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# THE LAPSTONE CREEK EXCAVATION: TWO CULTURE PERIODS REVEALED IN EASTERN NEW SOUTH WALES.

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(Figures 1-131.)

(Figures 95-131 are contained in Plates I-IV.)

This paper is an account of the results of the excavation of a rock-shelter situated (Figure 1) on the southern side of a gully a few hundred yards north of the bridge over which the Great Western Road crosses the Western Railway Line. This gully is on the eastern slope of the Blue Mountains, and the rock-shelter, which faces northward, is at its lower end. Lapstone Creek flows down the gully to the river half a mile to the east. From various vantage points above the rock-shelter the aborigines had a wide view of the lowlands towards the river. Before the railway was constructed there was easy access from this gully to the Nepean River and Emu Plains. Nowadays a high railway embankment runs across the gully and shuts off completely the old way of access.

The deposit was first noticed by a local resident, Mr. G. E. Bunyan, who found some flakes just below the surface in 1936. Soon afterwards, unfortunately, the whole of the occupational deposit at the western end of the rock-shelter was dug out by several private collectors, whose main interest was the acquisition of specimens, and they made no records of their work or of the specimens recovered. A small trench was dug by them at the eastern end, but otherwise the deposit excavated by us was undisturbed. Mr. Bunyan kindly invited a party to excavate the latter portion of the deposit, and in December, 1936, the task was undertaken by the late Mr. C. C. Towle and Messrs. G. Bunyan, C. Towle, Sr., G. A. Williams and the author. The late C. C. Towle and the author wrote a preliminary account of the work, most of which is included in the present report; to it I have added sections ii to vi.

This rock-shelter is one of a type which occurs commonly in the Hawkesbury Sandstone formation in the central coastal district of New South Wales. It is a deep rock-shelter (Figure 95) in which perfect protection is given in wet and cold weather. It measures 10 metres across the entrance, 3 metres from the front to the back wall in the middle, and 1.4 metres from the undisturbed floor to the ceiling which is smoke-blackened as a result of long occupation.

Prior to the occupation of the rock-shelter by the aborigines, some very large blocks of sandstone had fallen from the outer edge of the roof, and these, together with other rocks, formed a somewhat irregular platform across the entrance (Figures 97-98). This platform was approximately 8 metres in length, and its surface was 1.4 metres above the rock-floor of the cave. Some of the blocks on the outer side of the platform sloped steeply towards the bottom of the gully.

On their arrival at the site, the aborigines apparently found the rock-floor comparatively free of debris. The platform of rocks formed a natural barrier across the entrance and confined the hearth deposit, which, as it accumulated, spread to the limits of the cave. Eventually the deposit increased to such a height that it spread out over the rocky platform, and before we commenced our excavation only the tops of three of the larger blocks of sandstone were visible.

Within the cave conditions were favourable to the steady and undisturbed growth of the midden, and the work carried out by us revealed a homogeneous deposit 1.4

metres deep. At the extreme eastern end, owing to the slope of the rock-floor, the deposit was only 0.85 metre in depth, and this was the shallowest section excavated.

In the early stages of occupation the steeply sloping rock-floor must have made the cave a very uncomfortable place of abode for the aborigines because it has a general angle of about 45 degrees. The deposit rested entirely on the rock-floor, and its deepest part was behind the rocky platform around a central fire-place (Figure 98). The natives slept on a layer of grass (Hunter, 1793, p. 59) or rushes (Officers' Journal, 1789, p. 17).

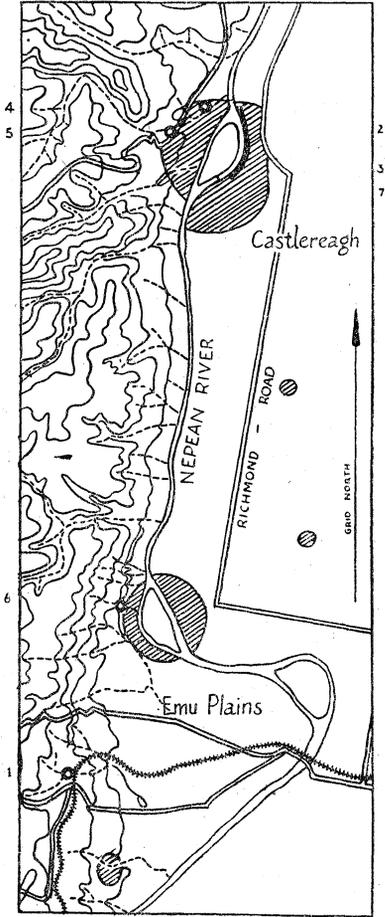


Figure 1.

Map of the Emu Plains and Castlereagh area showing the dissected escarpment of the Blue Mountains, and the Nepean River flowing through the plains. The creeks are shown as dotted lines. The river bank is fifty feet high, and west of the river the first contour line is the 100 ft., and the balance are the 200 ft. series to the top of the range. The positions of the sites dealt with in this paper are as follows: 1. Rock-shelter on Lapstone Creek just north of the junction of the railway line and road. 2. The shaded areas represent the various surface workshops. 3. The narrow black strip beside the river at the northern end of the map is the site of the axe-grooves and engraving of a kangaroo (Fig. 94). 4. Rock engraving of a kangaroo (Fig. 93). 5. Rock engraving of kangaroo hunt (Fig. 92) beside Hawkesbury Lookout Road. 6. Rock-shelter, in a creek bed, containing human hand stencils (Fig. 100). 7. Black's Falls, site of supposed fish-trap, shown by line across river at the southern end of the axe-grinding site. Scale 1 inch = 1 mile or 1.60 kilom.

We are unable to state with any certainty when the aborigines ceased to occupy the cave. The first farms along the Nepean River were established in 1794 and the aborigines were thinned out rapidly during the hostilities between them and the settlers during the subsequent ten years. There were natives in the Emu Plains district until about sixty years ago, but most of them were from west of the Mountains and elsewhere.

There is, at present, no satisfactory method of estimating the length of time during which the deposit was accumulating, but this matter will be referred to again. Palaeontological evidence is entirely lacking, and the only remains of fauna comprise a few small pieces of animal bone, practically unidentifiable, and two snail shells.

*Method.* We excavated (Figures 96–98) the whole of the deposit at the eastern end of the rock-shelter. Our excavation, as measured along the edge of the rocky platform, was 5·8 metres long, up to 3 metres wide, and from 0·85 to 1·4 metres deep. It is regretted that a test-strip was not left for future workers, but this course was decided against because we considered that any portion of the deposit left untouched by us would be ransacked as was the western end. Furthermore, the excavation of other rock-shelters in the gullies along this scarp will provide a suitable substitute for such a test-strip.

The work was commenced by digging a trench (Figure 2) from the front to the back of the rock-shelter at a distance of 3·71 metres from the eastern end. A layer of fine dust, up to 9 cm. thick, which had accumulated since the aboriginal occupation, was taken off the surface. Thin layers of the deposit were then put through a very

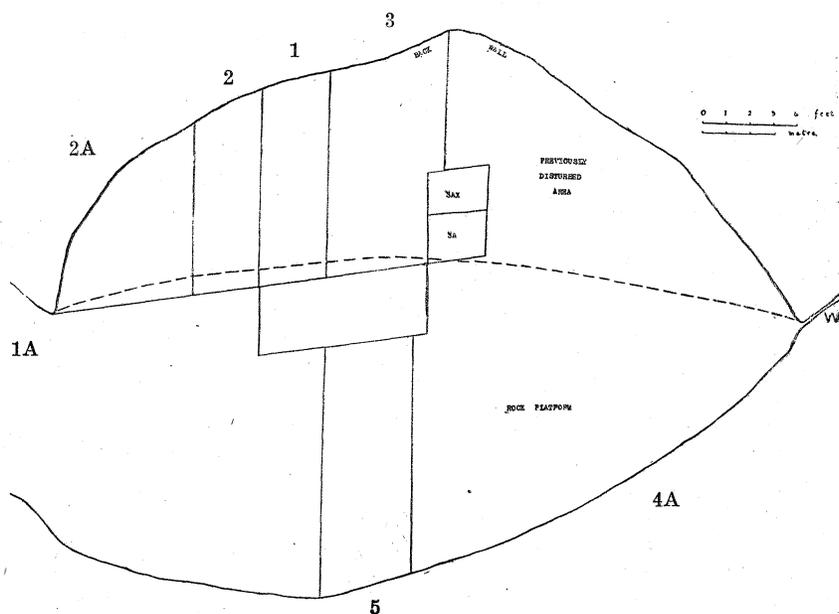


Figure 2.

Horizontal plan of the Lapstone Creek rock-shelter. The numbers represent the sections excavated, and the dotted line represents the margin of the rocky platform.

fine sieve, and each of the six layers A to F (Figure 3) was dealt with before the next one was commenced. The deposit excavated was taken out in seven sections; the results were compared and found to be uniform from top to bottom throughout the deposit. The many thousands of unused stone flakes and the large number of implements recovered were well distributed throughout the deposit, no part of which was devoid of them. Careful watch was kept for evidence of stratification or for any slight changes which may have taken place during the occupation, but there was no perceptible change visible to us in the compact, dark-coloured ash-laden midden. Apparently, therefore, the rock-shelter was in regular if not continuous occupation, although the implements in the deposit indicate very clearly that a somewhat abrupt cultural change took place at one period, about the middle, in its history.

Reference has already been made to the rocky platform (Figures 97–98) outside the rock-shelter, but its unusual character merits detailed description. It was, in all, 8 metres long. The first 3 metres at the eastern end consisted of large blocks of sandstone, the next 2·3 metres was composed of smaller lumps, and the remaining section

at the western end consisted also of large blocks. In the middle section the large blocks receded for almost 1 metre and the whole space was filled up by the smaller lumps of sandstone placed there by the aborigines. When this section was excavated it was found to consist of small blocks of sandstone of a handy size, averaging about  $45 \times 30 \times 15$  cm., around which ash was tightly packed. These blocks had been piled up by the aborigines to make the fire-place from time to time as the deposit increased in depth, and this niche was thus used continuously as the hearth. At a height of 60 cm. from the rock-floor, the aborigines added several more of these blocks in such a way that they formed a level platform about 1 metre wide, on top of which a larger flat-sided slab was propped on its side (Figure 97) with a smaller stone to support it possibly as a backing to the fire-place. A considerable quantity of ash was taken out of this niche and it contained implements from top to bottom. The *Bondi* points were met with in it at a depth of 90 cm. and were then found down to the rock-floor.

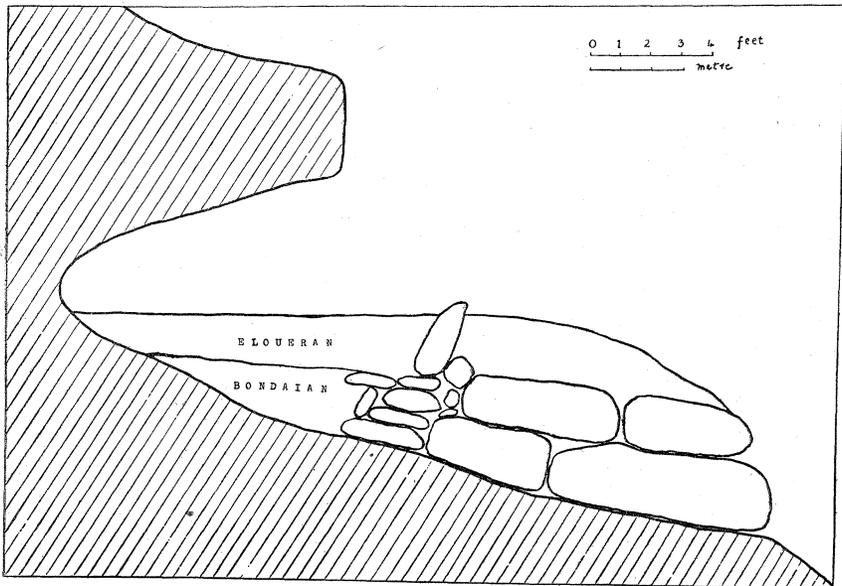


Figure 3.

Vertical section of the deposit from the outside edge of the rocky platform to the back wall of the rock-shelter. It shows the group of small blocks of sandstone in the fireplace, the large slab set on its edge on top of the latter, and the large blocks outside.

We have given close attention to the inner side of the rocky platform because in the middle of it the aborigines built the above-mentioned more or less regular wall. This may not have any great significance because they may simply have pushed back as far as they could any rocks projecting into the rock-shelter or lying on its floor. If, however, they had any deliberate intention of constructing a regular wall it is difficult to give any reason why it was done.

## II. DESCRIPTION OF IMPLEMENTS.

To simplify the description and understanding of the implements, and in view of the fact that they consist so definitely of two industries, they are dealt with accordingly. The Bondaian industry consists of layers A to C, and the Eloueran industry of layers D to F. There is a slight marginal overlap between the two industries, as excavated.

**Bondaian Industry.**

## COROID IMPLEMENTS.

## NUCLEI.

(a) *One Platform* (Figures 4-7).—Among the 49 cortex-backed nuclei 30 possess a plain and flat, 13 a plain and dished, 5 a faceted, and 1 a dished and faceted striking-platform. Eighteen of these have a pointed, 6 a flat, 25 a cortex-rounded (among which some have a straight edge), and 2 a chisel end. One of the latter two is a perfect example of the type (Fig. 6) from layer A, with a dished and faceted platform and narrow flake-scars. None bear battering or splintering on their distal end. In shape they are all flat or convex-faced elongate pieces, not very thick, knapped on the front and lateral margins, and their cortex back is frequently flat. One is quartz. Most of the flake-scars are narrow. Five are from 2 to 3 cm. long, the remainder up to 5 cm.

Among the 12 prismatic nuclei knapped all around, 4 have a plain and flat, 2 a dished and plain, 3 a flat and faceted, and 3 a dished and faceted striking-platform. Six have a chisel or keeled, 2 a pointed, and 4 a rounded cortex end. Most of the flake-scars are narrow. Three to 5.5 cm. long.

There are 12 secondary nuclei in the above two groups. Most of them bear one, sometimes two, narrow flake-scars on a lateral margin. Some of them are impossible to distinguish from burins, particularly where the flake-scars are truncated, and in fact might well have been used for burinate purposes. On the other hand, they probably represent failures in striking the points. Van Riet Lowe (1946, 242, fig. 2) has also drawn attention to this difficulty in connection with bi-polar fracture and stated that the possibility of these implements having been used as burins cannot obviously be ruled out. The secondary nuclei are from 3 to 3.5 cm. long.

The angles of the striking-platform and knapping face are as follow: 60 to 65°—2; 66 to 70°—0; 71 to 75°—12; 76 to 80°—9; 81 to 85°—9; 86 to 90°—4.

(b) *Two platforms at opposite ends* (Figures 8-12).—Among the 42 cortex-backed nuclei 22 bear 2 plain and flat, 1 two plain and dished, 9 one plain and one dished, 2 two flat and faceted, and 8 one plain and one faceted striking-platforms. Seven have one chisel or keeled end, and on 32 the two platforms are either at a right or a steep angle. It is impossible to make any distinction between chisel-ended and flat-based platforms because a few have the two platforms at right angles, some have one at a right angle and one at a steep angle, and some have both at a steep angle. Where the two platforms are at a steep angle the two knapping faces meet at an angle in the middle of one side of the nucleus, but on the other kinds the knapping face is usually vertical or nearly so. Most of these nuclei are thin and there are only a few thick irregular pieces among them.

Among the 35 prismatic nuclei knapped all round, 13 have two plain and flat, 3 one flat and one dished plain, 5 two plain and dished, 3 two faceted, 7 one plain and one faceted, 6 two faceted and dished striking-platforms. Fifteen have a chisel or keeled end, and 26 from flat to angled ends.

There are 25 nuclei from 2 to 3 cm. long, and 40 up to 5 cm., and one 7 cm.

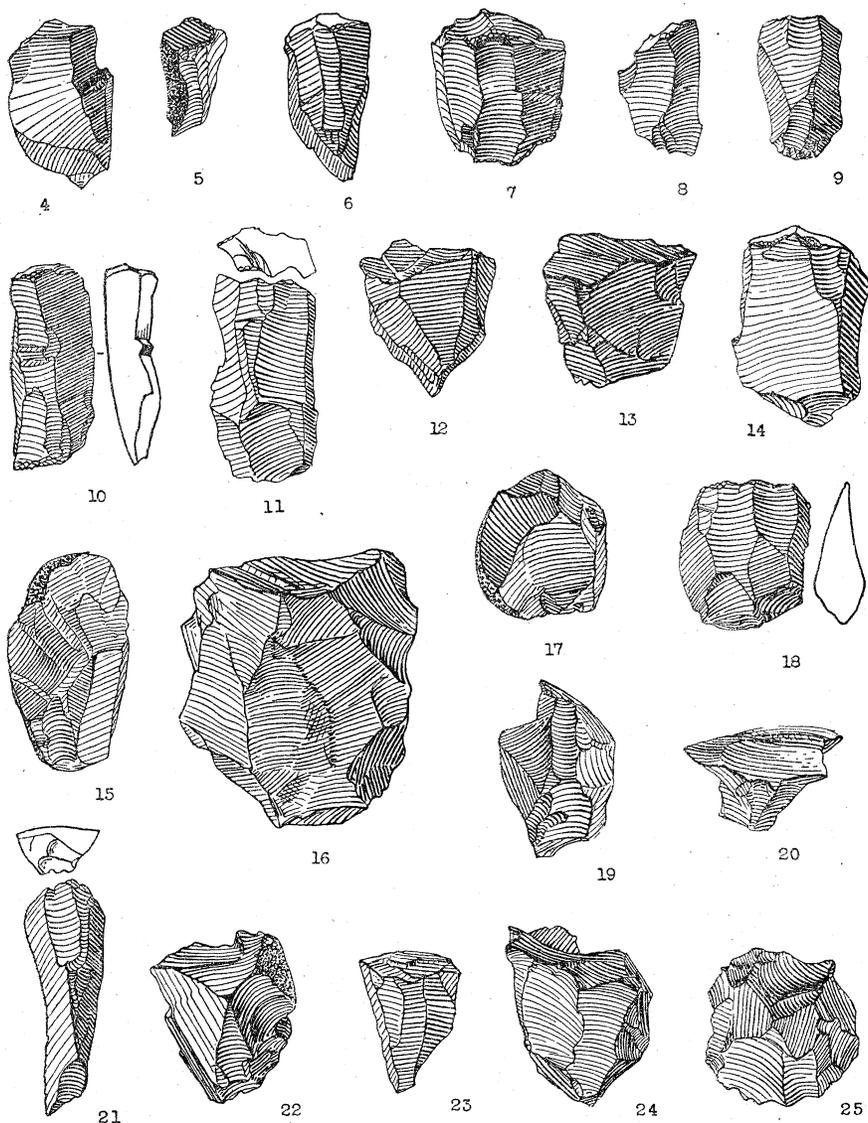
There are 16 secondary nuclei in the above two groups.

Several of these nuclei bear a concave working edge 1.25 cm. wide and 2 mm. deep on one lateral margin. One of the quartz nuclei displays bi-polar working.

The angles of the striking-platform and knapping face are as follow: 60 to 65°—2; 66 to 70°—0; 71 to 75°—16; 76 to 80°—13; 81 to 85°—10; 86 to 90°—9.

(c) *Two platforms at right angles* (Figure 13).—The 9 specimens are all irregular in shape, with all but several of the platforms plain and flat, the other being dished. One is 2.5, and the remainder from 3 to 5 cm. long. The angles are similar in range to the nuclei with one and two striking-platforms.

(d) *Alternate platforms*.—No examples.



Figures 4-25. Nuclei.

*Bondaian industry.*—4. Cortex back, one platform. 5. Cortex back, with plain and dished platform. 6. Cortex back, with faceted and dished platform, chisel-ended. 7. One faceted platform, keeled end. 8. Cortex back, with one plain and one faceted platforms. 9. With one plain and one faceted platforms. 10. Cortex back, with one plain and one faceted platforms. 11. Two dished and faceted platforms. 12. One dished platform and keeled end used as platform. 13. Two platforms at right angles.

*Eloueran industry.*—14. Cortex back, one faceted platform. 15. Cortex-backed quartz pebble. 16. Cortex back, one dished platform. 17. Cortex back, one plain platform. 18. One plain platform and keeled end. 19. One faceted platform. 20. Conical microlithic nucleus with dished platform. 21. One faceted platform. 22. Two plain and flat platforms. 23. One plain and flat platform. 24. Two plain platforms at right angles. 25. Discoid nucleus with alternate platforms.

The full range of nuclei is shown in this series in which the shapes and angles of the platforms are indicated.

*Re-directing flakes.*—The eighteen examples found comprise 11 thin pointed pieces from 3.5 to 6 cm. long, 3 blade-like pieces from 5 to 6 cm. long, and 4 thick blocks from 3 to 4 cm. long. All bear the characteristic truncated flake-scars.

#### KNAPPED IMPLEMENTS.

*Blocks* (Figure 26).—Four specimens, all 4 cm. long. One has three concaves 7 mm., 1 cm., and 1.5 cm. wide, and up to 4 mm. deep, on a lateral margin, one has one concave 1.5 cm. wide and 2 mm. deep, one is a convex end scraper, and one is a side and end trimmed scraper with a concave 3 cm. wide and 5 mm. deep on one lateral margin. The remaining specimen, 4.5 cm. long, has a shallow end concave 2.5 cm. wide.

*Slices.*—There are two examples from layer B. One (Figure 59) is a split-pebble slice  $13 \times 9 \times 2.5$  cm. in size, roughly trimmed along the thick outer crescentic margin and gapped by use along the chord. The other one is a side-blow slice,  $12.5 \times 10 \times 2.5$  cm., with a semi-discoidal and roughly trimmed thin edge and thick outer margin.

#### NORMAL FLAKES AND BLADES.

*Elouera adze-flake* (Figures 27–28).—Only five specimens were found in this industry. One of type i is trimmed on the inner edge of the thick margin, and its saw-trimmed chord bears a slight use-polish. It is 3.5 cm. long. Two are of type iii, both perfect examples, 4.5 and 5 cm. long, trimmed on both edges of the thick margin, and one of them has a shallow concave 1.5 cm. wide on the chord.

*Scrapers* (Figures 30–33, 35–37).—The side scrapers comprise 14 narrow to broad blades from 3.2 to 5 cm. long. Several are asymmetrical and cortex-backed. One is a broad side-blow flake 3.2 cm. long, and there are two side-blow blades, one of which is trimmed on the edge of the inner face. Another blade is trimmed on the inner face also. Only one has a faceted butt.

Among the double side scrapers is a blade (Figure 29) 8 cm. long, heavily trimmed on one lateral margin from keel to edge, and use-polished on the other lateral margin. There is also a blade 3.5 cm. long, 1.5 cm. wide, and 7 mm. thick, trimmed on the inner face of one margin and heavily use-polished on the other margin. The other two specimens are reverse-trimmed blades 3.3 and 3.5 cm. long.

The only side and end scraper is a narrow keeled blade 4 cm. long with a steep-faced end.

The end scrapers comprise a small series of blades, either keeled or flat, and some are very thin pieces. Two of them have a steep-faced working-edge. The latter on most examples is straight, and is oblique on three. Two of them have a faceted butt and one is a butt-end scraper. They are from 3.2 to 4 cm. long.

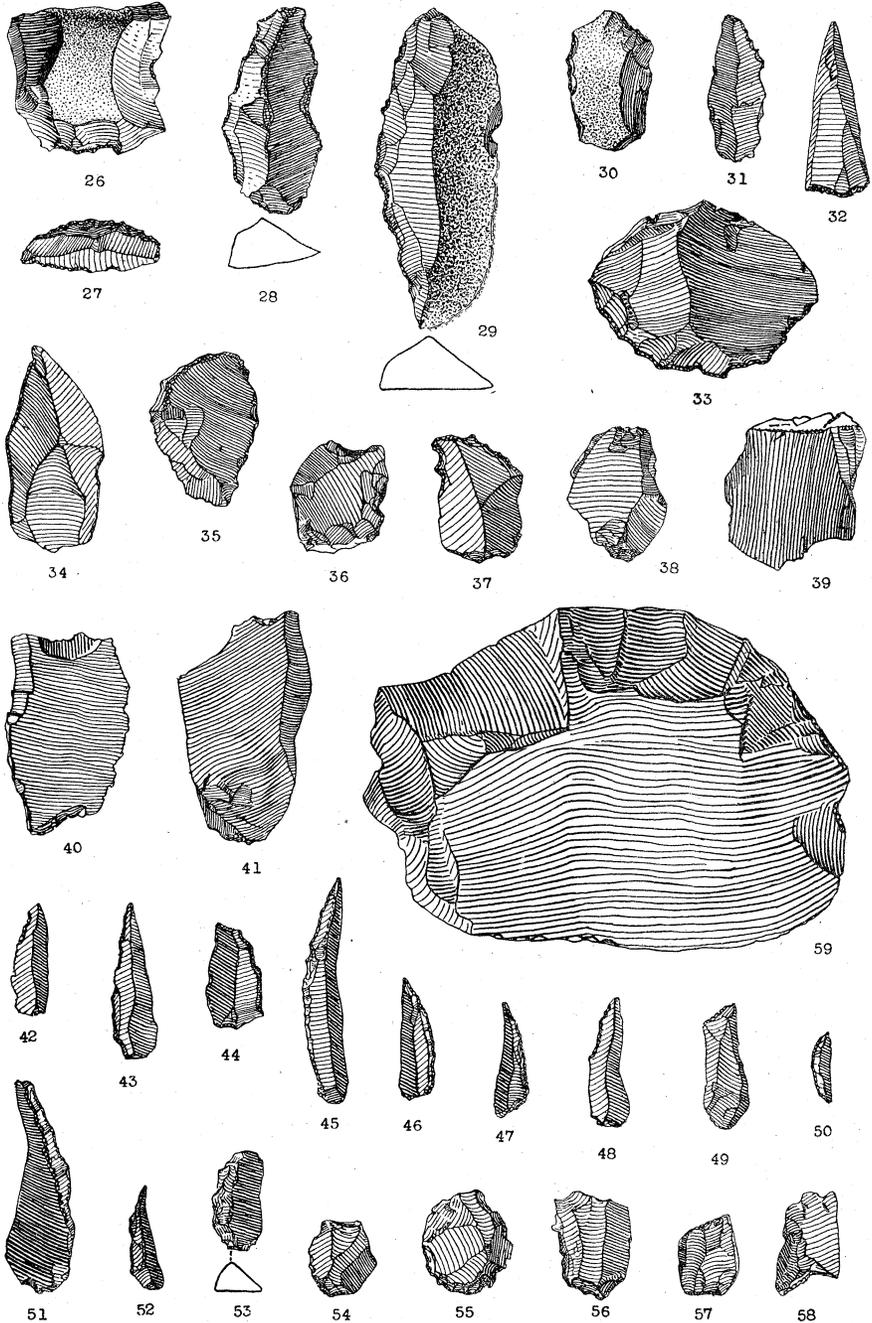
There is a fine example of a semi-discoidal scraper on a thick flake 6 cm. long, with several shallow concaves and a broad rounded nose on the working-edge.

The concave scrapers are well represented, being a mixture of flakes and blades on which 3 have the concave on the lateral margin, 3 on one end, and one on the butt. One has two reverse concaves on one end. Two of these specimens have a faceted butt. The concaves are from 1 to 1.5 cm. wide, one being 2 cm., and from 2 to 5 mm. deep. They are usually on a trimmed margin, and on a thick portion of the edge. One is a side-blow flake. They are from 3.25 to 5 cm. long.

Four blades bear a nose, three being on a corner of the distal end, and one on the lateral margin. One is like a parrot-beak in shape. The noses are rounded and small.

*Knives and saws* (Figure 34).—These are all narrow to broad blades, four of which have a faceted butt. Twenty of them bear a knife edge with primary scaling, and 3 have a bi-scaled saw-like edge. One has a cortex back, and several are pointed. They are from 3.5 to 7 cm. long.

*Burins* (Figures 39–41).—Those with a plain platform are a relatively poor series of 7 specimens, and only two of them might be regarded as utilized. Two are on side-



Figures 26-29. Bondaian industry.

26. Block, with lateral and end concaves. 27-28. *Elouera* adze-flakes of type iii, scraper use on chord. 29. Blade with heavy step-chipping on one margin and use-polish along the other margin. 30. Side scraper. 31. Side scraper, with use-polished edge on one margin. 32. End scraper. 33. Semi-discoidal scraper. 34. Knife used on both lateral margins. 35. Blade with scraper edge on one margin and saw-chipping on other margin. 36. Scraper with concaves on lateral margin and end. 37. Double-end scraper, with small concave on butt, nose on distal

blow flakes. The working edge is formed by one spall on six and by two spalls on one, and it is from 5 to 8 mm. wide. One has been re-struck. They are from 3.5 to 5.8 cm. long.

The scaled series comprises one rostrate and 8 concave platforms. The working edge is formed by one spall on 8 and by three spalls on one, and is from 4 mm. to 1 cm. wide. One (Fig. 40) which has been re-struck displays a truncated spall-scar and is a perfect example of the scaled burin. One is a double with a plain platform at the other end. Parts of their margins bear scraper trimming or knife use. They are 3.5 to 5 cm. long.

On the majority of the above burins the working edge is formed at the distal end of the blade or flake.

*Bondi Points* (Figures 42-52).—These were well represented in each of the three layers, and on analysis gave the following result:

1. Partly trimmed on inner edge:

A. Point end and plain butt	.. .. .	46
B. Point end and butt	.. .. .	13
C. Point end and faceted butt	.. .. .	14

Two in the B variety have an oblique and a straight butt end respectively and are thus of *Woakwine-point* type. Among the faceted-butt kind two are thick, broad and oblique ended, and one is short and broad like an asymmetrical trapeze.

2. Fully trimmed on inner edge:

D. Plain butt	.. .. .	26
E. Rounded trimmed butt	.. .. .	40
F. Faceted butt	.. .. .	16

The smallest point in the collection, 1.8 cm. long and 4 mm. wide, is in this group and is a beautifully made example of E. Two of the largest points, both broken at the distal end, are in this group. Several possess the high triangular form of trimmed butt. Two of the E variety are of *Woakwine*-type, and another one is a very thick point  $4 \times 1.5 \times 1.5$  cm. in size.

3. Trimmed on both edges of thick margin: G. Partly .. .. . 13  
H. Fully .. .. . 19

In the G variety 6 have a plain, 5 a trimmed, and 2 a faceted butt, and in the H variety 17 have a trimmed and 2 a faceted butt. One is a large flat point 6 cm. long and 2 cm. wide. One is trimmed half-way along the chord as well as on the thick margin.

4. Use on chord. Eight show primary knife use, one has a bi-scaled saw-like edge, and 4 bear scraper trimming. Three examples are trimmed on both margins at the point end, possibly for use as piercers.

5. Dimensions: 1-2 cm., 5; 2-3 cm., 120; 3-4 cm., 48; 4-5 cm., 9; 5-6 cm., 4.

There are 120 out of a total of 182 specimens in the 2-3 cm. group, which is dominant on all other sites in New South Wales analysed to date (McCarthy, 1943; McCarthy & Davidson, 1943).

Six of the points were found between 71 and 76 cm. deep in layer D, due no doubt to the contour of the surface of the deposit. I therefore place them in layer C.

*Flake fabricators* (Figure 38).—Few bipolar flake and blade fabricators were found. It is possible, therefore, that they were not used in fashioning the *Bondi*-points as I

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end, and several other small concaves on margins. 38. Bipolar flake-fabricator of punch-type, used at each end. 39. Scaled burin, with three transverse spalls, possibly of fluted type. 40. Scaled burin, showing re-struck spalls. 41. Scaled burin. 42-46. *Bondi* points trimmed on one edge. 47-48. *Bondi* points trimmed on one edge and of *Woakwine* variety. 49. Oblique trimmed blade. 50-52. *Bondi* points trimmed on two edges of thick margin. 53-58. *Microoliths*. 53. *Elouera* adze-flakes of quartz, type iii. 54-56. End scrapers. 57. Bipolar flake fabricator, punch-type, used at both ends. 58. Concave end scraper. 59. Large slice trimmed on one end and chord.

have previously suggested (McCarthy, 1943, p. 130). The four specimens recovered are from layer C. Two are crescentic blades 4 and 5 cm. long, heavily worked on both lateral margins, one is a narrow keeled blade, 4 cm. long, used at one end and use-polished on one lateral margin, and the other one is a blade, 3.5 cm. long, used at both ends.

*Unused flakes.*—Among the unused flakes and blades are 28 with a faceted butt. Most of them are narrow blades but some are of the slender point type.

#### PERCUSSION STONES.

These comprise five oval pebble hammerstones, from 5.5 to 10 cm. long, used lightly on parts of their margins and one on one surface in addition. One is made of quartz.

#### MICROLITHS.

*Blocks.*—Two have a concave 1 and 1.5 cm. wide and 3 mm. deep, and two have convex working edges. One of the latter is a thick semi-discoidal scraper. They are from 2.5 to 3 cm. long.

*Elouera adze-flake* (Figure 53).—The only example is of quartz, 2.7 cm. long, of type iii, and its outer face is cortex.

*Scrapers.*—The side scrapers comprise three flakes and two blades, one of the latter has a use-polished edge on a very thin margin, one is steep-faced, and one is trimmed on the inner face. There is one double side scraper on a thick flake. They are from 1.8 to 3 cm. long.

The end scrapers (Figs. 54–56) consist of 4 thumbnails with a trimmed semi-discoidal margin, whilst the trimmed end is convex on 3, straight on 2, and steep-faced on 1. They are mostly short blades, three of which are keeled, and one has a faceted butt. They are from 1.8 to 2.95 cm. long. There are also two oblique trimmed blades 3 cm. long.

There are two discoids, 2 and 2.5 cm. in diameter, from layer C, and one of them is reverse-trimmed.

The concave (Fig. 58) and nosed kinds are well represented, as in the larger normal flake and blade scrapers. They are mostly short blades and irregular flakes 2.5 to 3 cm. long. Four possess a concave from 1 to 1.5 cm. wide and up to 3 mm. deep, one has two similar concaves, and one has a concave 1 cm. wide and 2 mm. deep on the end and a scraper edge on the other margin. One is a side and end scraper with a small nose and concave on the end, and another one has a rounded nose between two concaves 7 mm. wide and 2 mm. deep. They are from 2.3 to 2.8 cm. long.

*Knives.*—There are six blades from 2 to 3 cm. long bearing primary knife use, and one has a bi-scaled saw-like edge. One has a faceted butt. Five are narrow blades and one a broad one.

*Burins.*—One 2.8 cm. long, with plain platform, has a transverse working edge 4 mm. wide and a faceted butt. The scaled series comprises one with a concave and one with a convex platform, with one and two opposing spalls respectively forming working edges 5 and 8 mm. wide. One is a double with a concave scaled and a plain platform, both with one opposing spall and working edges 4 mm. wide. They are 2.8 and 3 cm. long.

*Segment.*—One example (Figure 80), 3.3 cm. long, is steeply trimmed right along the inner edge of the outer margin, and lightly bi-scaled on the chord as though used for cutting.

*Flake Fabricators* (Figure 57).—These comprise one used on one lateral margin and six punch-type used at both ends. Five of the latter are quartz bi-polar struck blades. They are from 2 to 3 cm. long.

#### *Composition of the Bondaian Industry.*

It will be seen from the above description and the table that the Bondaian point is the outstanding specialized implement in the Bondi industry at this site, being abundant

throughout layers A to C. The *Elouera* adze-flakes and the flake-fabricators are scarce in these layers. Nuclei with one striking-platform, or two at opposite ends, are predominant. They are either cortex-backed or knapped all round, have a pointed, rounded cortex, chisel or flat base, and a flat, dished, plain or faceted striking-platform. Right-angled platforms are uncommon, whilst alternate and compound platforms are unrepresented. Blocks are scarce, whilst slices and long blades are absent. The side, concave and nosed scrapers are the commonest kinds; knives and burins are well represented. Among the microliths the side, end, concave and nosed scrapers are the commonest varieties; *Elouera* adze-flakes, flake-fabricators and burins are rare.

The *Bondi* points were met with at a depth of from 71 to 76 cm. in the greater part of the deposit, and in one part at 91 cm. From the wall of rocks in the front to the back wall of the rock-shelter the Bondaian industry was almost a level deposit and from west to east it varied only a few inches. The points were the most important implement of the natives who first occupied the rock-shelter, and remained so for an appreciable, but at present immeasurable, length of time.

TYPES.	BONDAIAN INDUSTRY.				ELOUERAN INDUSTRY.				OUT-SIDE.
	A.	B.	C.	Totals.	D.	E.	F.	Totals.	
Nuclei:									
I. COROID IMPLEMENTS.									
One striking platform .. .. .	9	19	33	61	24	11	3	38	8
Two striking platforms—									
At opposite ends .. .. .	9	22	46	77	24	12	2	38	5
At right angles .. .. .	2	1	6	9	3	5	1	9	1
Alternate platforms .. .. .	—	—	—	—	5	1	3	9	—
Indiscriminate platforms .. .. .	—	—	—	—	1	15	3	19	9
Re-directing flakes .. .. .	3	7	8	18	5	1	1	7	—
II. KNAPPED IMPLEMENTS.									
Blocks .. .. .	—	2	2	4	6	—	—	6	—
Slices .. .. .	—	2	—	2	2	1	—	3	1
<i>Worimi</i> cleaver .. .. .	—	—	—	—	1	—	—	1	—
Long blades .. .. .	—	—	—	—	1	—	—	1	—
Normal flakes and blades—									
<i>Elouera</i> adze-flake .. .. .	1	1	3	5	30	5	4	39	4
Scrapers—									
Side .. .. .	2	5	7	14	16	10	7	33	4
Side and end .. .. .	—	1	—	1	—	—	—	—	2
Double side .. .. .	—	—	4	4	6	—	—	6	—
End .. .. .	4	1	1	6	2	—	—	2	—
Semi-discoidal .. .. .	—	—	1	1	—	—	—	—	—
Concave and nosed .. .. .	4	4	5	13	14	2	2	20	1
Knives and saws .. .. .	1	10	2	23	12	10	1	23	—
Use-polished edges .. .. .	—	—	—	4	—	—	—	8	2
Piercers .. .. .	—	—	—	—	1	—	—	1	—
Burins—									
Plain platform .. .. .	1	4	2	7	1	—	1	2	1
Scaled platform .. .. .	1	2	6	9	1	—	1	2	—
Flake fabricators—									
General .. .. .	—	—	2	2	2	3	3	8	1
Punch-type .. .. .	—	—	2	2	6	4	3	13	—
<i>Bondi</i> points .. .. .	42	58	86	186	—	—	—	—	2
Microliths—									
Blocks .. .. .	—	2	2	4	—	—	—	—	—
<i>Elouera</i> adze-flake .. .. .	—	1	—	1	10	9	15	34	11
Scrapers—									
Side .. .. .	—	6	—	6	10	14	15	39	11
Side and end .. .. .	—	—	—	—	2	2	—	4	—
Double side .. .. .	—	—	—	—	—	2	1	3	1
End .. .. .	1	4	5	10	—	1	1	2	3
Discoidal .. .. .	—	—	2	2	—	—	—	—	—
Concave and nosed .. .. .	1	7	3	11	4	6	6	16	—
Knives and saws .. .. .	—	4	1	5	2	6	3	11	3
Piercers .. .. .	—	—	—	—	—	—	1	1	—



apply to the nuclei in this industry as in the Bondi industry, the actual angles varying from  $90^\circ$  to  $80^\circ$  and lower. One small nucleus has a concave working edge at one end. One prismatic example, 4 cm. long, has a heavily step-chipped gouge-shaped distal end due to use. There are two nuclei with knapping faces only 3 cm. high, two cortex platforms at  $80^\circ$ , and cortex back. One flat-sided nucleus has two platforms on one lateral margin at an angle of  $80^\circ$ . There are four elongate quartz nuclei 4–5 cm. long with a rough cortex platform at each end, and three narrow prismatic quartz nuclei 2.5–3 cm. long evidently knapped by the bi-polar method.

There are 17 nuclei between 2 and 3 cm. long, and the balance are up to 5 cm.

The angles of the striking-platform and knapping face are as follow: 61 to  $65^\circ$ —1; 66 to  $70^\circ$ —1; 71 to  $75^\circ$ —3; 76 to  $80^\circ$ —4; 81 to  $85^\circ$ —9; 86 to  $90^\circ$ —3.

(c) *Two platforms at right angles* (Figure 24).—Most of these nuclei have a concave flake-scar as the second platform, which is thus a dished one. A narrow flake-scar runs from one lateral margin across the striking-platform of one secondary nucleus. The largest nucleus is a roughly prismatic cortex-backed example  $6.5 \times 5 \times 3$  cm. in size, with a cortex platform on its longest margin at an angle of  $86^\circ$  to the knapping face, and a dished platform at right-angles to the cortex platform; the distal end is splintered and crushed as though from use on an anvil during knapping. Two are 2.5 and 3 cm., the others from 4.5 to 6.5 cm. long.

(d) *Alternate platforms* (Figure 25).—This method of knapping is represented on a small number of nuclei, as is usual in New South Wales industries. Most of the specimens are roughly worked in poor material. Two elongate pebbles, 4.5 and 7.5 cm. long, have been developed from single-platform nuclei into the alternate type. Five examples, all 4 cm. long, are oval biface discoids, and one of them is a thickish piece. The flake-scars are mostly short and broad but some are long and very narrow.

(e) *Indiscriminate platforms*.—There are many quartz nuclei of this kind in layers D to F, and they range from pieces 2 cm. long to pebbles 5 cm. long, with one 10 cm.

*Re-Directing Flakes*.—The seven specimens found range from slender edge-blades (which are sometimes mistaken for points or abrupt-trimmed blades) up to 4 cm. long to blocks from 4 to 6 cm. long.

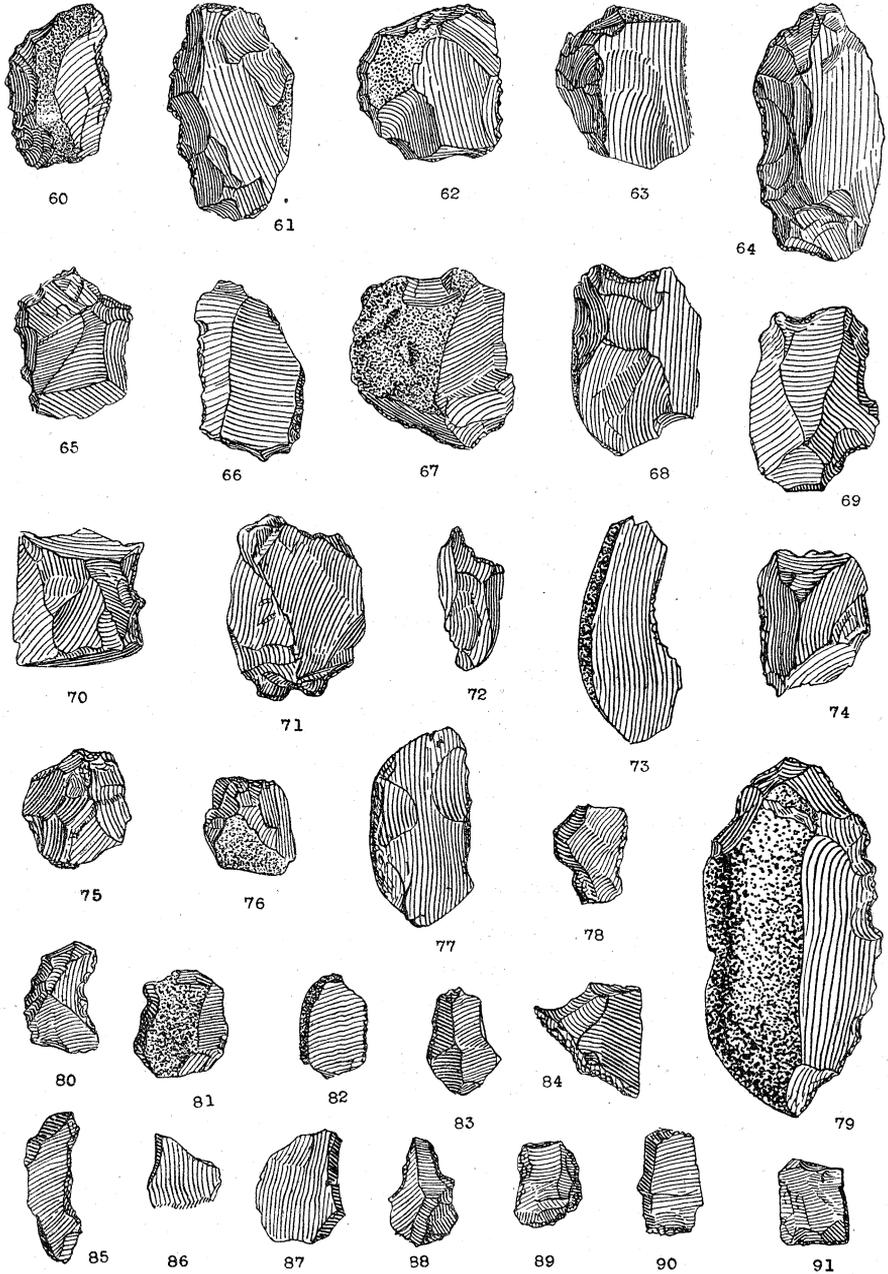
#### KNAPPED IMPLEMENTS.

*Blocks*.—In this industry, consisting of small implements, the blocks are few in number. One, 5 cm. long, is a side-blow flake with a trimmed convex end, and one, 3.5 cm. long, has a shallow concave at each end.

*Slices*.—These, too, are few in number. Two are side-blow flakes  $12 \times 11$  cm.  $\times$  4 cm. and  $11 \times 8 \times 3$  cm. in size, with convex edges used for cutting purposes. One is a split-pebble slice  $12 \times 7 \times 1.8$  cm. in size with flaking on the margin of the cortex face.

*Worimi cleaver* (Fig. 110).—A fine example was recovered from layer D, and it is the only specimen from the site. It is  $20 \times 6 \times 6$  cm. in size and 2 lb. 6 oz. in weight, with the point of percussion at the junction of the three surfaces at one end, that is, on the corner of the chord. The outer face is of cortex, the inner face a flat cleavage surface, the inner edge of the thick back is crudely trimmed along the lateral and convex end margins, both of which also bear evidence of percussive use. The straight chord is use-polished in the middle, particularly on the inner face, and the edge is slightly rounded or blunted as a result. It is made of a grey hornfels and resembles very closely examples from workshops on the north coast of New South Wales (McCarthy, 1941, p. 24, Pl. vi, fig. 11, and 1947).

*Long Blade* (Figure 79).—A unique chert blade from layer D is worth special mention. It is 8.8 cm. long, has a median ridge or keel from end to end of its outer surface, and a cortex striking-platform. It is trimmed along one lateral margin, on which there are five concaves from 7 mm. to 1.25 cm. wide and up to 4 mm. deep, and



Figures 60-91. Eloueran Industry.

60. *Elouera* adze-flake of type i, scraper use on chord. 61. *Elouera* of type ii, use-polished on chord. 62. Broad *Elouera* of type iii. 63. *Elouera* of type i, use-polished right along straight chord. 64. *Elouera* of type iii, use-polished right along convex chord. 65. Lateral concave scraper. 66. Double-side scraper. 67. End scraper. 68. End concave scraper. 69. Lateral concave scraper. 70. Scraper with concaves and nose on lateral margin. 71. Scraper with two noses and small concave on end. 72. Piercer. 73. Knife. 74. Biface flake fabricator used on both lateral margins. 75. Biface coroid fabricator. 76. Bipolar flake fabricator of quartz,

around the convex distal end to form a large but shallow concave 4 cm. long at the end of the other margin. Some of the small concaves are worked from the outer face and some from the inner face.

#### NORMAL FLAKES AND BLADES.

*Elouera adze-flake* (Figures 60-64).—This implement out-numbers all other types in the normal flake and blade group in this industry. Thirty-four of the examples are less than 3 cm. and 39 more than this length. The latter series consists of 22 of type i, 8 of type ii, and 3 of type iii, there being six broken and indeterminate specimens. Twenty-nine are abrupt-trimmed on one edge, which is the inner edge on the great majority, and 9 on both edges, whilst one is untrimmed, on the thick lateral margin or back. Seventeen are scraper-trimmed, 9 bear knife or saw use, 7 are use-polished, and 6 are unused on the chord. The chord is straight on the majority but varies from convex to shallow concave on the others. Among the use-polished edges five are straight and 2 convex, and on 6 of them the polishing is on an edge trimmed on one or both facets, but the remaining one has a perfectly straight smoothed edge. In shape the *elouera* are mostly elongate blades, but they range from slender to broad, from thin to thick, and from blades to almost semi-circular flakes. Ten are straight on both ends. One has a faceted butt, and one has a chisel-edge on the distal end. One has a very thick trimmed back and the two flat cleavage faces forming its inner and outer faces meet in a straight unused chord; this example is in every respect similar to the *Merna Wadna adze-flake* (McCarthy, 1946, pp. 27, 29, Fig. 109).

*Scrapers* (Figures 65-72).—The simple side scraper is in the greatest numbers in each layer. One is a pointed blade 4 cm. long with a convex lateral working edge. Most of them are blades. Three from layer E are inverse-trimmed, and one is a cortex-backed asymmetrical blade. None have a faceted butt. They are a poorly developed series from 3.1 to 5.5 cm. long. Among the double side scrapers is a triangular flake 3.25 cm. long, and three reverse-trimmed blades from 3.5 to 5 cm. long, a blade 4 cm. long with a faceted butt, and two flakes 3.5 and 5 cm. long. The end scrapers comprise two flakes 3.5 cm. long with a convex working edge.

The concave scrapers are also abundant as this kind of working edge is of fundamental importance to a people with round-shafted wooden weapons. The specimens include a miscellaneous series of rough blades and flakes from 3.2 to 6.5 cm. long. The concaves range from 5 mm. to 2.5 cm. wide and up to 5 mm. deep. Two bear a butt concave 1 and 1.5 cm. wide and both 5 mm. deep, and on one of them the concave is worked inwards on its striking-platform. The concaves are usually on a thick margin but one is on a thin distal end of a blade. Two have two concaves 1 and 1.5 cm. wide on their lateral margin, and the concave is on the end of 7 specimens, including the two largest pieces. There are three nosed scrapers, one a blade with a tiny rounded nose between two concaves on its distal end, one a thick flake 4 cm. long with rounded noses 5 mm. long and 1 cm. wide at their base, and 4 × 8 mm., separated by deep concaves 1 cm. wide on one end, and one a narrow blade with a pointed nose-like piercer 2 cm. wide beside a concave on the corner of one end. They are from 3.5 to 5 cm. long.

*Knives and saws* (Figure 73).—The 23 specimens are all blades excepting two flakes, and are from 3.2 to 6 cm. long. Three have a faceted butt which is unusually heavily trimmed on one of them. The lateral margin used for cutting may be a straight, convex or shallow concave edge, and its use ranges from light primary scaling to a well-marked bi-scaling. None are serrated.

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punch-type, used at both ends. 77. Flake fabricator used on both lateral margins. 78. Microlithic *Elouera* of type ii, scraper use on chord. 79. Blade with trimmed convex end and series of small reversed concaves on lateral margin. 80-91. *Microliths*. 80. *Elouera adze-flake* with concave working edge on chord. 81. Lateral concave scraper. 82. Side scraper. 83. Side scraper trimmed on inner face. 84. End scraper. 85. Double side scraper, reverse trimmed. 86. Scaled burin. 87. Burin with plain platform. 88. Bi-marginal point. 89. Bipolar flake fabricator used on four margins. 90-91. Bipolar flake fabricators, punch-type, used at both ends.

*Burins*.—One is a flake 4.5 cm. long from layer F with a plain platform and a working edge 8 mm. wide formed by three spall-scars. There are three utilized burins with working edges 3 mm. wide formed by a single spall. One thick flake 3.5 cm. long has a small rounded nose between two concaves 1 and 1.5 cm. wide on one lateral margin, and a single spall forms a working edge 3 mm. wide on the other margin at the distal end.

*Flake-fabricators* (Figures 74-78).—The high ratio of these implements in this industry is notable. Five are bi-faceted on one lateral margin and three on both margins. One of the latter is a thick piece 3.25 cm. long that is undoubtedly a fabricator, and two are thin flakes. The punch-type is represented by 13 specimens, several of which are quartz bi-polar blades, and others are cortex-backed. They vary from thin to comparatively stout pieces, and some are used at one end only. The working-edge is gouge-like on some examples. 3.25 to 4.25 cm. long.

#### MICROLITHS.

*Nuclei*.—These are included in the general description of the normal flake and blade cores.

*Blocks*.—Each of the three examples, which are from 2.5 to 3 cm. long, possesses a small concave on its end or lateral margin.

*Elouera adze-flake* (Figure 80).—Among the 34 specimens 21 are of type i, 6 of type ii, and 7 of type iii, a ratio which differs slightly from that of the shell-midden workshops on the south coast of New South Wales (McCarthy, 1943, p. 132). Twenty are trimmed on the inner edge and 14 on both edges of the thick margin or back. Twenty-two are scraper-trimmed, 7 bear signs of cutting use, and 5 are unused on the chord. Three bear a concave on the chord, including one 1.5 cm. wide and 3 mm. deep, and a small reverse-trimmed concave 1 cm. wide. Several bear a small concave on the inner edge of the back. One 2.8 cm. long is a stout example worked on both edges of the back, of which the inner edge is a long shallow concave with a humped nose on one corner and a piercer-like projection on the distal corner of the chord. They are all elongate blades, excepting one broad flake, and range from 2.5 to 3 cm. long. They do not resemble the geometrical segments in workmanship.

*Scrapers* (Figures 82-85).—There are 39 side scrapers from 2 to 3 cm. long, consisting of 11 irregular flakes and 28 blades. The trimmed edge on some is a long shallow concave. Three blades are inverse-trimmed and there are two double-side reverse-trimmed blades. Some of the blades are cortex-backed and asymmetrical. One is a narrow abrupt-trimmed blade, three are keeled side and end scrapers, and one has a faceted butt. Among the end scrapers are two triangular flakes abrupt-trimmed on their wide distal end, being of a type common in the Bathurst district (McCarthy, 1943, p. 206, Fig. 25).

Among the 16 concaves (Figure 81) are 12 narrow and medium blades and 4 flakes. The majority possess one concave only, but some have two, and they range in size from 5 mm. to 2 cm. wide and up to 4 mm. deep. One has a long shallow concave along one margin. One has a faceted butt. They are from 1.8 to 2.9 cm. long. One has a nose between two concaves 1 and 1.5 cm. wide and 2 mm. deep on its distal end. The concave working edge is usually steep-faced on a thick edge.

*Knives and saws*.—All but two are from narrow to medium blades. One is heavily bi-scaled along its working edge, and one has a crudely serrated edge. The cutting edges are either straight or convex. From 2 to 3 cm. long.

*Burins*.—In layer F were found two examples. One (Fig. 87) is a blade 3 cm. long on which the plain platform is the striking platform of the blade, and its working edge, 5 mm. wide, is formed by a single spall. The other one (Fig. 86) is a triangular flake 2 cm. long with a convex-scaled platform and a working-edge 4 mm. wide formed by a single spall. The burin from layer D is a thick flake 2.98 cm. long with a small platform

at one end, a working edge 5 mm. wide, and a trimmed lateral margin below the short spall-scar.

*Bi-Marginal Point* (Figure 88).—One example 2.5 cm. long, with a broad rounded butt end, and a short oblique distal end. The margins are not trimmed right along to the butt.

*Piercer*.—A narrow blade 2.5 cm. long with a short piercer at one end and two concaves almost 1 cm. wide on the same margin.

*Flake Fabricators* (Figures 89–91).—There is a surprisingly high number of these less than 3 cm. long, and the punch-type is the commoner kind. Eleven are used on one lateral margin, sometimes on one surface only, and 5 on two margins, 3 on one lateral margin and one end, one on two lateral margins and end, and two on one end. They consist of flakes and blades, mostly rectangular in shape, many of which are trimmed on both inner and outer face. They range in size from 2.5 × 2 × 1 cm. to thin blades 2.5 long and 1.25 cm. wide. Three are of quartz.

Among the punch-type 14 are used at one end, 20 at both ends, one on three margins and one on four margins. One-third of them are quartz, and one-third are obvious bi-polar flakes. The punch-type consists of elongate blades, approximately rectangular in shape, from 7 mm. to 2 cm. wide, thick at one end or in the middle, and a small number are very flat, thin blades. One is a nucleus 3 cm. long, with two striking-platforms at right angles, and each gouge-like working edge is heavily splintered and battered by use as a fabricator. They range from 1.7 to 3 cm. long.

Many of these trimming flakes are faceted all over both surfaces. The working-edge may be straight or gouge-like, and it varies considerably in strength among the range of specimens which may be thin and frail or fairly stout and strong.

#### PERCUSSION STONES.

The small number of hammerstones in the industry is surprising. Two are oval quartz pebbles, 4 and 4.5 cm. long, used at each end, and one is an oval pebble 7 cm. long by 2.5 cm. thick used on its lateral margin only. They are all lightly worked. The finest fabricator (Figure 106) is an oval pebble 14 × 8 × 4 cm. in size, with a trimmed biface lateral margin along its thinner side on which the edge is battered from percussion use.

#### EDGE-GROUND IMPLEMENTS.

##### AXE-HEADS.

*Windang Uniface pebble axe*.—One example from layer D is elongate-oval and straight-sided in shape, and is 12 × 6 × 3 cm. in size and 12 oz. in weight. A strip has been broken off right along one lateral margin. This axe-head is ground on both facets at a steep angle, and bears percussive marks on its butt and two anvil-pits on both surfaces adjacent to the convex blade.

One end of a pebble, 9 cm. wide and 4 cm. thick, is flaked on one surface round its margin, and it has a use-polished area opposite it on the end of the other cortex surface; these two facets form a straight edge. Although not actually ground, this implement no doubt served a similar purpose to the *Windang* axe-heads.

*Pebble axe-heads*.—There are two from layer D and one each from layers E and F. They are from rectangular to elongate-oval in shape, and are 9 × 6 × 2, 13 × 7 × 3, 15 × 9.5 × 2.5 (Fig. 105), and 10 × 7 × 3 cm. in size, and from 14 oz. to 1½ lb. in weight. The ground facets of the convex blades form angles of from 70 to 90 degrees, being steep and well marked off from the cortex surfaces. The facets show striations due to the method of grinding which run parallel with the long axis of the implements. Several bear flake-scars at the butt-end and on the lateral margins, and the butt of one is lacking, due to percussive use. All bear the latter marks on the butt and one has two

anvil-pits on its butt. They all display percussive use on both surfaces, mostly near the blade, but on one in the middle, and it varies from a shallow bruising and gashes to deep anvil-pits. They are flat or slightly convex on both surfaces.

A trimmed pebble axe-head from layer D is oval in shape,  $12.5 \times 9 \times 2.5$  cm. in size, and 1 lb. in weight. One surface is almost wholly but crudely flaked, and also half of the other surface. The convex blade end has been trimmed preparatory to grinding the facets but the latter process has only just been begun on one facet only.

*Biface coroid axe-head.*—One fine example (Fig. 104) of the type was found in layer D. It is elongate-oval in shape,  $12.5 \times 8.5 \times 4$  cm. in size and  $1\frac{1}{2}$  lb. in weight. It is round in transverse section and bears percussive use on one surface and on the flat butt. The ground blade is wide and convex.

*Additional axe-heads.*—It should be noted that about eighteen edge-ground axe-heads were dug out of the western end of the deposit by collectors and we secured two more from the shallow deposit outside the cave.

*Bulga-knife.*—Only one complete example (Figure 108) was present. It is a typical elongate-oval segment  $11 \times 6.5 \times 1.5$  cm. in size. The ground blade is slightly convex and well made with the facets at a steep angle. One surface bears about a dozen fine parallel scratches 1 cm. long, and there are two on the other surface, one of which is 5 cm. long. This example, and half of another one, each has one cortex and one cleavage surface, and they came from layer E. From layers E and D, however, we got two blanks of this implement. They are both side-blow slices with one cortex surface, and are  $11 \times 7 \times 2.5$  (Figure 107) and  $7 \times 5.5 \times 1.7$  cm. in size. The outer margin is trimmed to a crescentic shape. On one the latter margin is battered, and its chord is use-polished.

*Composition of the Eloueran Industry.*—It will be seen from the description and table that the most important specialized implements in the Eloueran industry are the edge-ground axes of *Windang*, pebble, and biface coroid types, the edge-ground *Bulga*-knife, and the *Elouera* adze-flake. The nuclei are the same as those in the Bondaian industry, with the addition of those with alternate platforms. It should be noted that the concave working edge is one of the most abundant types, indicating a wood-working industry of round-shafted weapons and other implements characteristic of all Australian aboriginal culture. There is one *Worimi*-cleaver, blocks, slices and long blades are rare, simple side scrapers and knives are common, burins are poorly developed and uncommon, chisels are abundant and use-polished working edge is fairly common. Microliths less than 3 cm. long are best represented by the side scrapers, *Elouera* adze-flakes and chisels.

#### Specimens Found Outside the Cave.

After completing the excavation within the cave, a section 1.4 metres wide was commenced on the outside. Almost immediately difficulties were encountered. Very large rocks occurred 30 cm. and more below the surface and these had to be removed to ascertain whether there was an occupational deposit beneath them. Bedrock was eventually reached at a depth of almost 2 metres, but the lower metre consisted of sandy soil in the crevices and was barren of implements. Implements were found to a depth of approximately one metre or less, and it was therefore considered unnecessary to remove the large closely-packed rocks deeper than half a metre in this outside area. There is, of course, no definite method of correlating the implements found outside with the two industries occurring within it, but from the general formation of the site it is considered that the greater portion of the outer deposit was built up after the deposit inside the cave had grown sufficiently to spread out over the platform of rocks. The implements from outside would, therefore, be grouped chiefly with the more recent or Eloueran industry, a conclusion supported by the presence of the edge-ground implements, and the relatively numerous *Elouera*. Moreover, one of the only two *Bondi* points found

here was from a depth of 33 cm., and the other one, found on the surface, was probably dropped by the collectors who dug out the western end of the cave.

#### COROID IMPLEMENTS.

*Uniface Pebble Implements.*—A very weathered pebble, 9.5 × 7 × 2.5 cm., is crudely trimmed along the end of one surface. It is probably an axe-blank.

*Nuclei.*—Among the single platform type, 4 are cortex-backed, 4 cm. long, and two of them are flat and not very thick. One is a fine example of the chisel-ended nucleus, 3 cm. long, with a dished and faceted striking platform at 99° and the chisel end at 80°. One has a trimmed concave 1.5 cm. wide and 3 mm. deep. There are four prismatic nuclei knapped all round, one of which is a secondary nucleus. They all possess a plain platform, one of which is at an angle of 80°. One is 2.5 cm., and three 3.5 cm. long.

Among the nuclei with two opposite platforms two are chisel-ended, 3 and 3.5 cm. long, one of which has a plain flat striking platform at an angle of 75°, and one a dished platform at 80°. Another one has both plain and dished platforms at 80°, with the flake-scars meeting in the middle of the knapping face. There are two quartz nuclei 3.5 and 4.5 cm. long with cortex platforms at each end. Eight quartz pebbles are crudely knapped.

The re-directing flakes comprise five bolecks with truncated flake-scars.

#### KNAPPED IMPLEMENTS.

*Slices.*—A side-blow slice, 10 cm. long, trimmed on the convex thick margin and showing chopper or scraper use on the chord, is similar in shape to the *Bulga*-knife.

#### NORMAL FLAKE AND BLADE IMPLEMENTS.

*Elouera adze-flakes.*—There are two of type i, one of type ii, and one of type iii, from 3.3 to 6 cm. long. Those of type i and type ii are trimmed on the inner edge of the thick back, and the type iii specimen on both edges, and all have well trimmed scraper edges on the chord. The type ii example has a utilized burinate edge at the butt end and a shallow concave 1.3 cm. wide at the distal end. The largest specimen, made of grey chert, has a bi-scaled saw edge on the chord, and a spall has been struck off one corner to form a utilized burinate edge 8 mm. wide.

*Scrapers.*—The four side scrapers, 3.5 to 6 cm. long, consist of two blades and two flakes, one being a side-blow flake with a steep-faced working edge. The two side and end scrapers, 4 cm. long, are on one blade and a flake with a faceted butt. One thick flake 3.5 cm. long has a concave 1.5 cm. wide and 3 mm. deep. A broad blade 4.5 cm. long has a trimmed distal end and a use-polished lateral margin 3.5 cm. long.

*Burins.*—One with a plain platform, concave, with a single opposing spall-scar 4 mm. wide, and knife use on both lateral margins.

*Flake fabricators.*—Only one example 3.5 cm. long used on one margin.

There are two narrow blades, unused, with a faceted butt.

*Bondi Points.*—The two examples are 3.5 cm. long and partly trimmed on the inner edge of the back. Both have a faceted butt. One has three small concaves separated by rounded noses, which is unusually heavy trimming for these points.

*Hammerstone.*—A round, flat pebble 5 cm. diameter and 1.5 cm. thick used lightly on portions of its margin and one surface.

#### MICROLITHS.

Eight *elouera* of type i from 2.3 to 3 cm. long are trimmed on the inner edge of the thick back. The chord on four bears knife use and on three scraper trimming. One has a faceted butt. Three others of type i 2.5 cm. long are trimmed on both edges of the back and all bear scraper trimming on the chord.

The eleven side scrapers are from 2 to 3 cm. long. The end scrapers, with convex working edges, are from 2.5 to 3 cm. long, and a reverse-trimmed double-side scraper is a thin blade 2.5 cm. long.

There are three knives from 2.5 to 3 cm. long.

Among the flake fabricators are 7 punch-type used at one end, and 7 at both ends, whilst one is used on both lateral margins. Three of them are of quartz. They are from 2.3 cm. long.

#### EDGE-GROUND IMPLEMENTS.

*Pebble axe-heads.*—An example rectangular in shape, 10.5 × 7.5 × 2 cm. in size and 12 oz. in weight. It has rounded corners, is flat on both surfaces, has sharply angled facets on the blade, and bears percussive use on the butt and lateral margins. One of the lateral margins is trimmed from one side only. There are deep and extensive anvil-pits and percussive marks covering an area 4 cm. wide on each surface, adjoining the blade and exactly opposite each other.

*Windang uniface pebble axe-head.*—An oval specimen (Figure 109), 12 × 7 × 2.5 cm. in size and 12 oz. in weight. It is flaked all round its margins from both sides and their edges are battered. A large flake has been removed by percussive use across the butt end. One surface is trimmed all over and the other only marginally. There are slight percussive gashes on one surface, and it is ground on both facets.

*Axe-blank.*—An oval pebble (Figure 103) 15 × 10.5 × 3.25 cm. in size, marginally trimmed on both surfaces along the sides and one end.

*Axe-grinding grooves.*—Several of these occur on a rock outside the cave.

#### Technique.

The nuclei (Figures 4–25), which are very small in average size, display a mixture of parallel and convergent flake-scars, without any emphasis on either type. Apart from the cortex-backed kind the nuclei are mostly straight-sided prismatic forms, and the pyramidal nuclei are represented by two small specimens only in contrast to their abundance at Singleton (McCarthy & Davidson, 1943, pp. 212–3, fig. 71). As the analysis of the striking-platforms demonstrated in both industries, the plain flat platforms are in the majority, whilst dished and faceted platforms are present in reasonable numbers. Nuclei with single platforms, and with two platforms at opposite ends, are in the absolute majority, alternate and right-angled platforms are uncommon, and compound platforms are absent altogether. Cortex platforms are few in number. Nuclei with pointed, rounded cortex, flat, chisel and keeled ends are all well represented. The chisel end is usually made by the removal of a single flake at a steep angle but on some nuclei this end is a keeled edge used as a second platform. On a small number of nuclei abrasions and splintering occur on an end opposite to a striking platform, indicating the use of an anvil in knapping, and the nuclei are so small on the average that this would appear to be the most practicable method of knapping them. There is very little trimming of the upper end of the flake-scars on the nuclei with a plain platform, although the spurs were removed on many of them. The short blows required, and the relatively thin flakes and blades removed, did not produce many troublesome spurs, so that on these nuclei the edge formed by the striking platform and knapping face is frequently untrimmed. Most of these nuclei, furthermore, are probably in the reject stage.

The dished platforms are mostly formed by the removal of a single flake leaving a concave flake-scar, but on some the flake removed left a narrow flake-scar along one margin of the platform, or two flake-scars are present separated by a median ridge. The re-directing flakes thus vary from elongate narrow to thick block-like pieces. The striking-platforms are mostly elongate or rectangular, but half rounded and triangular shapes are common.

The flake-scars on the nuclei are markedly narrow, although they are frequently short and broad. A high percentage of them failed to run the full length of the

knapping face even though most of the nuclei are only 2 to 5 cm. long. The angles of the striking platform and knapping face range on the average between 71° and 91°.

Blades form the great majority of pieces struck from the nuclei. The following series of inner angles were obtained from the 242 flakes and blades possible to measure in both industries: 86 to 90°—3; 91 to 95°—0; 96 to 100°—13; 101 to 105°—17; 106 to 110°—26; 111 to 115°—31; 116 to 120°—50; 121 to 125°—35; 126 to 130°—21; 131 to 135°—5; 136 to 140°—1. Among the *Bondi* points the following result was obtained from measuring 79 with plain and faceted butts: 86 to 90°—2; 91 to 95°—4; 96 to 100°—17; 101 to 105°—19; 106 to 110°—23; 111 to 115°—11; 116 to 120°—3.

Attention is drawn to the fact that the series of lower angles, from 86 to 105°, are mainly those of the pieces with a faceted butt. Even so, there is a remarkably low and consistent series of angles associated with the *Bondi* points. There are, it might be mentioned, in the Bondaian industry, forty pieces with a faceted butt among the normal flakes and blades and microliths, and thirty-four among the *Bondi* points; on the other hand, there are only five pieces among the flakes and blades of the Eloueran industry. The difference between the two industries is probably due to the point technique in the Bondaian industry.

There are forty semi-salient and salient bulbs among the normal flake and blade implements from the two industries.

In the Eloueran industry there is a very low ratio of quartz implements to the vast number of broken pebbles of this material.

Van Riet Lowe (1946), in a recent paper, described the flake fabricators, so-called, as chisels made by the bi-polar method. He stated that a small pebble was held in a vertical position on a stone anvil and was then struck with a hammerstone. In this way, spalls or splinters were often simultaneously removed from both ends or poles of the pebble, as well as from both faces, ultimately leaving a sharply bevelled bifaced chisel-like edge, either straight or like a gouge. All the work is primary, and the shapes of the tools were arrived at by perfectly straight-forward direct rest percussion, and bipolar trimming. The term now generally applied to such tools is chisel, not scraper, which falls within the French descriptive term *ciseau* or under the generic term *outils écaillés*. The bipolar technique is of very widespread occurrence as a method of stone-fracture and stone-shaping common to many cultures and climes and not exclusively associated with any particular stone culture or time. The anvils and hammers are scarred, according to the amount of use.

At the Lapstone Creek site these implements (Figures 41, 58, 75-78, 89-91) are either uniface or biface trimmed and used; some are made from tiny pebbles, and others are pieces of pebbles subsequently shaped by bipolar working. The anvil and hammers were chiefly edge-ground axes, although pebbles were also used, but they are scarce in both industries. The bipolar technique explains clearly the reason for the percussive marks in the form of patches of scars and pits on the surfaces of the axes and the battered nature of their lateral margins and butts due to use as hammers. These remarks apply, of course, to sites elsewhere, and it might be remarked that the elongate pebble hammer-anvils so abundant on coastal middens form perfect implements for use as anvils and hammers in bipolar knapping and trimming. Van Riet Lowe suggests no use for these chisels. I have previously considered them to be flake and blade trimmers but, judging from the small number associated with the *Bondi* points at the Emu site, it is improbable that they are point trimmers. They occur in large numbers with the *elouera* adze-flakes in the Eloueran industry and might have been used for retouching the working edge of this implement.

#### Fauna.

One surprising result of this excavation was the almost entire absence of animal bones and mollusc shells. In layer F in various parts of the deposit we obtained a few small pieces of bone only 2 cm. long, some of which are burnt fragments. There is also

a fragment of a fresh-water mussel shell (*Unio* sp.) and two complete snail shells (*Strangesta strangei* and *Meredolum depressum*) from layer F. Layer E yielded several more fragments of burnt bone. No shell or bone implements were found. Therefore a list of the foods of the inhabitants of the rock-shelter cannot be made.

### III. COMPARISON OF THE BONDAIAN AND ELOUERAN INDUSTRIES.

The similarities in these two industries are: (a) The same kinds of nuclei and knapping techniques, although the faceted butt technique was used more commonly to produce the *Bondi* points in the earlier industry than it was in the later industry; (b) a similar range of scraper and knife flakes and blades; (c) a scarcity of blocks, slices and long blades; (d) the presence of the use-polished working edge; (e) the presence of vast numbers of thin and small scraps and flakes which might have been used as "barbs" on the death-spears (Hunter, 1793, p. 496) which were used in this area.

The differences are marked and of great importance in the study of Australian prehistory. The edge-ground implements—axe-heads and *Bulga*-knife—and the *Worimi* cleaver occur only in the Eloueran industry, the *elouera* and trimming flakes are both abundant in the Eloueran industry and uncommon in the Bondaian industry, and the *Bondi* point is restricted entirely to the Bondaian industry.

Among the microliths the same kinds of flake and blade implements as given above for the larger normal series, are most abundant in the two industries, but here, too, the *elouera* and trimming flakes are plentiful in the Eloueran industry and uncommon in the Bondaian industry. Furthermore, 125 *Bondi* points out of 182 are less than 3 cm. long in the Bondaian industry. Only one geometrical microlith was found, it being a segment in the Bondaian industry in which were also present a few thumbnail and discoidal scrapers and oblique trimmed blades. Trapezes and triangles are entirely lacking.

In regard to material there is a gradual change from an abundance of grey to green cherts and quartzites, with a very small amount of quartz, in the Bondaian industry, to an enormous increase in the quantity of knapped quartz pebbles and flakes although very few of the latter show any signs of use. Most of the materials are derived from either the ancient beds of the Nepean River on the side of the Mountains, or from the pebbles in the existing river bed. One implement, a flake of silicified wood, might have come from the coastal middens between Bondi and Bellambi, from thirty to fifty miles away, where this material was commonly used. In the *Bondi* industry a few *elouera* and points are made of a light-grey chert similar to that used in the Hunter River basin, but it is of local origin.

The cultural development that took place at this site is difficult to interpret. There is no evidence to indicate a break in the occupation. The change, however, involved entire abandonment of the *Bondi* point, the greater use of the *Elouera* adze-flake, knives and trimming flakes, and the adoption of the edge-ground axe and *Bulga*-knife. At present I cannot perceive any relationship in form or function between the edge-ground implements and the *Bondi*-point, or, on the other hand, between the latter and the *Elouera* adze-flake, in function. It is surprising to note, furthermore, that no choppers occurred in the Bondaian industry. If the *Bondi* point was a dual spear-barb and point, as I believe it was (McCarthy, 1943A, p. 149), then it might have been replaced by a wooden barb, but none of these were found, or by the thin flakes of stone and shell with which the death-spear was armed. Obviously, as I have shown (McCarthy, 1940, p. 262), the edge-ground technique was in process of diffusion in Australia, but for some reason it was accompanied at this site and probably elsewhere by an elaboration of the use of *Elouera* and trimming flakes.

### IV. ABORIGINAL RELICS IN THE EMU PLAINS—CASTLEREAGH AREA.

Within a comparatively small area occurs an interesting series of other relics left by the aborigines, and their relationship to the Bondaian and Eloueran industries is important.

## i. Surface Workshops.

The most important sites (Figure i, No. 2) are extensive workshops for the production of uniface pebble implements, edge-ground axe-heads and *Bulga*-knives, all of which have been collected on the surface or turned up by the plough on the rich farming and dairying flats in this area. I have, fortunately, been able to examine a large series of these implements comprising 46 in the Australian Museum, 106 in the C. C. Towle Collection of Stone Implements (Australian Museum), and 268 in Mr. G. Bunyan's collection. Thorpe and Stanley (1928) gave a brief description of the workshops and some of the implements. The main site is an extensive area at Castlereagh which extends for half a mile along and back from each bank of the river, in the bed of which is an inexhaustible supply of pebbles. There are four other workshops to the south, as shown in Figure 1, and one of these is traversed by Lapstone Creek just below the rock-shelter. The most favoured material among the Nepean pebbles for the large implements is hornfels, although a wide range of other stones is present. Axe-heads of the same kinds occur in the whole of the area eastward to the coast but they are not included in this study.

i. *Uniface pebble axe-blanks*.—These are classified according to the amount of trimming.

(a) *End* (Figure 119).—Sixty-nine specimens ranging from  $9.5 \times 5.5 \times 1.25$  to  $23 \times 11 \times 4$  cm. and from  $\frac{1}{2}$  to 3 lb. in weight. Thirteen only bear signs of percussive use as hammerstones on the butt. One bears use-polishing on both facets of its trimmed end. On most of them the trimming appears to be for the purpose of eliminating the thick edge that would otherwise have to be ground away in the making of an axe-head, and on several specimens the trimming is taken back to the middle of the pebble. There are eight large examples in the series. One (Figure 120),  $17 \times 14 \times 4.5$  cm.,  $3\frac{1}{2}$  lb. in weight, has a very thick end on which the trimmed edge is pointed in the middle, the butt is hammered, and it appears to have been used as a chopper. Another one, E.33235, figured by Thorpe (1932, Pl. ix, fig. 5), is  $18.5 \times 10.5 \times 5.75$  cm. and 3 lb. 4 oz. in weight.

(b) *Lateral* (Figure 116).—Seven examples ranging from  $9.5 \times 5 \times 1.5$  to  $18 \times 10 \times 3.5$  cm. and from 5 oz. to  $2\frac{1}{2}$  lb. in weight. The smallest one (Figure 117) is a thin flat pebble with a concave working edge 4 cm. wide and 1 cm. deep.

(c) *Lateral and End*.—Forty-two specimens ranging from  $11.5 \times 8 \times 2$  to  $18 \times 15 \times 2$  cm. and from 1 to 3 lb. in weight. Nine of the series are large in size. One (Figure 121) is trimmed right along both lateral margins, one on one lateral margin and both ends, and one is semi-biface trimmed. On two specimens the thicker butt end is trimmed instead of the usual thinner end of the pebble. The trimming is mostly steep-faced in nature. Eight are trimmed on one end and one lateral margin, 14 on one end and half-way up both lateral margins, and 16 on one end and right along both lateral margins. One is an elongate narrow example,  $15.5 \times 7 \times 3$  cm., and of an uncommon type. Four are hammered on the butt.

(d) *Uniface*.—Nine specimens forming a mixed series. One oval example (Figure 118)  $14.5 \times 10 \times 2.5$  cm. and  $1\frac{1}{2}$  lb. in weight is flattened and not very thick, has a trimmed oblique edge at one end, and the trimming all round its margins has left an island of cortex in the middle. Two others of similar type are  $14 \times 9 \times 4$  and  $17.5 \times 12 \times 3$  cm. in size and bear percussive marks on one surface. Two specimens have been formed by the removal of a large slice, leaving a narrow band of cortex at one end, and their margins are trimmed. Three examples are flaked all over one surface. Two of them have steep-faced margins. The third one is a true *Sumatra*-type,  $12 \times 7.5 \times 4$  cm., oval in shape, amygdaloid in form with a high crown at one end; its edges are trimmed all round, and are well used, particularly the straight edge at the thick end. The occurrence of this specimen might be merely fortuitous and of no cultural importance, but on the other hand it may indicate the possibility of the existence of the older Kartan uniface pebble culture in this area.

(e) *Split-pebble Slices*.—Eleven specimens, one of which is broken at one end, ranging from  $11 \times 9.5 \times 4$  to  $15 \times 14 \times 4$  cm., and irregular in shape. One is trimmed along the straight end and lateral margin, two on both lateral margins and convex end, two on both lateral margins, two on one straight lateral margin, and three (Figure 115) right around. One of the latter is pseudo *Sumatra*-type in appearance. Several of them are similar in form to the *Bulga*-knife and are probably blanks.

(f) *Worimi Cleaver*.—A large and thick slice with outer cortex and inner cleavage faces. It is  $18 \times 10 \times 5.5$  cm. The outer edge of its thick back is worked right along the lateral margin and both ends, and its chord is steeply trimmed.

## ii. Edge-ground Implements.

### AXE-HEADS.

(a) *Windang-type*.—The 84 examples vary considerably in the amount of trimming on the one surface so treated. Fourteen are trimmed on the blade end only (Figure 111), 12 along one end and lateral margin (Figure 113), 31 along one end and both lateral margins (Figure 123), and 9 all over one surface (Figure 126). One is trimmed round the butt end only (Figure 124), three are semi-uniface trimmed, and 12 are split-pebble slices. The blade is ground on the lower cortex facet on 5, on the upper trimmed facet on 8, and on both facets on the remainder. The butt is hammered on 28, and of these 15 bear percussive marks, including several with a deep anvil-pit, on one or both surfaces. Two are broken transversely at one end. One (Figure 122) unusually well fashioned rectangular example,  $11 \times 10 \times 3$  cm., is trimmed along both lateral margins, hammered on the butt, ground on both facets of the blade and also along one lateral margin. They range from  $8 \times 6 \times 1.5$  to  $20 \times 14 \times 4$  cm., and from 3 oz. to  $3\frac{1}{2}$  lb. in weight. There are 12 large examples in the series.

(b) *Pebble Axe*.—There are 130 axe-heads consisting of a plain pebble with a ground blade at one end, 14 of which are broken either transversely or lengthwise. Twenty-two of them are large axes. The blade is convex on the great majority and straight on the remainder. One is a cylindrical and curved pebble,  $18 \times 6 \times 4$  cm., and is exceptional in shape, all of the others being broad and flattened pebbles (Figure 112), excepting about a dozen chisel-like specimens, narrow and thin, 8–13 cm. long, 4–6 cm. wide, and 1–2 cm. thick. All but 20 of them are hammered on the butt, there are percussive marks on about one-quarter of the series, but a small number only bear anvil-pits (Figure 114) of any depth. One lacks a large flake on one facet of the blade due to use, and it has a ground facet along one lateral margin, and percussive use has removed flakes on the butt of a number of specimens. One axe has an oblique line of incised parallel lines about 1.25 cm. long in the middle of one surface. They range from  $9 \times 6 \times 1.25$  to  $15 \times 11 \times 2$  cm. and from 5 oz. to 2 lb. in weight, most of them being less than 3 cm. with a maximum of 4 cm. in thickness.

(c) *Trimmed Pebble Axe*.—The 52 examples all possess a convex blade. The butt, and the lateral margins, after preliminary trimming on both facets, are hammered on almost all of them (Figure 127), and this use has removed large flakes on some specimens. Six are trimmed and hammered along one lateral margin only (Figures 113–4). Fourteen have a deep anvil-pit on one or both surfaces. This variety of axe-head, therefore, can be regarded as a hammer-axe in function to a greater degree than the other varieties. They range from  $10 \times 7 \times 1.5$  to  $16 \times 9.5 \times 2.5$  cm. and from 9 oz. to  $1\frac{1}{4}$  lb. in weight.

*Axe-blanks and Axe-heads*.—A comparison of the trimmed uniface pebbles and the axe-heads above described demonstrates an intimate relationship. The end-trimmed pebbles are blanks for the making of the edge-ground pebble axe-head, and these two types are the most abundant in their respective groups. All of the other uniface pebbles—trimmed on one lateral, the end and one or both lateral margins, all round, or all over one surface, or the split-pebbles—are represented in the edge-ground *Windang*-axe series, and are, therefore, to be considered as axe-blanks also. On the

other hand, there can be no doubt that some of these uniface pebbles served as choppers and scrapers, but they are in a marked minority. Attention might also be drawn to the lack of percussive use on the trimmed uniface pebbles, and it is apparent that their use as hammers and anvils was principally after the grinding of their blade.

(d) *Biface Coroid Axes*.—The four specimens are all ovate in shape,  $11 \times 8 \times 3$  to  $12 \times 7 \times 3.5$  cm. They are all hammered on the butt, and there are anvil-pits on both sides of one. One specimen is made of a dark-coloured igneous material and appears to be an axe traded from the Mountains.

(e) *Pecked Axes*.—There are seven examples from these workshops, all in the possession of Mr. Bunyan. Five of them are elongate, with round to oval transverse section, from  $10 \times 5 \times 4$  to  $15 \times 7 \times 3.5$  cm., and all hammered on the butt. Two are hammered on the butt and blade, the latter being flattened, and one (Figure 131) of these has a second ground-edge blade at the other end. These five specimens are typical of the pecked round-axe found throughout eastern New South Wales, but their scarcity on these workshops suggests that they came by trade, a conclusion supported by the dark igneous material of which they are made. Two others are local pebbles about  $15 \times 9 \times 3$  cm., on which the pecking was begun in a narrow band adjoining the blade.

(f) *Pecked and Grooved Axes*.—Two exceptionally fine specimens from Castlereagh, the only examples known from the workshops, are in Mr. Bunyan's collection. One (Figure 125) is oval,  $19 \times 13 \times 3$  cm., and 3 lb. in weight, with a polished central groove, the other is pear-shaped,  $21 \times 11 \times 3$  cm., with a pecked central groove and a bevelled butt edge roughly trimmed. They are both flattish pebbles pecked on the semi-circular blade. Grooved axe-heads are extremely rare in the central coastal area of New South Wales, and these two examples are unusually large and flat, although they conform to the general shape of axe used in the Emu-Castlereagh district. The Australian Museum possesses another grooved axe from the Nepean River,  $12 \times 9 \times 5$  cm.,  $1\frac{3}{4}$  lb. in weight, and bearing anvil-pits on its surfaces.

#### BULGA-KNIFE.

There are four fine examples from the Castlereagh workshop. Three of them are crescentic in shape, from  $9 \times 6 \times 3$  cm. to  $11 \times 9 \times 2.5$  cm., and side-blow slices with their blades ground on both facets. One is a trapezium in shape,  $13 \times 9 \times 2.5$  cm. Their working edges are either slightly convex or straight. Another one is a rectangular uniface slice  $9 \times 6.5 \times 2$  cm., but its edge is unground and it is therefore a blank. At least three others were found by Mr. Bunyan in this locality.

#### iii. Percussion Stones.

(a) *Pebble*.—The ordinary pebble hammerstone is scarce on the workshops, although there are 27 specimens. These are oval to round in shape, 6 to 13.5 cm. long, and 1.5 to 4.5 cm. thick (but mostly 2 to 3 cm.). Two (Figure 129) have trenches of several anvil-pits down the middle of each side and they are also battered all round their margins. One is a concavo-convex pebble 12 cm. in diameter, and another one is a large waisted pebble  $17 \times 12 \times 5$  cm. One (Figure 128) is a rounded *kulki*-type with anvil pits on both surfaces and round the battered cylindrical sides; it is an oval pebble 8 cm. long and 4.5 cm. thick. The general use of the edge-ground axe as a hammer-axe took the place of the pebble percussion stone to a large degree.

(b) *Biface Coroid*.—There are 19 trimmed pebbles battered by use on the butt and lateral margins (Figure 130). Three of them are roughly trimmed on one surface only. One is an elongate pebble with a well trimmed bi-faceted lateral margin used as a fabricator. They range from  $10 \times 7 \times 3$  to  $18 \times 10 \times 2.5$  cm., and from 8 oz. to  $1\frac{5}{8}$  lb. in weight.

One oval pebble, trimmed all round its margins on both surfaces, and  $14 \times 14 \times 3$  cm., has an oblique face, rubbed flat, 6.5 cm. wide at one end.

(c) *Hammer-axes*.—Eight edge-ground pebble axe-heads have their blades flattened by percussion at a face up to 5 mm. wide. The butt is also hammered on two of them. One is an elongate pebble,  $22 \times 7 \times 1.5$  cm., and  $2\frac{1}{4}$  lb. in weight. One of the blades on the double-ended pecked axe (Figure 131) has been flattened in this way.

The general type of pebble used for the above implements is not very thick, is either flat or only slightly convex on both surfaces, is short to long oval and commonly tending to a rectangular form, and has straight or convex lateral margins. This is the general type found in the gravel deposits and very little discrimination was needed by the natives in selecting the pebbles used for implements.

#### iv. Knapped Implements.

Blocks, slices, normal flake and blade implements occur scattered intermittently throughout the workshops. They are not very plentiful now because the area has been turned over by the plough for a very long period of time. They include *elouera* adze-flakes, which are plentiful, but the *Bondi* points are very rare. It is probable that the river floods have washed these implements from the open camp-sites and distributed them over the flats where silts have covered them.

#### 2. Axe-grinding Grooves.

At Lower Castlereagh (Figure 1, No. 3), on the eastern bank of the main channel of the river between Black's Falls and Rose Falls, the sandstone outcrops for half a mile in horizontal beds now forming a series of narrow and broad ledges, whilst there are many large blocks which have been broken off the outcrops and washed into the river bed during periods when the river has been at a high level. The lower series of ledges, and many of the blocks, are thickly covered with an immense number of grooves from 15 to 60 cm. long, 2.5 to 8 cm. wide, and 1.5 to 6.5 cm. deep; the whole series can only be seen when the river is very low during the summer months, or in times of drought. The great majority (Figures 101–102) are axe-grinding grooves, and these are relatively short and broad, up to about  $32 \times 5 \times 3.5$  cm. Here and there are long narrow grooves which were used to smooth the surface of spears, and these are about  $50 \times 4 \times 1.5$  cm., whilst some of the axe-grooves have also been used for this purpose. The most remarkable grooves (Figure 101), however, are very long, wide and deep, those measured as examples being  $60 \times 8 \times 5$ ,  $55 \times 5 \times 2.5$ ,  $53 \times 7.5 \times 5.25$ , and  $50.5 \times 3.5 \times 3.5$  cm. These are also to be seen here and there, and one series of eight side by side was noted. Some of them occur on the vertical ends and faces of the rocks and these are very deep, being up to 15 cm. These large grooves were probably produced by rubbing in them wooden club-heads and digging-sticks, and also axe-heads, to smooth the surface; a straight shaft will not fit into them because their deepest point is in the middle and both ends are shallow. Their edges are sharp whilst those of the axe-grooves and spear-grooves are rounded and frequently only slightly convex.

It is obvious that this grinding workshop was used for a very long period of time, and it is probably the most extensive site of its kind in the central coastal district. Axe-grooves in varying numbers are also scattered about the creeks and rock surfaces of the foothills and gullies in this Blue Mountains' scarp.

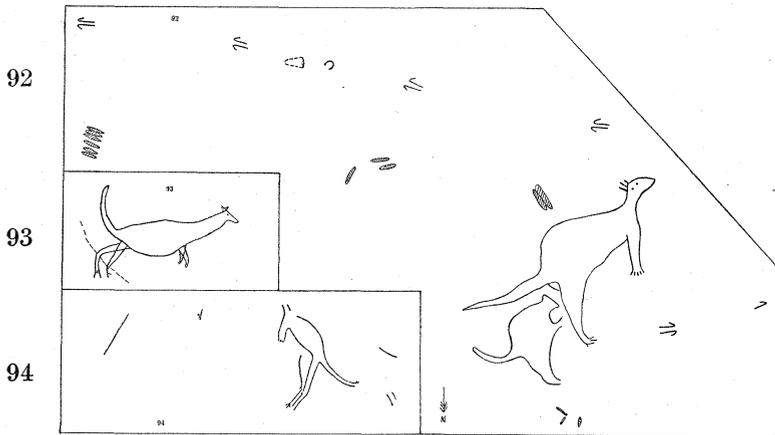
It appears probable, furthermore, that this site was in actual use when the First Fleet explorers penetrated this area. Hunter (1793, pp. 450–1) stated that on the Hawkesbury river, in the vicinity of Richmond Hill which is about 6 miles north of Castlereagh, an old native in a canoe was met by Governor Phillip's reconnaissance party. He was well known to *Colebe* and *Ballederry*, two natives from Port Jackson who accompanied the Governor, and they concluded that the old man and his companions in the canoe had made the journey up the Hawkesbury river in order to procure stone hatchets. The natives got the stones from a part of the river near Richmond Hill, which the old man said was a great way off (for him) and the road to it pretty bad. *Colebe* and *Ballederry* also stated that because of the long distance overland to the place

where the hatchets were obtained, the natives had to visit it in canoes. There was a good native path running alongside the river. A hafted axe was dug up on the bank above the axe-grinding grooves by a resident many years ago.

Mr. Bunyan possesses several large portable axe-grinding stones. One is only half of the specimen but it is 30 × 24 cm. and bears several grooves on each side whilst its rounded margin appears to have been formed by trimming and rubbing. It was revealed by an excavator-grab at a depth of forty feet in a gravel island in the river bed.

### 3. Rock Engravings.

There are three sites of rock engravings at Castlereagh. One (Figure 94) is on a large rock surface in the river bed bearing axe-grinding grooves. Two kangaroos are engraved here, and old residents claimed their parents told them that these figures were cut by a local native more than eighty years ago with a steel tomahawk that he got from one of the settlers. Both figures are incomplete, and an examination of their outlines revealed that the smaller one was undoubtedly made with a steel pick and it shows a different art style from the characteristic engravings of these animals. The



Figures 92-94. Rock engravings.

92. Kangaroo hunt at foot of Hawkesbury Lookout road. 93. Kangaroo on rock between Nepean River and Hawkesbury Lookout road. 94. Kangaroo and its track, with two curved lines, on one of the rock surfaces bearing axe-grinding grooves. Scale  $\frac{1}{3}$  inch to 1 foot (30 cm.).

large one is a genuine engraving by the aborigines re-done in parts with a pick. There are several short lines and one kangaroo track near by, all with conjoined punctured outlines 1.5 cm. wide and 5 mm. deep, suggesting that there were other figures now weathered away. Weathering is a rapid process here because of the river running over the engravings at frequent intervals. Thus it is interesting to note that the local story is partly true, and also to see the difference in the art styles of the old and recent engravings.

The second site is half a mile west (Figure 1, No. 4) of the above one, on portion of a low ledge of rock on the 50-foot contour line half-way between the river and the Hawkesbury Lookout Road. The rock is flat in parts, and slopes from south to north. On it is engraved a kangaroo (Figure 93) 180 cm. long, with outlines of conjoined punctures 1.5 to 2 cm. wide and 4 mm. deep, in a coarse flat part of the rock. The animal is rather elongate in formation, and is posed as though it is either alive and lying down, or a dead animal traced around by the artist. One eye is shown, the toes are indicated on the hind legs, and an unusual feature of it is that both pairs of limbs are crossed.

The third site is about half a mile south-west (Figure 1, No. 5) of the second one. It is at the base of and beside a bend in the Hawkesbury Lookout Road, and is on the southern slope of the bottom of a deep gorge on the northern side of the road. The site is a large rounded and isolated outcrop of sandstone, sloping from south to north, with a steep face on its northern and western sides. A kangaroo hunt (Figure 92) is engraved across this rock. A magnificently portrayed buck with a doe close behind him is posed in full flight to the westward. The buck has three ears, two eyes, toes and fingers, but the doe lacks all these details. Four pairs of large kangaroo tracks about 180 cm. apart lead away to the south-east, whilst one pair and a single one are directed to the south-west. The outlines of these kangaroos and tracks are all smooth rubbed grooves 2.5 to 4 cm. wide and 1.25 cm. deep, very distinct and well preserved.

There is a small circular outline showing punctures 1.5 cm. wide, but shallow, between two of the pairs of kangaroo tracks, but the balance of this figure has been chipped away by a vandal. A human foot-like outline occurs near one pair of tracks but it is now impossible to say whether it is an engraving or not. Axe-grinding grooves are scattered about as shown in the diagram.

In the northern face of the rock is a small rock-shelter, the deposit on the floor of which has been dug out by campers. Implements scattered about as a result comprise normal flake and blade scrapers, *elouera* adze-flakes, and edge-ground pebble axes, but no *Bondi* points have been found to date, so that the site would appear to belong to the Eloueran culture period.

#### 4. Human Hand Stencils.

In a gully about one and a half miles north of Lapstone Creek is another rock-shelter in the bed of a creek (Figure 1, No. 6) whose waters run over the floor of the cave. Its wall and ceiling are decorated with about seventy-two red stencils of the human hand (Figure 100), but there is no occupational deposit on the floor. This shelter was evidently a favourite rendezvous as a cool resort in the summer.

#### 5. Fish-trap.

Just above the axe-grinding rocks is a pebble-bar across the Main Channel (Figure 1, No. 7) of the Nepean River, and it is known as the Black's Falls (Figure 99). At the present time there are two roughly parallel rows of large boulders across this bar which are believed to have formed the basis of a weir for catching fish. Logs, which are washed down by the stream, if placed against these boulders to form a weir of two walls, would have formed a simple trap in which the imprisoned fish could be speared with ease. The large boulders are covered when the river rises, and there is a long deep stretch of the river above the bar.

### BONDAIAN AND ELOUERAN CULTURE MATERIAL FROM OTHER STRATIFIED SITES IN EASTERN NEW SOUTH WALES.

#### Bondaian Culture.

The following rock-shelters have yielded implements of the Bondaian culture:

1. *Lapstone Creek*. A small rock-shelter higher up Lapstone Creek than the cave dealt with in this study. A mixture of Bondaian and Eloueran culture implements (McCarthy, 1934, and 1943, p. 150).

2. *Gore Creek, Lane Cove River*. Eight scrapers, 1 microlithic *elouera* adze-flake, 3 *Bondi* points.

3. *Harris's Flat, Wollombi*. Two rock-shelters containing stencils of human hands and weapons, drawings and paintings (Hammond, 1892). A test-trench in one of these deposits yielded 11 nuclei (10 microlithic) comprising both cortex-backed and completely knapped kinds with one or two striking platforms, 1 quartz nucleus with indiscriminate platforms, 1 small trimmed block, 3 narrow re-directing flakes, 2 *elouera* adze-flakes, 1

side-scraper, 1 knife, 2 bi-polar flake fabricators, one of punch-type, 2 microlithic end scrapers, 1 use-polished blade, 54 *Bondi* points.

4. *Hoolahan's Farm, Howe's Valley*. A test-trench yielded 3 nuclei (microlithic, 1 single and 2 with opposite striking platforms), 1 quartz nucleus; 2 side-scrapers, 1 concave and nosed scraper, 1 oblique trimmed blade, all microliths; 8 *Bondi* points.

5. *Merrick's Farm, Howe's Valley*. A rock-shelter containing human hand stencils. A test-trench yielded 3 nuclei (microlithic, 2 with one and one with 2 striking platforms); 1 discoid scraper of quartz, 1 end scraper, 1 oblique trimmed blade, all microliths; 2 bi-polar flake fabricators used at one end, 12 *Bondi* points.

6. *Winter's Run, Jerry's Plains, Hunter River Valley*. Two re-directing flakes, 1 *elouera* adze-flake, 1 end scraper, 1 *Tula* slug, 1 side scraper and knife, 2 concave scrapers, 3 microlithic bi-polar flake fabricators, 1 notched blade, 18 *Bondi* points, including two with concave working edges on chord, 1 microlithic *elouera* adze-flake heavily used on chord, flakes and blades with faceted and plain butts.

7. *Dural Station, Jerry's Plains, Hunter River Valley*. One end scraper, 1 butt-end concave and nosed scraper, 1 knife, 1 scaled burin, 17 *Bondi* points. Faceted and plain butts are represented on the flakes and blades.

8. *Milbrodale*. A rock-shelter on Dodd's Farm which contains a large culture-hero drawn in red ochre, white lines, and stencils of human hands and weapons (Mathews, 1893, pp. 353-6, Pl. xix, map; 1896, pp. 90-1, Pl. I, fig. 1; McCarthy, 1944, p. 184). Nine *Bondi* points were the only implements in the shallow deposit obtained by Mr. F. A. Davidson and presented to the Australian Museum.

9. *Putty*. Rock-shelter containing stencils of human hands. A test-trench dug by Mr. F. A. Davidson yielded 22 *Bondi* points, 1 thick microlithic segment, 3 oblique trimmed blades, 2 narrow re-directing flakes.

10. *Wolgan Gap*. A large rock-shelter containing stencils of human hands and weapons, and other drawings. Test-trenches dug in various parts of the shallow deposit by Professors J. L. Shellshear and A. A. Abbie, and the author, yielded 2 bi-polar flake fabricators, 8 *Bondi* points, 1 thick microlithic segment.

11. *Menai Creek, Heathcote*. A test-trench dug by Mr. W. H. P. Kinsela yielded 16 *Bondi* points, 2 *Elouera*, 8 flake fabricators, 2 side, 1 side and end, and 1 double side scrapers, and 2 microlithic end scrapers. A fish-hook file was found near the surface, and an edge-ground axe blade was picked up on the surface.

12. *Singleton*. Geometrical microliths, *Bondi* points, and *Elouera* adze-flakes abundant in an industry found on high terraces of the Hunter River (McCarthy and Davidson, 1943).

A perusal of the above list of sites will reveal that the Bondaian culture is associated with raw-ochre drawings, paintings and stencils in five rock-shelters. Furthermore, in the Milbrodale rock-shelter (No. 8) the figure of the culture-hero, approximately 3 metres high and 5 metres across the hands, is of the All-father type so important in the religion of south-east Australia; it is possible, therefore, that this All-father belief belongs to the Bondaian culture period. It is necessary to draw attention to the fact that the *Bondi* point has not yet been found in association with the outline rock engravings in the central coastal area of New South Wales, but future excavations or other field-work may reveal such an association and so increase the antiquity of this interesting art cult.

#### Eloueran Culture.

The following rock-shelters and other sites have yielded implements of the Eloueran culture period.

1. *Lapstone Creek*. A small rock-shelter higher up Lapstone Creek than the cave dealt with in this study. A mixture of Bondaian and Eloueran implements (McCarthy, 1934 and 1943, p. 150).

2. *North Harbour, Port Jackson.* A rock-shelter containing human hand stencils, a midden on the shore, and a group of rock engravings 110 metres away. The cave yielded a skeleton covered with a large stone, split kangaroo bones, and a siliceous flake. The short midden yielded two skeletons each covered with large stones, split kangaroo bones, a fish-hook file and a siliceous flake (David and Etheridge, 1889).

3. *Long Bay.* A skeleton, together with an edge-ground *Bulga*-knife, and a flake, from beneath a pumice bed covered by sand (David and Etheridge, 1889).

4. *Brown's Bay, Pittwater.* A deposit from 30 to 110 cm. deep in a rock-shelter yielded 6 split-pebbles, 2 worked pebbles, 56 normal flake and blade implements, 1 *elouera* adze-flake, 1 edge-ground *Bulga*-knife, 1 nucleus, 1 hammerstone, 1 rasp, and 2 pieces of red ochre (Kennedy, 1934, and McCarthy, 1943, p. 150).

5. *Lake Burrill.* A deposit about 110 cm. deep in a rock-shelter, excavated by the Anthropological Society of New South Wales, yielded 16 nuclei, 3 utilized nuclei, 1 nucleus with alternate platforms, 11 blocks, 2 slices, 3 uniface pebble implements, 17 *elouera* adze-flakes, 95 scrapers, 35 knives and saws, 6 burinates, 4 piercers, 18 bi-polar flake fabricators, 7 hammerstones, 1 anvil-stone, and 1 edge-ground axe (Thorpe, 1931-32, and McCarthy, 1943a, p. 151).

6. *North-West Arm, Port Hacking.* A shell midden up to 110 cm. deep yielded skeletons, a fish-hook file, 3 bone awls, and 1 scraper.

7. *Woolwich, Port Jackson.* A rock-shelter yielded a fish-hook file, 2 *elouera* adze-flakes, 1 scraper and several bone awls.

8. *Middle Harbour.* A rock-shelter containing human hand stencils yielded 1 human skull, 1 cranium, 2 lower jaws, 8 edge-ground axes, and 1 "nose ornament" (probably a fish-hook file). (Bray, 1888.)

The material from the above sites now makes it possible to establish the association of some of the important culture elements of eastern New South Wales with the Eloueran culture, which is a much richer one than the earlier Bondaian culture. In addition to the edge-ground technique, the Eloueran culture embraces outline rock engravings, stone cairns, fish-hooks and files. It inherited the rock drawings, paintings and stencils from the Bondaian culture. Burial by covering the body with large flat stones is typical of the above Eloueran period sites Nos. 2 and 3, but insufficient data is as yet available on the disposal of the dead to differentiate the various methods associated with the two cultures.

The reasons for this grouping of traits can be stated briefly. Axe-grinding grooves occur so frequently with the outline rock engravings in the Sydney-Hawkesbury district that there can be no doubt that this art flourished during the Eloueran period. Moreover, stone cairns also occur with some of these groups of rock engravings, as at Somersby and at two sites in Kuring-gai Chase. In addition in a rock-shelter at Brisbane Water engravings and dry pigment drawings occur together, and edge-ground axes were dug out of a rock-shelter, No. 8, at Middle Harbour, which contained human hand stencils. In regard to the fish-hook technique I suggested (1940B, p. 269; 1943a, p. 151) that it had diffused down the east coast of Australia, and the frequent occurrence of fish-hook files with the edge-ground axes and *Bulga*-knives now makes it possible to ally this diffusion with the Eloueran period; early accounts of the aborigines of Port Jackson and Botany Bay record the making and use of fish-hooks by the aborigines. It is, of course, particularly important to note that the Long Bay pumice bed skeleton, and the axes recovered from the ancient land surface at Shea's Creek, Botany, in association with dugong remains (Etheridge, David and Grimshaw, 1896), can now be dated as Eloueran period. It is interesting to note that Browne (1945, p. xxiii) is of the opinion that the Shea's Creek find of dugong bones and axe-heads indicates human occupation before the Pleistocene quite came to an end, and the latter event took place, he thinks (*op. cit.*, p. vi), some 9,000 years ago. According to this statement, therefore, the Bondaian culture period is late Pleistocene in age and the Eloueran existed throughout

the Recent period. This conclusion is supported by the cultural evidence of the age of the ground-edge technique, which has been shown (McCarthy, 1940, pp. 40-42) to belong to the Hoabinhein II culture of the mesolithic period in south-east Asia.

#### Surface Sites in South-Eastern Australia.

In previous papers (McCarthy, 1943, A-B; 1947) I have shown that the Eloueran and Bondaian cultures are intermingled on east coast shell-middens as far north as Tallow Beach, south to about the Victorian border, and inland to the tablelands. It is evident, of course, that the same cultural changes took place on these sites as in the Lapstone Creek rock-shelter. In other words, the transitional methods of working stone were not changed, but some types of flake and blade implements produced were abandoned and others given more importance. In addition, traits such as the edge-ground technique and fish-hook making diffused southward and were embodied in the culture of the natives, but there is no evidence to indicate that they were brought by a new wave of aborigines from the north.

The geometrical microliths present a problem upon which much more evidence from excavations is necessary before an explanation can be given for their somewhat erratic occurrence. They occur from south-east South Australia right across to the eastern coast of Victoria in enormous numbers, and are comparatively scarce in eastern New South Wales excepting at Singleton on open workshops (McCarthy and Davidson, 1943) where they are abundant, together with *Bondi* points, on Bondaian period sites restricted to a high terrace of the Hunter river. Thus the almost complete absence of the triangles, trapezes and segments in the rock-shelter deposits of eastern New South Wales containing Bondaian culture material is in keeping with their scarcity on most of the surface sites, and it is a cultural variation of some importance. In any case, the small number recovered from these deposits indicates that the geometrical microliths belong to the Bondaian culture, and throughout Victoria and South Australia they are found in association with the *Bondi* point. The explanation appears to be that the Lapstone Creek rock-shelter deposit represents an early phase of the Bondaian culture, and that the full development of the geometrical microliths was a subsequent event. The Singleton site would thus represent a later phase of the Bondaian culture.

The wider relationships of the Bondaian and Eloueran cultures with those elsewhere in Australia, and in other countries, will be fully discussed in a forthcoming paper.

#### Hafting of the Elouera and Edge-Ground Axes.

*Elouera* adze-flake. This implement has hitherto been described as a scraper-knife (McCarthy, 1946, p. 27) with the reservation that it might be an adze. Hunter (1793, p. 452) stated that on the Hawkesbury River, in the vicinity of Richmond, the spear-thrower "had a piece of hard stone fixed in gum instead of the shell commonly used on the sea-coast; it is with these stones, which they bring to a very sharp edge, that the natives make their spears". Bradley (October, 1788) said that the adze in the Sydney area was made of the same kind of stone, and was secured to a stick in the same manner as the axe-heads; he probably meant that both implements were hafted with the aid of gum-cement. It appears obvious from the analyses given of the Eloueran culture in this and other papers that the only implement to which the statements of Hunter and Bradley could refer is the *elouera*, and I now propose that it be termed an adze-flake in the future.

*Edge-ground axe.* Hunter (1793, p. 445) stated that a man on the western bank of the Hawkesbury River in the vicinity of Richmond Hill carried a stone axe, and there are many other references, which need not be quoted, to their use by the natives met by the explorers of the First Fleet in this and the Sydney district generally. They also pointed out that the natives used the axes to cut toe-holds when climbing trees, to cut and wedge off sheets of bark from the trunks of trees for making canoes and shields,

to make holes for burning-out or securing opossums, and as a general working tool. Illustrations in existence demonstrate that the axes were hafted in a pliable withy, gummed where it passed around the axe-head, and tied at various points along the handle. Bradley (October, 1788) stated that they were secured with gum and lashing to a stick two feet long in the Port Jackson area.

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## EXPLANATION OF PLATES.

## Plate i.

- Fig. 95 (top left).—The rock-shelter on Lapstone Creek.
- Fig. 96 (top right).—The deposit behind the fireplace in process of excavation.
- Fig. 97 (bottom left).—View taken from inside the rock-shelter showing the large slab of stone at the back of the fireplace and the rocky platform outside.
- Fig. 98 (bottom right).—View taken from the eastern end showing the fireplace and the trench through the shallow deposit on the rocky platform outside the rock-shelter.

Photos, F. D. McCarthy.

## Plate ii.

- Fig. 99 (top).—View southward up the Nepean River at Castlereagh, showing rocks on left bearing axe-grinding grooves, and the Black's Falls on the pebble bar in the middle distance.
- Fig. 100 (middle).—Some of the human hand stencils in the rock-shelter in the bed of the creek (see Fig. 1).
- Fig. 101 (bottom).—One of the large and deep grooves is shown in the middle of this photograph, and a series of other grinding grooves on the rock in the lower right-hand corner.

Photos, late C. C. Towle.

## Plate iii.

- Fig. 102.—Two large series of grinding grooves on some of the numerous rocks bearing them on the river bank at Castlereagh.

Photos, late C. C. Towle.

*Bloueran industry implements.*

- Fig. 103.—Trimmed pebble axe blank.
- Fig. 104.—Biface coroid edge-ground axe.
- Fig. 105.—Pebble edge-ground axe with battered butt.
- Fig. 106.—Pebble fabricator with biface edge.
- Fig. 107.—Side-blow slice from a pebble trimmed into a blank ready for grinding the blade to form a *Bulga*-knife.
- Fig. 108.—Edge-ground *Bulga*-knife.
- Fig. 109.—*Windang* uniface pebble axe.
- Fig. 110.—*Worimi* cleaver, showing trimmed back.

Photo, G. C. Clutton.

## Plate iv.

*Implements from Surface Workshops.*

- Fig. 111.—*Windang* uniface pebble axe, trimmed and ground on one facet only. Castlereagh.
- Fig. 112.—Pebble edge-ground axe. Emu Plains.
- Fig. 113.—Pebble edge-ground axe, trimmed and used as a hammer on one lateral margin and butt. Emu Plains.
- Fig. 114.—Pebble edge-ground axe, used as a hammer on one lateral margin and butt, with a deep anvil-pit on both surfaces. Emu Plains.
- Fig. 115.—Split-pebble slice. Emu Plains.
- Fig. 116.—Uniface pebble implement with trimmed lateral margin. Castlereagh.
- Fig. 117.—Uniface pebble implement with trimmed concave lateral margin and end. Emu Plains.
- Fig. 118.—Uniface pebble implement trimmed all over one surface, and probably an axe-blank. Emu Plains.
- Fig. 119.—Pebble axe-blank trimmed on one side at one end. Castlereagh.

Fig. 120.—Large uniface pebble implement trimmed on one end, and used as a hammer on the butt. Castlereagh.

Fig. 121.—Uniface pebble axe-blank trimmed on both lateral margins and one end. Castlereagh.

Fig. 122.—*Windang* uniface pebble axe, ground on both facets of blade and along upper surface only on both lateral margins. Used as a hammer on the butt, and as an anvil on one surface. Castlereagh.

Fig. 123.—*Windang* uniface pebble axe reverse-trimmed on lateral margins, ground on both facets of the blade, and used as a hammer on the butt. Castlereagh.

Fig. 124.—*Windang* uniface pebble axe, trimmed round butt end, and showing flaking done prior to grinding the blade. Castlereagh.

Fig. 125.—Pecked and grooved axe-head. Castlereagh.

Fig. 126.—*Windang* uniface pebble axe trimmed all over one surface, ground on both facets of blade, used as a hammer on the butt and as an anvil on both surfaces. Emu Plains.

Fig. 127.—Trimmed pebble edge-ground axe-head.

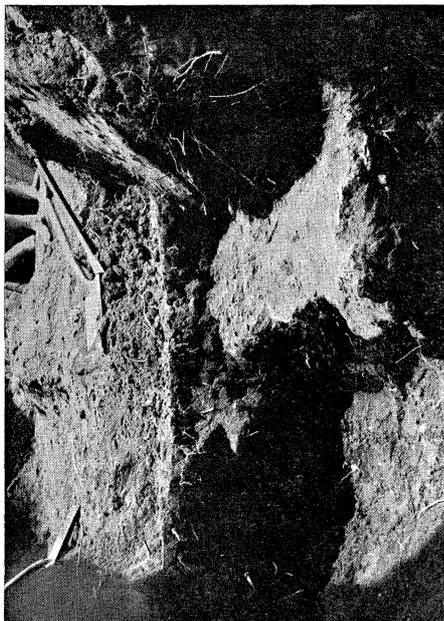
Fig. 128.—Pebble percussion stone used as a hammer around edge, with a deep anvil-pit on both surfaces. Castlereagh.

Fig. 129.—Pebble percussion stone used as a hammer along lateral margins, with trenches of anvil-pits on both surfaces. Emu Plains.

Fig. 130.—Trimmed biface coroid fabricator. Castlereagh.

Fig. 131.—Pecked axe-head, with a ground blade at each end, round transverse section. One of the blades has been hammered to a flat face. Emu Plains.

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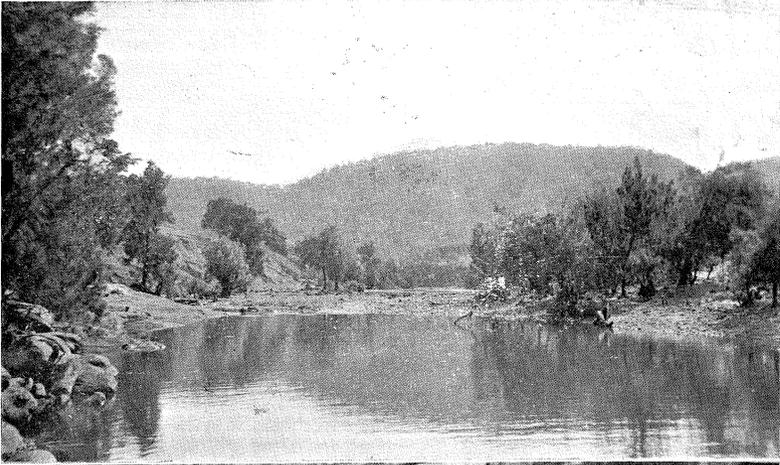
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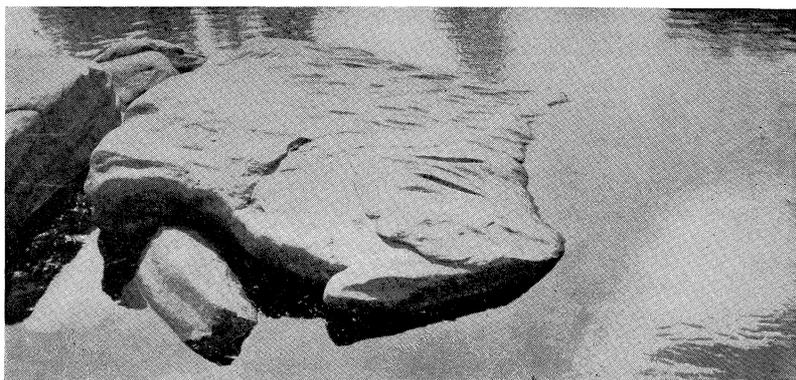


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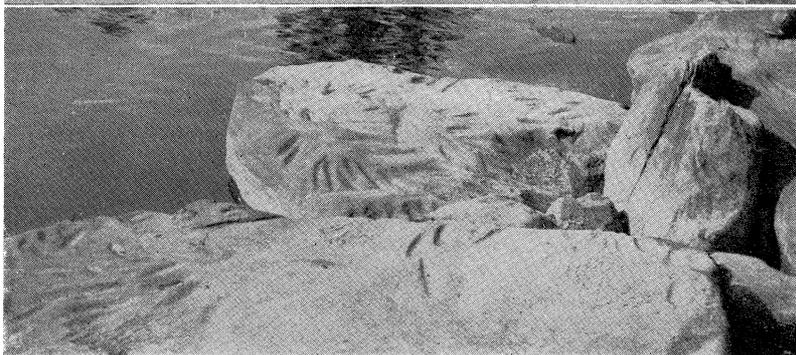


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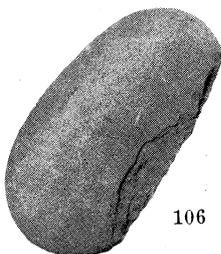
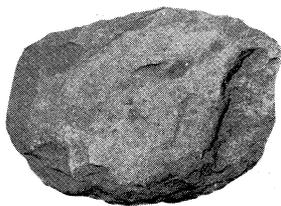




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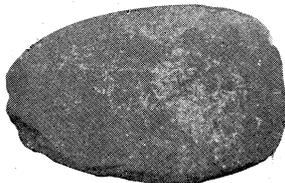
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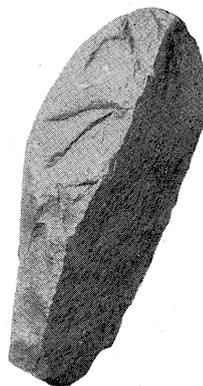


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