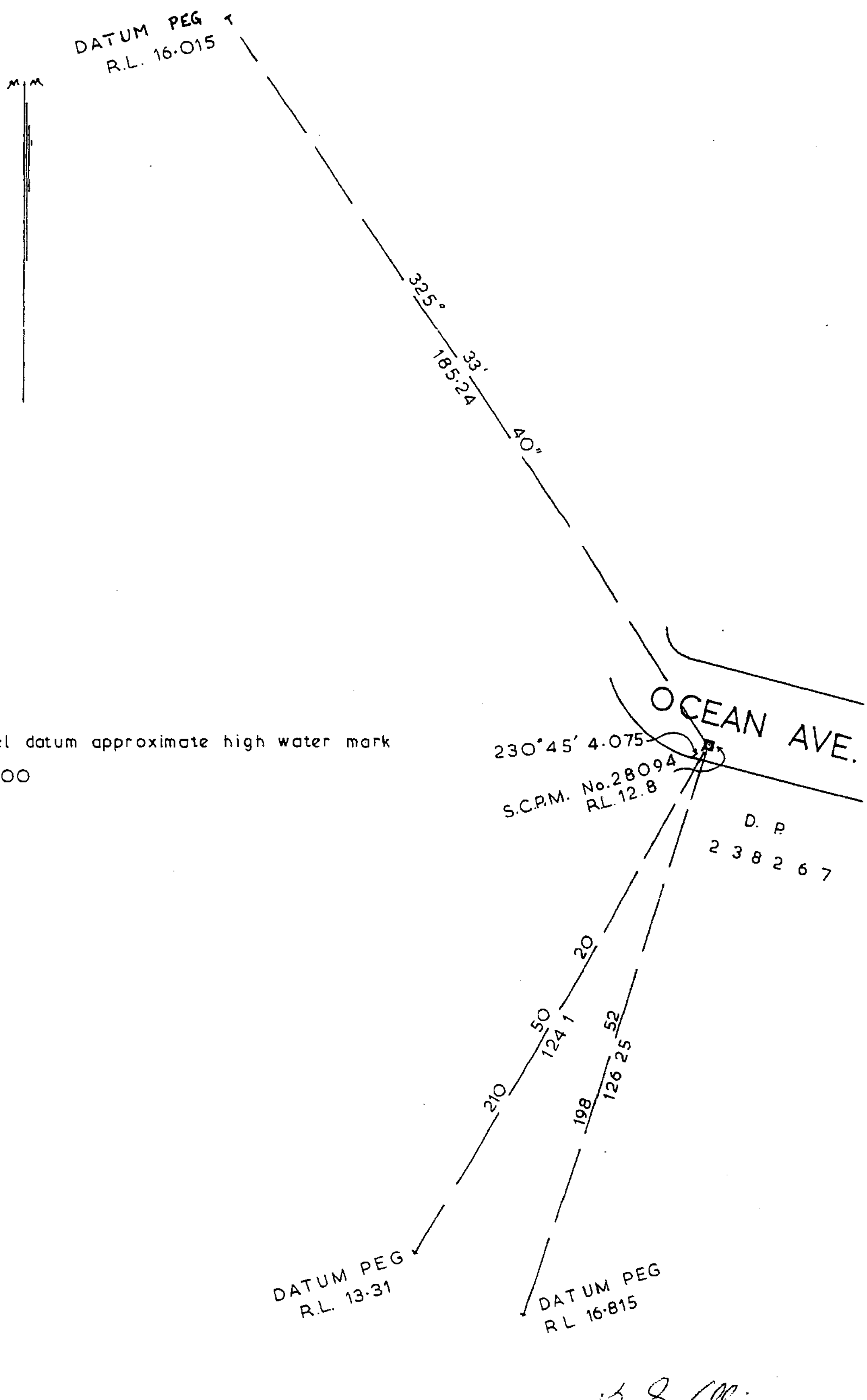
APPENDIX II continued



Level datum approximate high water mark
1:1000

Surveyor, Registered under the Surveyors Act, 1929.

APPENDIX 12: pH OF SOIL SAMPLES

The pH values were measured by Kim Marshall (Technical Officer, Department of Chemistry, University of Newcastle), using a standard pH meter.
Method: 1 teaspoonful of soil was added to distilled water (25 mL). Between measurements, the sample was stirred, allowed to stand, restirred, etc as listed below. Dilution of the mixture to 50 mL changed the pH by less than 0.1 unit.

Sample	**After 1 min (stirrer on)**	**At 1 min, stirrer off**	**After further 10 min of stirring**	**Then with stirrer off**
20 cm up in drift sand behind peg 14, AB-trench	7.1	7.4	8.2	8.6
A-2, Level 0, bottom	8.6	9.0	8.4	8.7
A-2, bottom of Level 1	7.6	7.8	8.1	8.6
A-2, soil from Peg 12 (15 cm depth)	8.8	9.0	8.8	9.1
A-2, midpoint, 25 cm depth	8.5	8.8	8.5	8.8
A-2, midpoint, 35 cm depth	8.2	8.6	8.3	8.6
A-2, midpoint, 45 cm	8.7	8.9	8.9	9.1
A-2, Level 4, Pegs 3-13 baulk	8.6	8.8	8.4	8.7
A-2, midpoint, 55 cm depth	8.9	9.1	8.6	8.9
A-2, Level 6, yellow patch	8.9	9.3	9.3	9.5
A-2, midpoint, 75 cm depth	8.3	8.7	8.5	8.8
A-2, Level 8, midpoint, 85 cm depth	8.9	9.1	8.9	9.1
A-2, 105 cm depth, midpoint	7.8	8.2	8.4	8.6
A-4, bottom of Level 0	8.4	8.7	8.6	9.0
B-1, midpoint, at 115 cm depth	8.3 dupl.8.0	8.5 dupl.8.4	8.7 dupl. 8.7	8.9 dupl.8.7
B-2, Level 3 hearth	8.8	9.0	8.7	9.0
C-1, Level 0 (at 5 cm depth)	8.7	8.9	8.8	9.0
C-1, at 25 cm depth (15-Y wall)	8.2	8.5	9.0	9.0
C-1 at 25 cm, midpoint	8.0	8.4	8.3	8.8
C-1 at 80 cm depth	8.4	8.8	8.7	9.0
Road loop sand dune	7.4	8.0	7.6	8.0

See Chapter 6 (page 52) for reasons why small differences are not significant.

APPENDIX 13: Material from “Level 11” (105-115 cm depth) in Square B1

This Level was a dark brown soil covering a mass of shell variously found at depths 108 to 115 cm below Datum. This shell was mixed in with large waterworn cobbles and smaller stones, all of the local acid volcanic type. There was also a lot of shellgrit. This material was noted to extend at the same level out along the shoreline of the headland, and is presumed to be material thrown up in heavy storms. Probing to 115 cm failed to find a rock bottom.

The material listed below was sorted out from a small excavated sample.

SHELL

Species	Item and	Number	Minimum Number
Cartrut	spires	12	
	fragments	21	12
Chiton	segments	47	6
Cockle (Sydney)	fragments	9	4
Flame dog cockle	hinge fragments	10	
	other fragments	6	6
Limpet	intact	2	
	spires	22	
	rim fragments	4	24
Nerita	intact	4	
	openings	4	
	domes	27	
	fragments	29	27
Pipi	shells[a]	13	7
Ramshorn	fragment	1	1
Topshells	shells	2	2
Triton	spires	5	
	openings	2	
	fragments	28	5
Turban –green	operculi (≤1 cm)	21	
	fragments	3	21
Turban –heavy	columellae	37	
	operculi(>1cm) intact	23	
	operculi (broken)	18	29
Unidentified	columellae (large)	3	3
	other fragments	3	
	Minimum number of edible shellfish		147

a Pipi shell ranged in size from small to large.

Other shell material 57 Tiny shells made up of 1 australwink, 3?volutes, 24 kelpshells, 1 limpet, 2 topshells, 2 unidentified bivalves and 24 unidentified univalves.

BONE 3.13g made up of 0.28g birdbone and 2.85g fish bone.

Bird bone 5 Items (one coccyx, one charred end of a longbone, one clavicle, one small longbone and one vertebra).

Fish bone

Black bream Minimum number 1 (one left upper jaw of a 150g fish).
There were 83 unidentified fish bones.

CHARCOAL 0.17g (made up of nine fragments).

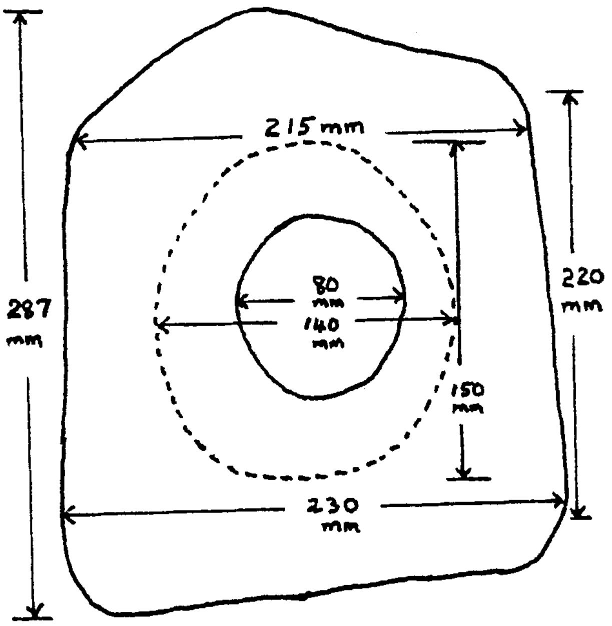
STONE

Rubble	1348 (333.49g), all apparently acid volcanics and none obviously man-made
Cobbles	3 (all acid volcanics). Wts. 297.76, 105.41, and 70.38g, the last one being broken.
Pebbles	550 (mostly tiny heavily-weathered pieces of acid volcanic). Wt. 347.18g.
Pumice	200 (41.63g).
Large sand grains	185 (10.89g). All siliceous.

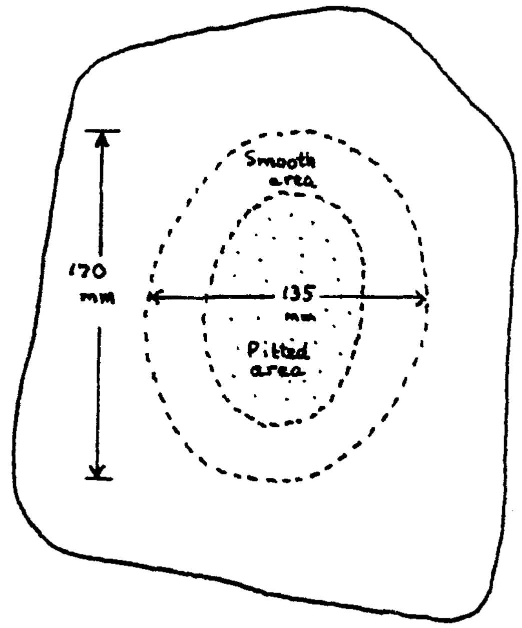
NOTE: All this stone material was retained. The sand grains, pebbles, and rubble were recombined, because the divisions between these categories had been arbitrary and unsatisfactory.

A roughly equal volume of still smaller stone rubble was discarded. It looked like swash zone material.

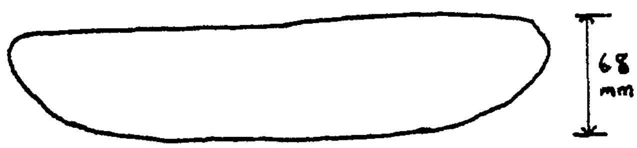
APPENDIX 14: A GRINDSTONE FROM THE WILLIAMTOWN-FULLERTON COVE AREA



Top view



Bottom view



Side view

Notes

The material was identified by Dr. S. St. J. Warne as sandstone, with the bedding planes clearly visible. The colour is grey, but yellowish where the patina has suffered recent damage.

The slab is waterworn, and its edges have not been altered by man. These edges are thus smooth and rounded in both the vertical and horizontal planes.

Top side The grinding depression measures 150x140 mm, and its boundaries are ill-defined. The surface of this depression has flaked as a result of weathering. The central part of this area is better defined, and scratches from grinding use extend around the circumference. This central pit is 9 mm deep.

Bottom side This depression is oval-shaped and shallow. The entire inner part is extensively pitted, while the surrounding annulus is polished smooth.

LIST OF APPENDICES

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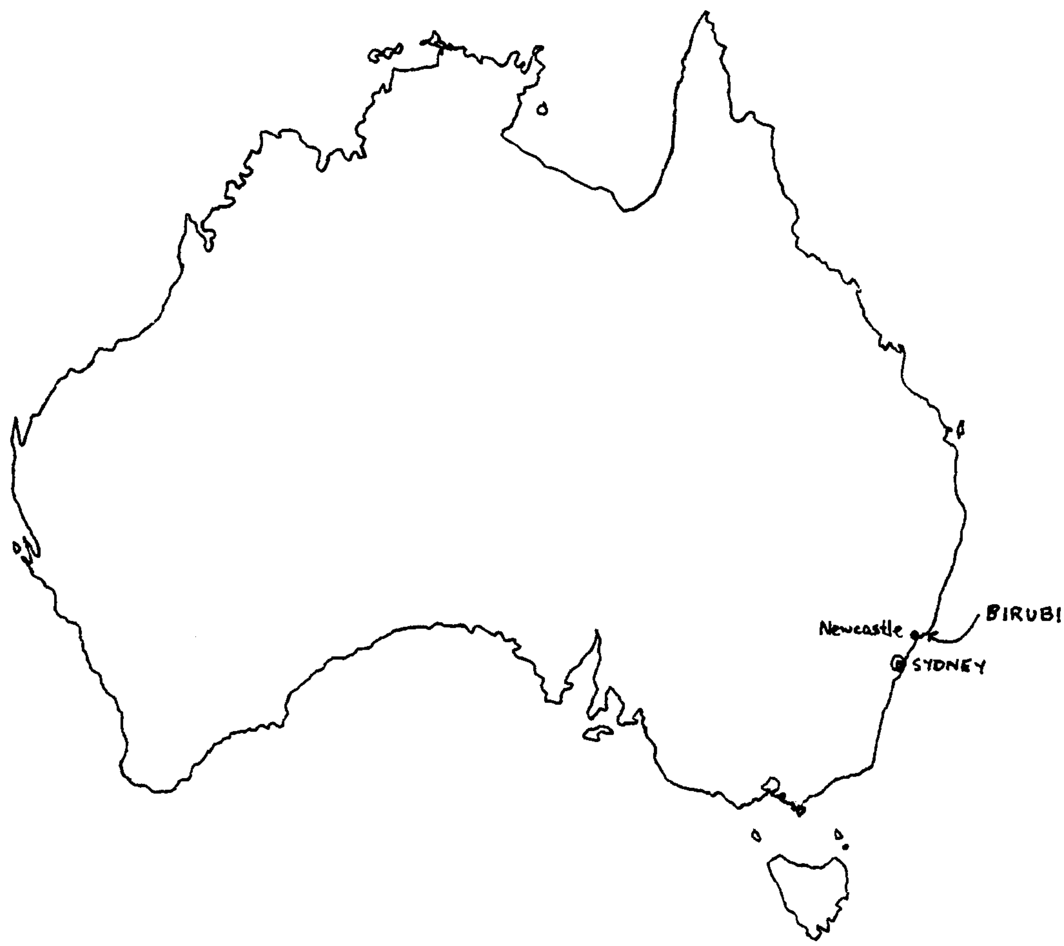
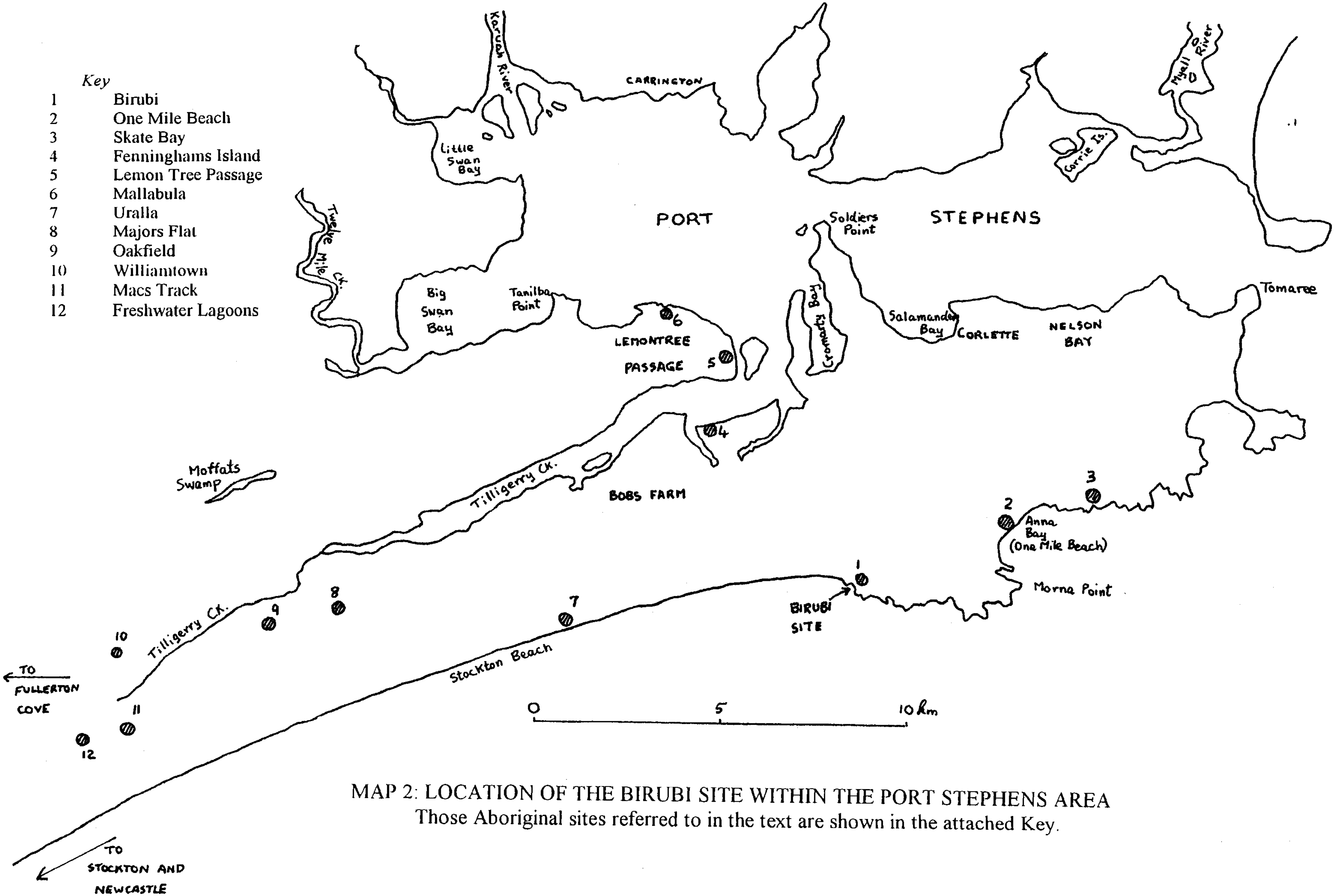
MAP 1: LOCATION OF THE BIRUBI SITE IN AUSTRALIA



Key

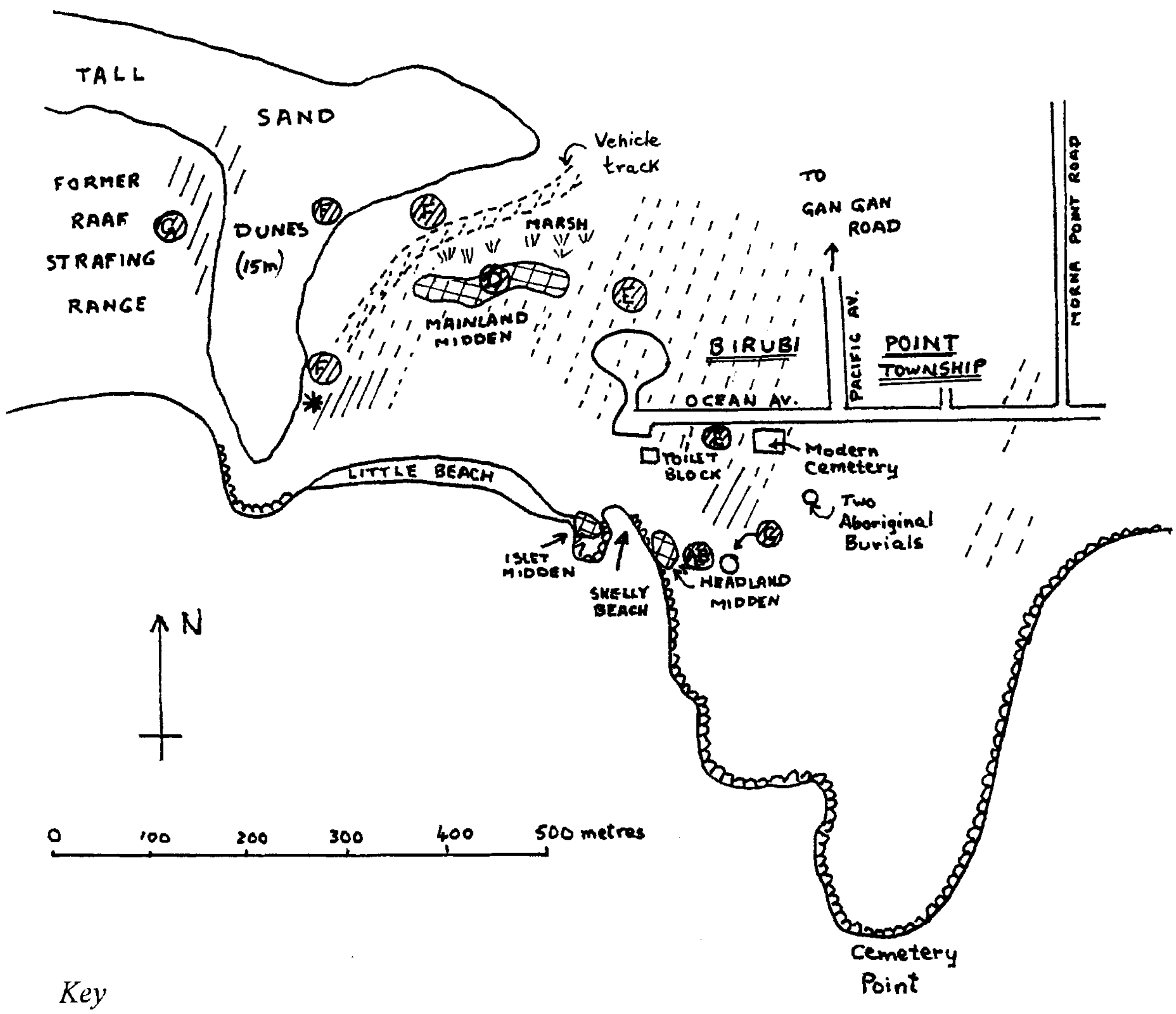
1	Birubi
2	One Mile Beach
3	Skate Bay
4	Fenninghams Island
5	Lemon Tree Passage
6	Mallabula
7	Uralla
8	Majors Flat
9	Oakfield
10	Williamtown
11	Macs Track
12	Freshwater Lagoons



MAP 2: LOCATION OF THE BIRUBI SITE WITHIN THE PORT STEPHENS AREA
Those Aboriginal sites referred to in the text are shown in the attached Key.

MAP 3: SKETCH MAP OF THE BIRUBI SITE

Dated April 1977. Note that Midden C was not visible at that time, and was added to this sketch in 1978.



Key

	Shell middens (intact in 1977)
////	Scattered material (deflated midden)
	Former shell middens (destroyed before 1977)
	Rocky shoreline
	Marsh
	Midden designation
*	Approximate location of burials excavated by Thorpe in 1926

MAP 4: THE "HEADLAND MIDDEN" AND "ISLET MIDDEN" AT BIRUBI

This sketch map is dated April 1977