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Archaeological Fieldwork in Tasmania

Under the auspices of the Australian Institute of Aboriginal Studies, and the Department of Anthropology at the University of Sydney, an expedition was carried out from 17th December 1963 to 7th March 1964.

We spent six weeks excavating a cave at Sisters' Creek, near Wynyard on the north coast. This cave is situated on a seaward-facing quartzite cliff, and in it we found up to 5 ft. of dense shell midden resting on 4 ft. of sterile sand. The excavations yielded a rich stone assemblage, with enough variety of tools to enable a typological study to be made. Most of the flakes have plane platforms, but some

have two or three facets on their striking platforms. Many flakes show four, five or more primary negative scars on their dorsal surfaces, thus implying some degree of prepared core technique. The most obvious tool types are the following: unidirectionally and bidirectionally worked pebbles; cores with flakes taken off around a central axis at right angles to a single primary flake scar; pieces with step-flake retouch, sometimes the side being straight and in others the retouch forming a concave edge, thus resembling the 'spokeshave' of the literature; a range of worked or use-retouched flakes; and a broken piece of soft

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micaceous shale, having had a small hole drilled or cut into it. Other finds include haematite ore, quartz crystals, and one red crystal of zircon. Two bone tools were found, one of which had been extensively chipped, the other rubbed down into a completely smooth convex curve. Due to the neutrality of the deposit, large numbers of bones were found. Of particular interest was the discovery of hundreds of fish bones. This supports the finds of Gill and Banks [1] and conflicts with the ethnographic conclusions gathered by Ling Roth [2] which have been quoted so often by later authors, that the Tasmanian aborigines did not eat fish. The kind of picture which emerges is that of a self-sufficient hunting and gathering economy exploiting intensively a varied and rich environment.

In order to put the Sisters' Creek site into some kind of archaeological perspective, a reconnaissance was made on the east and west coasts. In both areas, there are extensive middens in dunes, and plenty of good sites

can be found. At the Bay of Fires on the east coast we found a row, 270 ft. long, of 138 flat stones arranged like a pathway on a coastal midden. Excavations revealed a second arrangement of stones, stratified one foot beneath the top one. It is interesting to note that here the traditions of stone arrangement building persisted for an archaeologically appreciable length of time. Near the West Point lighthouse on the west coast, there is a large grass stabilised midden. A sounding revealed 7 ft. of midden resting on sand. The stone industry was rich, and a change in raw material could be seen. There were about 2000 bones obtained from the cutting, mostly of seal, but macropods, Tasmanian devils, migratory birds and fish, together with one human molar, were also found. A large-scale excavation at this site might give a detailed account of the protein diet, pattern of occupation, and stone typology of the prehistoric peoples of this part of Tasmania. Further work is planned.

RHYS JONES

NOTES

[1] Gill, E. D. and Banks, M. R., 'Cainozoic History of the Mowbray Swamp and Other Areas of North West Tasmania', *Rec. Q. Vict. Mus. Launceston*, n.s., 6, 1956.

[2] Roth, H. Ling, *The Aborigines of Tasmania* (1890).

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ARCHÆOLOGICAL RECONNAISSANCE IN TASMANIA, SUMMER 1963/1964

By RHYS JONES*

GENERAL ACCOUNT

The expedition was carried out under the auspices of the Australian Institute of Aboriginal Studies and the Department of Anthropology at the University of Sydney. I was accompanied by Messrs. F. J. Allen, I. C. Glover, and R. A. Wild of the University of Sydney, C. McKnight of the University of Melbourne, and R. Reece formerly of the Australian National University. We left Sydney on the 17th December, 1963, and returned on the 7th March, 1964, having spent from 20th December to 3rd March in the field in Tasmania.

The object of the work was to carry out a reconnaissance of archæological sites in Tasmania, and to excavate some of those which seemed the most promising. My particular interest was to try and isolate total industries for the purpose of setting up definitions which might be compared with mainland sites, and also to investigate any ecological or geographical variations and adaptations within the island.

The project was much aided by the information given to me by Mr. J. Mulvaney¹ concerning a coastal cave site at Sisters' Creek near Wynyard, where excavations were commenced on January 1st and were continued for the next five weeks. (See detailed account). While we were working on this cave, we also made a survey of other sites in the neighbourhood, and mention might be made of a seaward-facing cave with a cemented conglomerate adhering to its ceiling, which I interpret as an old raised beach, associated perhaps with a 100 foot high sea level, and thus of interest to Pleistocene geologists. The full excavations at Sisters' Creek gave us a large industry associated with animal, bird and fish bones, and I now felt that we should extend our researches to other parts of the island in order to try and get comparative material, so that the Sisters' Creek site could be viewed in some sort of archæological perspective. I was particularly interested in some of the ideas put forward by Mrs. T. B. Kemp (1963) concerning a possible dichotomy between east coast and west coast industries.

We spent two weeks on a reconnaissance of sites on the east coast. Local reports of a midden at St. Helens, proved fruitless due to its causal relationship to an adjacent abandoned oyster cannery. However we were told² of an interesting area about 20 miles to the north at Anson's Bay, on the northern end of the Bay of Fires. These sites consisted of shallow middens in sand dunes, now in the process of erosion, due to the active shift of the dunes; small scale excavations were carried out in order to

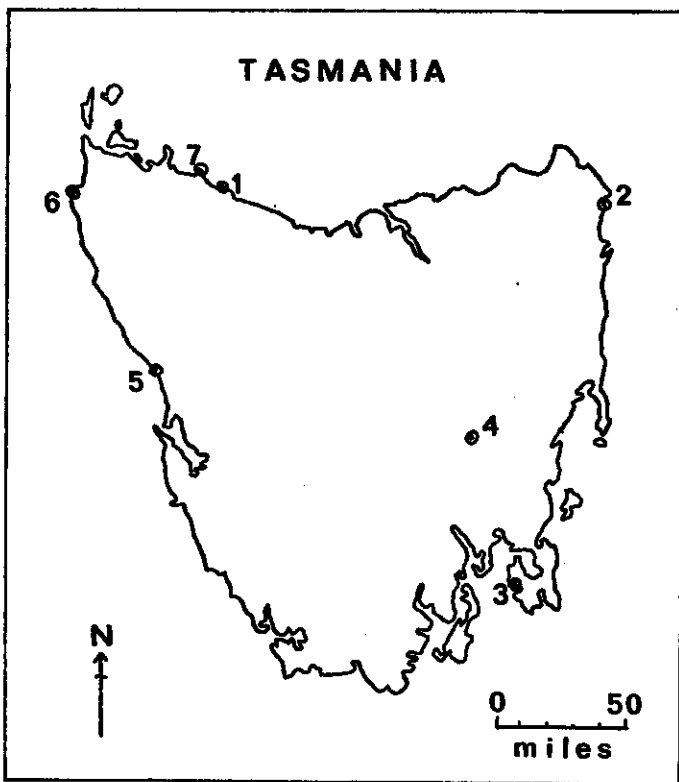
* Department of Anthropology, University of Sydney.

¹ Mr. Phil Dart, of Wynyard, showed the cave to the geologists, Dr. Lundelius and Dr. Turnbull, who informed Mr. Mulvaney, who wrote to me.

² Mr. W. E. Tucker, of St. Helens, told me of this interesting area near Anson's Bay, and suggested that I look at the configuration of stones.

get an idea of the industry. This proved to be quite rich, but as it consists almost entirely of amorphous quartz its value to the typologist is much diminished.

About two miles south of Anson's Bay we found a row of flat stones arranged like a pathway on the surface of a coastal midden. Excavation showed the presence of a second arrangement stratified about a foot below the first. (See detailed account.) The reconnaissance was continued, moving southward along the coast in order to



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|--------------------|-------------------|
| 1. Sisters' Creek. | 5. Trial Harbour. |
| 2. Bay of Fires. | 6. West Point. |
| 3. Roaring Beach. | 7. Rocky Cape. |
| 4. Oatlands. | |

try and find an area where the primary chipping material was good enough to enable a typological study to be made. After looking at middens at Piccaninny Point, Oyster Bay, Little Swanport River, Dunalley and Eaglehawk Neck, such an area was found at Roaring Beach near Nubeena, on the tip of Tasman's Peninsula. Here we put a sounding into a small sandstone rock shelter, and found an industry made of indurated mudstone.

So far all our work had been done on the coast, and in crossing over to the west coast via Hobart, I decided to have a look at some of the sandstone country around

Melton Mowbray and Oatlands. We investigated a small valley called Murderer's Gully, which contained upwards of thirty rock shelters. Most of these showed signs of recent erosion on their roofs however; and examination did not reveal any signs of occupation. Around the lake at Oatlands there were some dozens of rock shelters, most of whose floors were hidden by water, but there were several which were dry. We put a sounding into one of the latter and although the deposit was only 18 inches deep it was very rich and yielded some fine bone tools. (See detailed report).

We moved to the west coast and investigated some middens at Trial Harbour, and Granville Harbour. At Trial Harbour artefacts dating from the early mining days, for example, some dozens of clay pipes, were found mixed up with Aboriginal implements, in a dune beneath several feet of sand, and can only serve to emphasize some of the dangers inherent in surface collecting on unstable dunes. Following detailed reports,³ I wanted to look at the area between Marrawah and the Arthur River. Near the West Point lighthouse we found a very large grass stabilised midden. A sounding put into this site proved very interesting. (See detailed report). A further survey was carried out some miles south of the Arthur River and many middens were seen. A general impression given of this area is that there is a complex of practically continuous midden along the coast. Due to the recent attrition of the vegetation cover, the dunes are shifting inland and have thus exposed tens of thousands of eroding artefacts. We also found three rock shelters with small middens in them.

On the way back to Launceston, the caves at Rocky Cape were visited in order to assess the value of attempting detailed rescue excavations there. In the southern cave large unfilled pits could be seen, one of which is four and a half feet deep. The vandalism in these caves still continues, for one small hole had been dug between late January and early March. The presence of stratified hearths to be seen in the wall of the largest pit showed that at least some of the midden is still undisturbed. In the northern cave there is also a large hole, but here again undisturbed midden can be seen.

DETAILED REPORTS

(a) "*Blackman's Cave,*" *Sister's Creek*

Excavation. The cave is situated some 150 feet above sea level on the side of a Pre-Cambrian quartzite cliff. The entrance is 35 feet long and the height of the lip is about six feet above the surface of the talus. The cave goes into the rock obliquely to the line of the entrance lip, and it opens out into a chamber 15 feet high, 30 feet long and 20 feet broad. A small stream at the back disappears into the talus. Beyond this chamber a narrow crack enters the rock to a further distance of 20 feet. Inspection shows that the top of the midden at the entrance is about seven feet higher than the floor at the back of the cave, and allowing for a downward gradient for the drainage of the stream the total depth of about ten feet might be expected. However we only found a maximum depth of five feet of midden resting on four or

³ Dr. Grote Reber and Mr. Max Bennett, of the C.S.I.R.O. in Hobart, had carried out small sample soundings in some of the middens at West Point, and they very kindly told me of their finds, gave precise field instructions, and invited me to investigate further.

five feet of sand, itself resting on the bedrock. We get a picture of the cave filling up with sand, with no occupation, and then the midden is built up on the talus of sand. The midden itself is continuous and the junction between sand and shell is very marked.

We excavated three adjacent pits, each five feet by five feet, in the area where the midden seemed to be deepest, and the roof of the cave was only two or three feet above the surface of the deposit. We obtained a maximum depth of five feet of midden, and although we found large quantities of bone, the yield of worked stones was rather low. I then moved my attentions to the area just under the lip of the shelter where there is plenty of light and a headroom of six feet. Almost immediately our efforts were rewarded, and we found ourselves excavating very rich occupational material. There was one hearth complex which yielded up to 100 pieces of chipped stone per cubic foot. After having extended the trench, there remained a problem to be solved, namely were the differences to be seen between the two groups of excavations a function of time (i.e. representing some kind of cultural "sequence"), or were they a function of their position within the cave? The nature of the stratigraphy, consisting as it did of scores of limited and interleaving lenses of hearth material and shell, meant that one had to obtain at least one complete section joining up the two areas of excavation. When this had been done, resulting in a section 30 feet long, it could be seen that the deposits excavated in the two sets of pits were synchronous, and the conclusion is that the differences in the assemblages must be interpreted as being due to their position in the cave. Obvious and trivial as this may be, we should note that when working in an unknown area, a single pit dug into a cave can sometimes produce misleading results. Perhaps there is the more general point noted by Cook and Treganza (1947) for Californian sites, that there are great local variations to be found in the shell and artefact content of shell middens. A large number of pits and disturbances, both recent and prehistoric, were noted, in particular one circular pit one and a half feet in diameter and two feet deep, which was sealed by undisturbed hearths and had been filled with large mutton fish shells. Two latex impressions of excavated sections were made, and carbon, shell, and pollen samples were taken. The discovery of unidirectionally worked pebbles in the furthest, and completely unlit recess of the narrow crack at the back of the cave helps dispel the rumour so often quoted, that the Aborigines did not go into dark caves.

Other excavations were then back-filled and disguised as much as possible.

Finds, Sisters' Creek excavations

(a) *Stone.* The artefacts were made mostly from siliceous quartzites, but basalt, chert, quartz and metamorphic rocks were also used. These have been washed and marked, but no detailed work has been done yet. However, the following types can be abstracted:

1. Flakes with plane platforms; or sometimes with two or three facets on the striking platform. Many flakes have three, four, five or more primary negative scars on their dorsal surfaces.

2. Cores—some showing alternate negative flake scars, other with flakes having been taken off around a central pivot, at right angles to a single face. (Fig. 1: 1, 2.)
3. Unidirectionally and bidirectionally flaked pebbles commonly called "choppers". In two cases the sharp edge had been very badly bruised, showing that they at least had been used for a chopping or smashing purpose. (Fig. 2: 1, 2.)
4. Pieces with a steep step flake retouch (Fig. 1: 4), sometimes the side is straight, and other times the retouch forms a steep concave edge, thus resembling the "Spokeshave" of the literature.
5. Small circular or semi-circular retouched pieces; one example smaller than a threepenny bit has over 35 tiny flake scars on it. (Fig. 2: 4, 5.)
6. Pieces with several primary scars arranged concentrically around a central pivot, the concave edges thus formed show secondary retouch or use fracture. (Fig. 1: 5).
7. Retouched flakes—a large range of flakes showed secondary retouch around the margins. (Fig. 2: 3, 6).
8. A piece of soft micaceous shale (1.9 inches by 0.7 inches), with a small circular hole drilled or cut into it. The shale had split in prehistoric times across part of the hole. This is to my knowledge a unique implement from Tasmania and when complete could have been used as a pendant. Morphological comparisons with similar objects from some late Palæolithic sites in East Europe might be interesting. (Fig. 1: 3).

(b) *Bone*. Two bone tools were found, and as far as I know they are typologically unique for Tasmania, and add to the list quoted by Meston (1956), and Gill and Banks (1956).

1. A stout piece of bone (1.8 inches by 0.8 inches), with one end having been rubbed, so that it was shaped into a completely smooth convex curve.
2. A portion of a macropod longbone (2.4 inches by 0.5 inches), which had been split down the middle giving it a U-shaped cross section. Then the two margins have been extensively chipped so as to make them into sharp edges. This type of flaked bone tool is quite common in Palæolithic assemblages and, for example, it is figured by Semenov (1964), p. 148, and p. 174.

(c) *Other*. Other finds include several kinds of hæmatite ore, symmetrical prismatic crystals of quartz, and one tiny red crystal of semi-precious stone zircon.

Dietary Evidence

The pH value of the soil was seven, and thus there was abundant bone in the site. The following animals were represented: seal, small and large macropods, wombats, possums, several types of large bird, marsupial rodents etc. Of particular interest was the discovery of hundreds of fish bones. Vertebræ and jaws were found

the base of the stones being embedded in the dune sand. A stratigraphical demonstration of the Aboriginal origin of the bottom feature is thus given, and by inference I would postulate a similar origin for the top one.

Bonwick (1870) mentions circles and piles of stones in the centre of Van Diemen's Land, but as no location nor reference is given, his claim cannot be substantiated. On the Australian mainland, Radcliffe-Brown (1926) mentions stone arrangements marking such ceremonial sites as totemic centres or initiation grounds, and in both cases he makes the point that these are usually geographically fixed. It is rather interesting that here we have evidence of the continuation of the traditions associated with stone arrangement building, being carried on for an archæologically appreciable length of time. A carbon date for the bottom feature, although probably of no great antiquity, would be of interest to archæologists and social anthropologists alike.

(c) *Rock Shelter at Oatlands*

The shelter is a small one with a shallow floor, but it contains three bone tools worthy of note.

1. Double ended bone point (3.5 inches by 0.3 inches). One of the ends is broken but extensive oblique abrasion marks can be seen along the length of the tool, showing the way in which it had been fashioned.
2. Small burnt single ended bone point (0.9 inches by 0.3 inches), again with oblique abrasion marks.
3. Roughly triangular fragment of bone (dimension of the sides being 1.8 inches; 1.4 inches; and 0.7 inches), with several incised marks on its surface, forming two groups of lines crossing each other at roughly right angles. Whether this represents some form of mobiliary "decoration" or whether the lines are due to some utilitarian purpose, for example, the cutting of meat or sinews, can only be determined when other finds of a similar nature are made.

(d) *The West Point Midden*

A sounding five feet by five feet was put into this site, and seven feet of continuous midden resting on at least four feet of sand was found. There are several points to be made:

1. The depth was the greatest that I found in the reconnaissance.
2. The industry was quite rich, and a change of raw material could be seen. In the top three feet, out of a total of 1,000 pieces of chipped stone, 94% were made of fine-grained spongy chert, 5% of quartzites and 1% of basalt. Below three feet there was a marked change, and in the next three and a half feet, out of 400 artefacts, 40% were made of chert, 30% of quartzites and 30% of basalt. This change was associated with a band of sand about nine inches thick. The middens above and below the sand were quite different in lithology, the former being blacker, denser and less sandy than the latter. Below about four feet we only excavated half the trench, so

that the apparent paucity of artefacts in the lower group is only illusory. If we measure the concentration indices of artefacts, we have roughly comparable figures for the two midden deposits. In both cases we were finding about 12 artefacts per cubic foot, and in the sand this figure was reduced to about five.

The sounding was excavated in 12 spits, and the change in raw material was sudden and could be correlated closely with the sandy band. The length of time represented by the stratigraphic break cannot be estimated, due to the ease with which sand is blown onto and off middens even now. Carbon samples were taken at the base of the sounding and also at the level of the sandy band.

3. There was a very large quantity of bone to be found. Out of our cutting we obtained about 2,000 individual bones. The following animals were represented: seal (two varieties), wallaby, whale, native cat, Tasmanian devil, mutton bird, several other types of large bird, cuttle fish and a few fish bones.

More species will probably emerge under detailed study.

4. The bones of migratory creatures such as mutton bird and perhaps seal, will enable seasonal occupation to be studied.
5. There was a marked variation in the frequencies of individual bones, especially in the case of the seal. In particular the lower jaws, and the portion of skull surrounding the ear-bones, were over-represented. This kind of data will give information concerning butchering techniques, food preferences etc., along the lines suggested by T. E. White (1953).
6. A second molar of the right lower jaw of a human was found. The tooth was heavily worn, and severe periodontal disease had caused marked erosion of the roots. This is the only human bone that I have found so far in my examination of the material, and as it is the first such specimen found in a recorded archæological context in Tasmania, a full description is being prepared by Professor Macintosh and Mr. Barker of the School of Anatomy at the University of Sydney.
7. The midden is very big and offers the opportunity of obtaining a large sample for statistical analysis.

FUTURE WORK

Apart from the analysis and publication of the result of last season's work, the following projects present themselves.

1. A large-scale excavation at the West Point midden might give a definitive account of the protein diet, pattern of occupation and stone typology of the prehistoric peoples of the west coast of Tasmania, over a reasonable length of time, together with the hope of finding some more human remains.

2. A careful and thorough pilot excavation must be made at Rocky Cape, preferably in the southern site. This is now all the more desirable, because detailed

comparison might be made with the industry and fauna found at Sisters' Creek, a cave ecologically similar and about six miles to the east. Points which must be especially tested are Meston's claim for a 15 foot depth, and Tindale's theory of a typological sequence (see Mulvaney, 1961). Carbon dates taken under controlled archæological conditions from the base of this site would be extremely interesting, otherwise they are useless or even misleading.

3. Further work might be done on the Bay of Fires stone arrangements, especially a detailed survey and the stripping off of the midden to see the full shape and extent of the lower feature.

4. A zoological survey in the area immediately adjacent to the Sisters' Creek site, would not only yield information as to the ecological positions of the land fauna, fish and shell fish, but would also provide very valuable comparative osteological material. The same work would have to be done in the West Point area, if a detailed excavation is carried out there.

5. The sandstone area around Nubeena is worth investigating more fully in order to get a larger comparative industry from the east coast.

6. The sandstone areas around Melton Mowbray, Oatlands and Bothwell contain numerous shelters, some with occupational deposit. A large stratified assemblage is required from an inland area.

If one is to test the hypothesis put forward by Mrs. T. B. Kemp (1963) of the dichotomy between the west coast and the midland/east coast industries, then the last two areas must be investigated thoroughly.

CONCLUSION

The chief immediate results of the field work can be summarised as follows :

1. There is no paucity of sites in Tasmania, neither on the coast nor in certain areas inland.

2. Due perhaps to climatic factors, there are some sites which have a degree of conservation of bone so far unrivalled in Australian archæology. This gives an opportunity of applying the economic approach to prehistory.

2. The stone industries are complex enough to enable a typological study to be made.

4. The discipline of archæology has a special contribution to make to Australian anthropology. In Tasmania some examples where archæology can correct or supplement ethnology are in the discoveries of the stone arrangement, the multiplicity of bone tools, and the abundant fish bones.

The archæological record in Tasmania is rich enough for extensive prehistoric research to be carried out there, and further work is planned.

ACKNOWLEDGEMENTS

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I also thank Dr. Bryden and Mr. Ellis for their helpful advice and for the use of the Museum facilities at Hobart and Launceston.

My thanks are due to many people in Tasmania for their help and great hospitality. In particular I should like to express my appreciation to the following: Mr. and Mrs. P. Dart, Mr. and Mrs. Sadler, and Mr. Walker of Wynyard; Mr. and Mrs. Meredith of Rocky Cape; Mr. P. Broughton, Professor and Mrs. Firth and Dr. Grote Reber and Mr. Bennet of Hobart; Mr. W. E. Tucker of St. Helens, Mr. T. Stacey, and Mr. and Mrs. Noye of Nubeena; Mr. and Mrs. Beale of Deloraine; and Mr. and Mrs. Seager of Launceston.

I wish to acknowledge the loan of archæological, camping and surveying equipment borrowed from the Departments of Agriculture, Anthropology, Archæology and Geography at the University of Sydney. I should also like to thank Dr. J. Davis, Dr. E. D. Gill, Mr. J. Golson, Mrs. T. B. Kemp, Mr. F. McCarthy, Mr. J. Mulvaney and Mr. R. Wright for their professional discussions on the work. Miss D. Bingham drew Figure 1: 5, Figure 2: 3, 6.

My greatest thanks are to my colleagues who continued working unperturbed by fatigue, boredom, harsh living conditions, psychological irritations or the wet weather.

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him across and he survived the water. They continued their walk until they came across fire on dry land between streams. Small Gourd said, 'Oh my younger brother, I am going to die because fire is coming.' Small Pot said, 'You will not die.' When the fire came near to them Small Pot said to Small Gourd, 'Lie on the ground upside-down.' Small Gourd lay on the ground upside-down and Small Pot covered him by lying upside-down on top of him. The fire came and passed without burning Small Gourd because he was covered by Small Pot. When it passed they came together again and went on their way together, for they were great friends.

They feed the courtyard ridge (with rubbish) and it in return feeds its owner.³¹ Termites are pounded into the pot where others were.

BEE WAS HEIR TO BIG FLY (II, 6)

Big Fly begat his children. He lived till one day he became sick. He sent after his firstborn son, saying that he was seriously ill. When his son heard it he said that they should tell his father that he was dancing. When his sister's son Bee heard it he went there and said, 'My father, I have come.' Big Fly said, 'My child, I am going to die and my heritage is here.' As he was going to die let him take over the inheritance and scatter it all over the world.³²

Then Fly came and told his father that he had returned. He came when his father was dying. The father said to his son, 'Since I was dying in your absence, here is the wound; be sitting on the wounds of people. You shall eat decomposed things and sit on grass.' That us why people say, 'Bee was heir to Big Fly.'

A RIDDLE³³ ABOUT THE FACE (II, 7)

There are four men in the same homestead, having the same courtyard, but they never visit each other. Who are these people? They are the two eyes and the two ears. They never visit each other. Although they are handsome they never go round to see each other.

A PROVERB ABOUT AN INSECT CALLED SPIDER (II, 8)

Although the river is in flood a spider can put on its white barkcloth to cross without getting soaked. That is why when boys collect together one will ask the others to answer this, 'There is a man who, although the river is in flood, and he puts on his barkcloth, will never get soaked?'

However difficult a thing may be, a capable person may try it and succeed.

A RIDDLE ABOUT THE AMBOMU³⁴ AND RED GROUND FRUIT (II, 9)

The Ambomu said in double-talk, 'the land rainbow.' This means that the red ground fruit resembles the rainbow, for the fruit is very red (like the rainbow). A knowledgeable person will understand at once and say, 'It is the red ground fruit.'

A RIDDLE ABOUT THE CREATURE CALLED TORTOISE (II, 10)

It is a habit of the tortoise that when it is twelve o'clock³⁵ noon it cannot see the sun at all because of its shell which covers all its head and renders it unable to look up properly. The tortoise sees the sun only from early morning up to about eight o'clock,³⁶ and when it ascends higher it will disappear from its sight. It will only see sunlight [not the sun itself] until three o'clock. It sees the sun from about three o'clock till four o'clock and then till evening the tortoise sees the sun again. That is why people say in a riddle, 'There is a man who cannot see the sun at midday. He sees the sun only in the morning and in the evening.' A knowledgeable person will say, 'It is the tortoise.'

Notes

¹ An area of high grass is selected and a path trodden round it so that it can be seen by their spoor if animals have entered the area and have not left it. Nets are then erected at one side and men and dogs enter from the other side to scare the game into them. Children line the unnetted sides of the area to scare the game by shouting if they try to break out there.

² A very large snail called *duru* in Zande.

³ A blue-grey monkey which makes a squeaky sound, called *mbatu* in Zande.

⁴ These words would seem to indicate the croaking of the bird.

⁵ I think that solomon fish is the right identification for the Zande *saraba*.

⁶ This would appear to be the sense of *ri ngbi* here. It could mean 'over the world.'

⁷ The word used, *tukputukpu*, is that used to refer to the warthog's warts.

⁸ The word *mionio* means not only 'with a drizzle' but also in metaphor for the movement of the grey duiker in a drizzle—short quick steps.

⁹ The word is *fura*, hole or burrow. It appears to mean here another entrance to the den concealed under the surface of the water.

¹⁰ I was told that the word *sosoro* is a word here used meaning 'dawn' in the language of the partly assimilated Pambia people, but I think that it more probably renders the cry of this sort of francolin.

¹¹ A tiny bird, the first to sing in the morning, at about dawn.

¹² I believe this to be the correct identification for the Zande *kpaawe*.

¹³ The title is about how a child's hand got stuck in a hole, but there is nothing about a hole in the story. This is perhaps a confusion with other stories in which a child's hand is caught in a hole.

¹⁴ *Kpakpa* is the sound made by striking the drum on the wood at the edge of the membrane.

¹⁵ Members of this clan have the waterbuck for totem: it is believed that their body-soul changes into this animal at death.

¹⁶ *Giri*, cord. Thunder is regarded by Azande as a sort of creature. There is also a belief that it has a cord by which it descends, as, indeed, is the sense of the story.

¹⁷ Wau, the capital of the Bahr al-Ghazal Province of the Sudan. Its use here is to suggest a very great distance.

¹⁸ *Nzara* appears to have no meaning here.

¹⁹ *Sati* appears to be the same as *atari*, the usual oracle in Zande folktales. It behaves here in the same manner as the *atari*. Both take the plural pronoun.

²⁰ The Zande word is *akutu*, bumps or notches. The word is used for the warts of the warthog.

²¹ A well-known Zande proverb. A boy was told not to enter the carcass of an elephant when men were cutting it up with their spears. He disobeyed and got cut in consequence.

²² A big river in the Congo.

²³ A big river in the Sudan.

²⁴ This appears to be the meaning. As written *ri ngua* could mean literally 'eats the tree' or 'top of the tree.'

²⁵ The Zande is *fonzoro gugu*, which I have translated literally. I cannot say what is its meaning here.

²⁶ One of the best-known Zande proverbs. When a male snake is burnt its male organ protrudes, or so Azande say. Otherwise one cannot tell male from female.

²⁷ In some places the singular is used—one daughter—and in other places the plural—both daughters.

²⁸ A river and a place (called after a prince) in the Sudan. Both are intended to suggest a great distance.

²⁹ This may be an interpolation from the Bible. It must be borne in mind that these texts were written by a Christian convert and were used for teaching purposes in a mission school. The phrase does not seem to be to be Zande, but there is no certain means of knowing.

³⁰ One of the most used of Zande proverbs. The nearest English equivalent would be 'one good turn deserves another.'

³¹ This proverb also has the sense of 'one good turn deserves another.'

³² This is a rough rendering of the sentence.

³³ The word in the text is *sanza*. *Masaku* is usually used for 'riddle.'

³⁴ The Ambomu are the 'true' or 'original' Azande who have imposed their culture on foreign, now mainly assimilated, peoples. They pride themselves consequently on their greater understanding of metaphorical language.

³⁵ Ordinary Azande would not at this time have reckoned time in figures. This is missionary influence.

³⁶ The word here is *muambi*, an introduced word.

Excavations on a Stone Arrangement in Tasmania. By Rhys Jones, Department of Anthropology, University of Sydney. With a figure

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During an archaeological expedition to Tasmania, in the summer of 1963-1964¹ we investigated a row of stones on a midden at the Bay of Fires on the north-east coast. Excavations revealed a second arrangement stratified one foot beneath the top one, and it is postulated that both are of aboriginal origin.

Our attention was drawn to the site by Mr. W. E. Tucker of St. Helens, and it can be found on the coast, about two miles south of Anson's River. As one walks south of the outlet of Anson's Bay on the foreshore, after having passed an area of shifting dunes, one comes across a large storm beach of pebbles, about 12 feet above normal high tide. There is a long narrow grass-stabilized midden piled up behind and slightly above this pebble bank, and the ground immediately inland is swampy and has a marshy vegetation cover. Apart from a farm at Anson's Bay, the hinterland is practically unoccupied, and the bush is dominant until one reaches the environs of St. Helens about 15 miles to the south.

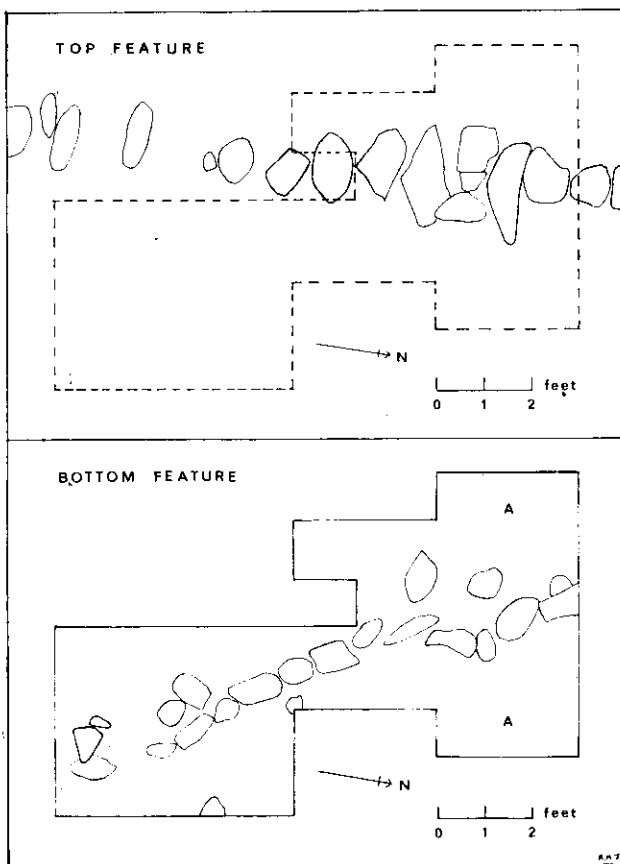


FIG. 1. PLAN OF EXCAVATION AT BAY OF FIRES, 1964

On the surface of the shelly soil can be seen a row of 138 stones arranged so as to follow the crest of the midden. The stones are flat, about two feet long and one foot broad, and they are set into the ground with their longest side at right angles to the general direction of the alignment, so as to form a feature which resembles a garden path in appearance. The alignment is 270 feet long, discontinuous in places, and follows a 175° - 355° direction. It is impossible to attach any significance to this particular bearing as

the coast also follows a north-south line at this point. Near the northern end of the feature, and on the surface of the pebble bank, can be seen a few piles of stones, about one or two feet high. Although they could be of aboriginal origin, the possibility of their construction by surveyors or hunters cannot be ruled out.

A small-scale excavation was carried out in order to ascertain the relationship of the stones to the underlying midden. The trench (A) revealed a depth of 12 inches of undisturbed midden material, with charcoal, stone flakes and some bone fragments, resting on clean dune sand. The flaked assemblage was made of crystalline quartz, and although the artifacts were plentiful, their use to the typologist is limited. The flat stones of the alignment were about three inches thick and were sunk into the midden with their top surfaces flush with the surface of the ground. Directly beneath the top feature, and separated from it by six inches of shell midden were found other stones. The excavations were extended at right angles to the first trench, so that an area 12 feet by three feet was uncovered. In this cutting an irregular row of 12 rounded sub-angular stones could be seen, aligned approximately in a 145° - 325° direction (see fig. 1). All of these stones had their bases set a few inches deep into the sand underlying the midden, and two of them had been extensively flaked prior to being placed *in situ*. The midden itself had accumulated around this structure, for no traces could be seen of any holes dug through the deposit to let the stones into the sand. There was a depth of 12 inches of shell deposited in the time between the building of the two arrangements. About six inches of midden had been laid down after the total disappearance of the bottom feature before the top one was constructed. In the case of the lower feature, it is impossible to say as yet whether it was intended to be a straight line of stones as is the case in the top one, or whether the stones exposed are part of some more complicated arrangement. Further work is required, to strip off the midden, so as to expose the full extent of lower structure, before any meaningful descriptions can be made.

Discussion

Stone arrangements are quite common on the mainland of Australia (for bibliographies see Towle, 1939, and Greenway, 1963), but this is the first published account of one in Tasmania. Bonwick (1870) in a discussion of the religion of the Tasmanian aborigines, and in particular writing of Druidical rites on the island, says (p. 192), 'circles have been recognized in the interior of Van Dieman's Land, piles of stones have been noticed, evidently of human design . . .'. This statement has been noted by Thorpe (1924) and McCarthy (1940). Bonwick, however, gives no reference nor any geographical location to support his statement, and Roth (1899, p. 57) dismisses it, saying that 'no aboriginal stone or other circles have yet been discovered.'

We were fortunate in the case of the lower feature to be able to give a stratigraphical demonstration of its aboriginal origin, and it is reasonable to infer that the top one was similarly built. Stones were readily available from the pebble bank, but large flat ones, such as were used in the top feature are quite difficult to find, and its construction would involve more than a casual expenditure of effort. It serves no apparent economic purpose and its situation on an exposed dune in an area undeveloped and practically unoccupied, makes the possibility of European origin extremely unlikely.

In attempting to reconstruct the sequence of events, one can say that first, the bottom feature was built on the surface of a dune, and the stones were probably pushed down a few inches to give them a little stability. A period of time then elapsed, when up to 12 inches of midden were deposited, after which the

top alignment was built. During this time, there had been occupation at the site, and the large number of flakes and cores indicates that normal industrial activities were carried out. Radcliffe-Brown (1926) mentions stone arrangements on the Australian mainland, marking ceremonial sites such as totemic centres, and initiation grounds. He points out that such ceremonial centres are usually geographically fixed. Whatever use the Bay of Fires arrangement may have had, it is interesting to note that the traditions connected with its construction continued for an archæologically appreciable length of time, a circumstance of interest to archæologists and anthropologists alike.

Note

¹ The expedition was carried out under the auspices of the Australian Institute of Aboriginal Studies, and the Department of Anthropology at the University of Sydney. A full report of the expedition is in press; see Jones, Rhys (1965).

The other members of the expedition were F. J. Allen, I. C. Glover and R. A. Wild, of the University of Sydney. I should like

to thank Mr. F. D. McCarthy and Mr. David Moore for their help with the literature, and Miss D. K. Billings for reading the manuscript.

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With a different commentary anthropological films designed for teaching can be adapted for a general television audience. As the world contracts there is an increasing need for international and interracial understanding, and films at this level can do much to break down the barriers of social and geographical distance.

Furthermore, anthropological films could play an invaluable role in industrial training. It is sometimes frightening how little Europeans working overseas know of the indigenous peoples amongst whom they are living and working.

(d) *Finance*. At present there is no direct kind of government sponsorship available in this country for this kind of project, and apart from the more spectacular travelogues there has been no television market in Great Britain for this kind of film until the advent of B.B.C.2. Foundations on the whole tend to view films as being supplementary to pure research and, therefore, outside their scope.

Most teaching documentaries are, in fact, sponsored by commercial companies, but, while these concerns can afford to make films in the pure sciences, as soon as human relationships come into the picture there are immediate political implications; for purely economic reasons a company cannot afford to offend the politicians of the countries in which it has vested interests.

therefore it is better to be selective on the basis of a research analysis wherever possible, rather than taking pot luck as things happen.

In a wedding, for example, several things tend to happen in different places at the same time. It is far easier to shoot the main events which involve a lot of people as they happen, and then to fill in by re-staging some of the simultaneous events afterwards. But dramatization would seem to be only valid when the course of events can be fairly surely predicted, and this usually confines it to fairly simple and uncomplicated situations involving a small number of people.

In certain cases a hidden camera has distinct advantages, particularly for recording in close-up, spontaneous reactions and emotions, although in many cases the lack of mobility can prove to be a disadvantage. If the situation which is being filmed is dramatic in itself, and the participants are used to the presence of a camera, the situation will hold their attention if they are fully absorbed in it, and they can then forget about the camera which can move around freely.

An alternative technique is the interview, but this way the characters are likely to say only what they want you to know or what they think you want to know. People must be made to forget the camera. For an interview you need a far more competent actor than you do when you put people face to face to discuss a live issue, when the odds are that they will become so involved with them-

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OBSERVATIONS ON THE GEOMORPHOLOGY OF A COASTAL CAVE NEAR WYNYARD, TASMANIA

by

RHYS JONES



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By

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ABSTRACT

A seaward facing cave is noted on the coast immediately to the east of the Sisters' Creek beach; and the presence of a cemented water rolled conglomerate adhering to parts of the ceiling suggests an old sea level, at a height of the order of 100 feet above the present sea level.

DESCRIPTION

During an archaeological survey carried out under the auspices of the Australian Institute of Aboriginal Studies, and the Department of Anthropology at the University of Sydney in the summer of 1963-64, an investigation was made into the caves to be found in the precambrian quartzites (Cave quartzite of Spry, 1957) of the Sisters' Hills on the coast about six miles northwest of Wynyard.

One of these caves is situated in the side of a high seaward facing cliff, about half an hour's walking distance across bush and rocky foreshore in an easterly direction from the end of the vehicle track at the eastern end of the Sisters' Creek beach. The entrance to this cave is about 30 feet high and 65 feet wide, and it faces out to sea in a northeasterly direction, the surface of the floor deposit being about 60 or 70 feet above sea level. When one stands on the talus at the mouth, and looks at the cave, one can see that it consists of two slits, the westerly one being 40 feet high and 16 feet broad, slopes down to the left at an angle of about 60 degrees; and the easterly one is 25 feet high and 20 feet broad at the widest part, and slopes down to the right. These are separated by a section of the folded bed-rock, 15 to 20 feet in thickness.

The roof of the easterly slit cave is smooth and fairly level, and adhering to it can be seen patches of a cemented conglomerate. This conglomerate is probably that named the Sisters Conglomerate by Spry (1957) and consists of tightly packed, water rolled stones in a sand matrix, some of these pebbles being completely rounded, and up to about a foot in diameter. Inspection shows that this conglomerate is cemented onto the ceiling of the cave, the junction being quite distinct, and it is very probable that these are the remains of a much more extensive deposit, the floor beneath being littered with chunks of cemented pebbles that have fallen off. The conglomerate had been laid down after the formation of the cave, and as there is no possibility of deposition by streams, I would suggest a marine origin. Such a theory is strengthened when one examines the back end of the cave, about

60 feet in from the entrance. Here the protruberances of the bedrock are rounded and smoothed by water action, with extensive remains of the cemented conglomerate having been injected into and against the hollows and corners.

The height of the outer edge of the upper lip of this cave is 101 plus or minus 4 feet above mean sea level, and the conglomerate attached to the ceiling extends from a height of 95 feet to 90 feet. The height of the corner where the ceiling meets the back wall of the cave is 90 feet and the conglomerate extends a few feet below this. I would suggest that both caves were formed by marine action, and that the remains of an old cemented raised beach can be seen in the easterly one. These phenomena might be associated with a sea level 90 to 100 feet above the present level, though the dangers in deducing the height of an ancient shore line from pebble deposits must always be borne in mind. (Zeuner, 1959, p. 282).

Johnston (1888) records "Helicidae Sandstone", which Jennings (1959), calls aeolianite, at a height of about 100 feet above sea level, on Mt Chappel Island in the Furneaux Group. Lewis (1935) correlated these deposits with his "Pre-Malannan" gravels in the Derwent Valley, but his scheme must be rejected following the criticisms of Jennings and Banks (1958). Edwards (1941) makes the suggestion of possible river terrace remains in the Mersey and Forth rivers, indicating a strand line at about 100 feet above sea level. The best documented evidence is that of Jennings (1959) where he records boulder beds of water rolled pebbles in the open cut of the Grassy Creek scheelite mine. These beds have been noticed at various heights between 90 feet and 150 feet above sea level, and Jennings postulates their association with a high sea stand at 120 feet to 150 feet, although correlation with a succession of strand lines at other heights of that general order is also considered. Elsewhere in Tasmania, Hills (1914) reports a deposit of rounded boulders and shingle indicating a raised beach at a height of almost 100 feet above sea level, on the south side of the base of Point Hibbs. An eustatic sea level rise of the order of 100 feet has been recorded in many places all over the world, and this is correlated by Zeuner (1959) to his "Tyrrhenian" phase, which is generally assigned to the Mindel/Riss interglacial period. Further it is possible that the Sisters' Creek caves and the Rocky Cape caves were formed during the same episode. They are similar in general shape, the bedrock in both cases is the Cave Quartzite, and they are situated within six miles of each other. Gill and Banks (1956),

and Gill (1959) assign a correlation to a 70 foot sea level, but doubt has been expressed by Jennings (1959).

In front of the Sisters' Creek cave is a large talus of hillwash which comes in from the outside slope above, and to the immediate west. This deposit has been cemented together, and consists of angular fragments of rock and soil. The front part of this talus is eroding away, and this leaves a face against the bedrock at the eastern end, which is about 15 feet deep. An examination of the top surface and the eroded face of this hillwash did not reveal any cultural material embedded in it. The floor of the western cave is behind this hillwash, about six feet below it, and it is very damp, being subject to flooding. The deposit is sandy and ravages of fossickers have upturned some shells and bones, attesting to at least some occupation by the aborigines in recent times.

ACKNOWLEDGEMENTS

I wish to thank my colleagues who accompanied me on the survey: Messrs. F. J. Allen, I. C. Glover, and R. A. Wild, from Sydney University; C. Mc Knight, from Melbourne University; and R. Reece, formerly from the Australian National University.

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Pwy oedd y Tasmaniaid?

—Ymchwiliadau

Archaeolegol

RHYS MAENGWYN JONES



Ganwyd Rhys Maengwyn Jones yn Llangefni yn 1941. Cafodd ei addysg gynnar yn Ysgol Gynradd Maenofferen, Ysgol Sir Blaenau Ffestiniog, ac Ysgol Ramadeg Whitchurch, Caerdydd. Enillodd Ysgoloriaeth Trevelyan i Goleg Emmanuel Caergrawnt yn 1958 lle astudiodd wyddoniaeth naturiol, ac wedyn archaeoleg, a graddio yn 1963. Y mae yn awr yn darlithio yn adran Anthropoleg, Prifysgol Sydney, ac yn gwneud gwaith ymchwil ar gynhanes yn Nhasmania.

Dechreuodd ei ddiddordeb archaeolegol yng nghastell Harlech wrth 'amddiffyn y porth yn erbyn y gelyn', ar ei nawfed benblwydd! Ei brofiad cyntaf o gloddio oedd gyda Dr. H. N. Savory o Amgueddfa Genedlaethol Cymru, ar dwmpath bedd yn St. y Nyll, Sain Ffagan, yn 1958. Er hynny y mae wedi gweithio yn Ogof Coygan, Sir Gaerfyrddin, ac hefyd bu ar ymgyrchion i Wlad y Lapp, Groeg, Twrci, a Phersia.

PAN laniodd Tasman ym Mae y Dyn Du, dwyrain Tasmania, yn 1642, fe glywodd swm dynion, ond ni welodd neb. Fe adawyd i'r Ffrancwr Du Fresne, yn 1772, i ddarganfod y brodorion cyntaf, ac yn y traddodiad Ewropeaidd, lladdwyd un ohonynt. Yn yr ugain mlynedd dilynol, bu llawer o archwilyr i'r ynys, er enghraifft Cook a D'Entrecasteaux, nes, yn 1803, sefydlwyd y wladfa gyntaf. Y maent yn amcangyfrif bod yna rhwng dwy a chwe mil o frodorion ar yr ynys yn yr amser hwnnw, ond erbyn 1830 dim ond 225 oedd yn fyw, ac yn 1876 bu farw Trugannini, y frodorwraig olaf. Yn yr hanes ffaidd hwn, llofruddiaeth, afiechydon a rhyfel oedd y lladdwyr pennaf, ac felly dilynodd yr hil Dasmaniaidd y Dodo a'r Aderyn Moa i ddifodiant.

Darwin

Yn 1871 ysgrifennwyd *Primitive Culture* gan E. B. Taylor, ac yn 1877 *Ancient Society* gan L. H. Morgan. Yn y llyfrau hyn yr oedd syniadau datblygiaethol Darwin yn cael eu cymhwyso i anthropoleg, ac yn sydyn yr oedd diddordeb enfawr yn y diwylliannau cyntefig cyfoesol. Yn yr un adeg, yr oedd yr archaeolegwyr yn cloddio

mewn ogofau yn Ffrainc a Phrydain ac yn darganfod fod olion dyn yn yr un haenau ag esgyrn y mamoth y rhinoseros gwlanog, yr heina, arth yr ogof, a yn y blaen. Yr oedd diwylliant materol y cyndrigolion hyn yn syml iawn, nid oedd ganddynt haearn pres, llestri pridd, na hyd yn oed gerrig llifedig. Yr unig offer a ddarganfuwyd oedd y rheini lalfnau ac asglodion callestr (gw. Ffig. 1) gyda phwyntiau a phicelli o asgrwn ac ifori. Galwyd ym amserau hyn 'Yr Hen Oes Garreg', neu'r 'Oes Balaolithaidd.' Yn Ewrop parhaodd y cyfnod o ryw hanner miliwn, hyd at ryw ddeng mil flynyddoedd yn ôl. Gwelir y sefyllfa yng Nghymru yn y cyfnod hwn yn Fleure *et alii* (1923), tud. 13-33. Mewn rhai mannau o'r byd, ar y llaw arall, y mae un radd o ddatblygiad economaidd yn parhau at presennol, er enghraifft, gyda'r Escimo, a brodorion Awstralia a Thasmania. Yr oedd yr anthropolegwyr datblygiaethol yn ystyried fod y bobloedd cyntefig hyn yn cynrychioli goroesiad o radda cynhanesol yn natblygiad dyn. Felly ysgrifennodd Taylor, *On the Tasmanians as Representatives of Palaeolithic Man* yn 1894, a Sollas, *Ancient Hunters* yn 1911.

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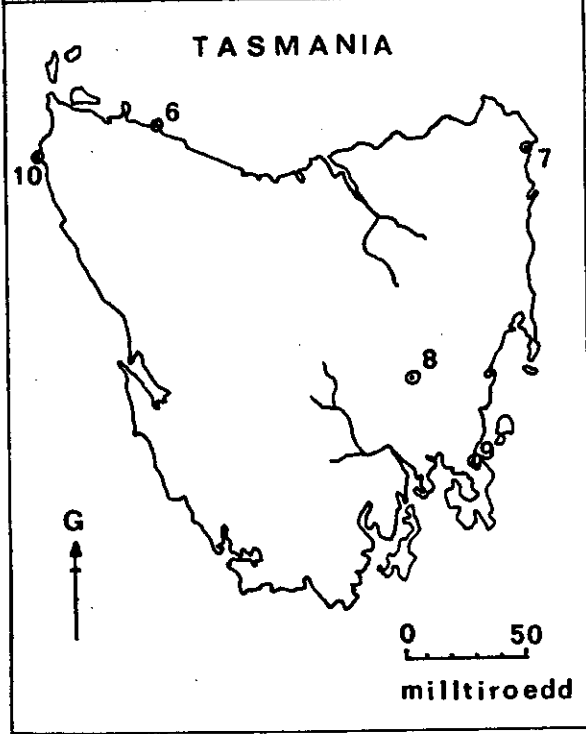
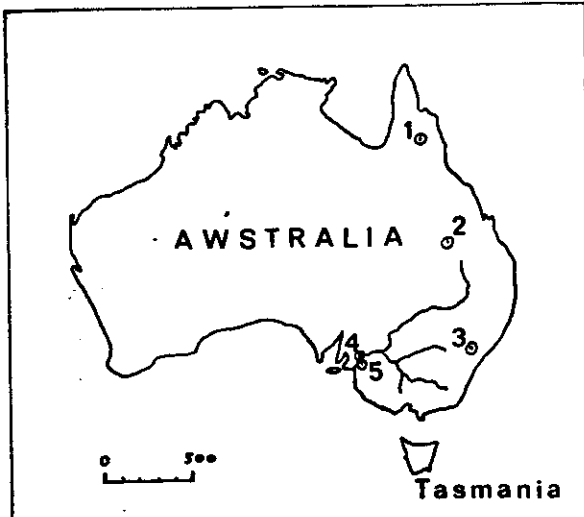
Dechreuodd ei ddiddordeb archaeolegol yng nghastell Harlech wrth 'amddiffyn y porth yn erbyn y gelyn', ar ei nawfed benblwydd! Ei brofiad cyntaf o gloddio oedd gyda Dr. H. N. Savory o Amgueddfa Genedlaethol Cymru, ar dwmpath bedd yn St. y Nyll, Sain Ffagan, yn 1958. Er hynny y mae wedi gweithio yn Ogof Coygan, Sir Gaerfyrddin, ac hefyd bu ar ymgyrchion i Wlad y Lapp, Groeg, Twrci, a Phersia.

PAN laniodd Tasman ym Mae y Dyn Du, dwyrain Tasmania, yn 1642, fe glywodd sŵn dynion, ond ni welodd neb. Fe adawyd i'r Ffrancwr Du Fresne, yn 1772, i ddarganfod y brodorion cyntaf, ac yn y traddodiad Ewropeaidd, lladdwyd un ohonynt. Yn yr ugain mlynedd dilynol, bu llawer o archwilyr i'r ynys, er enghraifft Cook a D'Entrecasteaux, nes, yn 1803, sefydlwyd y wladfa gyntaf. Y maent yn amcangyfrif bod yna rhwng dwy a chwe mil o frodorion ar yr ynys yn yr amser hwnnw, ond erbyn 1830 dim ond 225 oedd yn fyw, ac yn 1876 bu farw Trugannini, y frodorwraig olaf. Yn yr hanes ffaidd hwn, llofruddiaeth, afiechydon a rhyfel oedd y lladdwyr pennaf, ac felly dilynodd yr hil Dasmaniaidd y Dodo a'r Aderyn Moa i ddifodiant.

Darwin

Yn 1871 ysgrifennwyd *Primitive Culture* gan E. B. Taylor, ac yn 1877 *Ancient Society* gan L. H. Morgan. Yn y llyfrau hyn yr oedd syniadau datblygiaethol Darwin yn cael eu cymhwyso i anthropoleg, ac yn sydyn yr oedd diddordeb enfawr yn y diwylliannau cyntefig cyfoesol. Yn yr un adeg, yr oedd yr archaeolegwyr yn cloddio

mewn ogofau yn Ffrainc a Phrydain ac yn darganfod olion dyn yn yr un haenau ag esgyrn y mamoth, y rhinoseros gwlanog, yr heina, arth yr ogof, ac yn y blaen. Yr oedd diwylliant materol y cyndrigolion hyn yn syml iawn, nid oedd ganddynt haearn, pres, llestri pridd, na hyd yn oed gerrig llifedig. Yr unig offer a ddarganfuwyd oedd y rheini o lafnau ac asglodion callestr (gw. Ffig. 1) gyda phwyntiau a phicelli o asgwrn ac ifori. Galwyd yr amserau hyn 'Yr Hen Oes Garreg', neu'r 'Oes Balaeolithaidd.' Yn Ewrop parhaodd y cyfnod o ryw hanner miliwn, hyd at ryw ddeng mil o flynyddoedd yn ôl. Gwelir y sefyllfa yng Nghymru yn y cyfnod hwn yn Fleure *et alii* (1923), tud. 13-33. Mewn rhai manau o'r byd, ar y llaw arall, y mae'r un radd o ddatblygiad economaidd yn parhau at y presennol, er enghraifft, gyda'r Escimo, a brodorion Awstralia a Thasmania. Yr oedd yr anthropolegwyr datblygiaethol yn ystyried fod y bobloedd cyntefig hyn yn cynrychioli goroesiad o raddau cynhanesol yn natblygiad dyn. Felly ysgrifennodd Tylor, *On the Tasmanians as Representatives of Palaeolithic Man* yn 1894, a Sollas, *Ancient Hunters* yn 1911.



- | | |
|----------------------|--------------------------|
| (1) Laura | (6) Cilfach y Chwiorydd |
| (2) Ogorf Kenniff | (7) Bae y Tanau |
| (3) Dyffryn Capertee | (8) Ceunant y Llofrudd |
| (4) Rhos Dyfnaint | (9) Bae y Dyn Du |
| (5) Glanfa Ffomm | (10) Penrhyn y Gortlewin |

ynys orosiad llawer o anifeiliaid, megis y 'Diafol Tasmaniaidd' (*Sarcophilus*) a'r 'Teigr Tasmaniaidd' (*Thylacinus*), sydd wedi hir ddiplannu o'r cyfandir.

Dywed ysgolheigion eraill fod cyrff y Tasmaniaid yn debyg i'r Negritiaid o Felanesia. Dadleuant eu bod wedi dod i Dasmania ryw amser ar ôl ymwahaniad yr ynys o'r cyfandir, a'u bod wedi dod gyda llifogydd y môr o Galedonia Newydd rhyw 2,000 o filltiroedd i'r gogledd. Dywedant nad yw hyn yn amhosibl a bod ynsoedd y Pasifffig wedi cael ymsefydlu ynddynt yn yr un modd. A ydych yn cofio taith fendigedig y 'Kon Tiki'? Nid oes gennym ddigon o dystiolaeth eto i brofi'r naill ddamcaniaeth na'r llall.

Ar gyfandir Awstralia y mae'r archaeolegwyr yn dechrau casglu'r ffeithiau. Yn Ogorf Kenniff cloddiwyd pwll 14 troedfedd o ddyfnder gan Mulvaney (1964). Yn yr haenau uchaf (gydag oedran o 600 c.c.) darganfuwyd teip arbennig o offer cerrig o'r enw 'microlithion' (Ffig. 2 (3)). Y mae'r rhain wedi cael eu gwneud o asglodion bychain, gyda'u cefnau wedi eu difinio, er mwyn eu rhoddi mewn holltau yn ochr, neu ar flaen corsennau pren. Medr yr offeryn cyfansawdd hwn gael ei ddefnyddio fel gwaywffon, saeth, neu dryfer. Y mae y microlithion wedi cael eu darganfod yn Ne-Ddwyrain Asia, Affrica, Ewrop, a hyd yn oed yn Ne Cymru hefyd (Wainwright, 1963). O dan y microlithion, ac yn ymestyn yn ôl mewn amser hyd at 14000 c.c., y mae diwydiant carreg o asglodion mawrion, ac y mae siap y cerrig hyn yn debyg iawn i'r offer cerrig o Dasmania.

7,000 C.C.

Yn Nyffryn Capertee (McCarthy, 1964), y mae diwydiant gyda microlithion a 'phwyntiau Bondi' (Ffig. 2 (2)) yn gorwedd uwch ben diwydiant arall sydd eto yn debyg i'r cyfryw o Dasmania. Yn Rhos Dyfnaint (Hale and Tindale, 1930), ac ar Lanfa Fromm (Mulvaney, 1960), yn agos i Afon Murray yn Ne Awstralia, y mae gennym ddau gyfnod sicr, sef y cyfnod diweddar yn gorwedd uwch ben haenau gyda 'phwyntiau Pirri' (Ffig. 2 (1)), a microlithion o'r adeg 1800-3000 c.c. Yn hyn na'r rhain, y mae yn debyg fod gennym drydydd cyfnod gydag asglodion a chrafwyr mawrion yn ymestyn yn ôl hyd at 6000-7000 c.c.

Y mae gwaith mwy diweddar wedi ei wneud yng Ngogledd Awstralia, yn Laura, Penrhyn Efrog, gan Wright (1964). Cloddiodd Wright i ddyfnder o 20 troedfedd, gyda 14 troedfedd o dywod ag offer ynddo. Y mae'r haenau mwyaf diweddar gyda

bwyceill cam o asglodion (*Burren Adze Slugs*) (Ffig. 2 (4)), a bwyceill cerrig llifedig yn gorwedd uwch ben diwydiant gydag asglodion mawrion crafwyr â chefn uchel, crafwyr cafnog, ac yn y blaen.

I grynhoi felly, gwelir bod gennym dystiolaeth am lawer o draddodiadau cynhanesol yn Awstralia. Rhwng 18000-14000 hyd at 5000-4000 c.c. gwelwn y trigolion cyntaf gyda'u diwydiannau cerrig a'r asglodion mawrion yn gwneud offer fel crafwyr â chefn uchel, yn debyg i'r cyfryw o Dasmania yn y ganrif ddiwethaf. Ar ôl hyn, ar y cyfandir, rhwng 4000 c.c. hyd at 1000 A.D., daeth y digwyddiadau cymhleth gyda'r microlithion a'r pwyntiau Bondi a Phirri. Yn yr amseroedd cyfoesol, bu farw'r traddodiadau hyn, ond pery'r bwyceill cam a'r bwyceill llifedig hyd at y presennol.

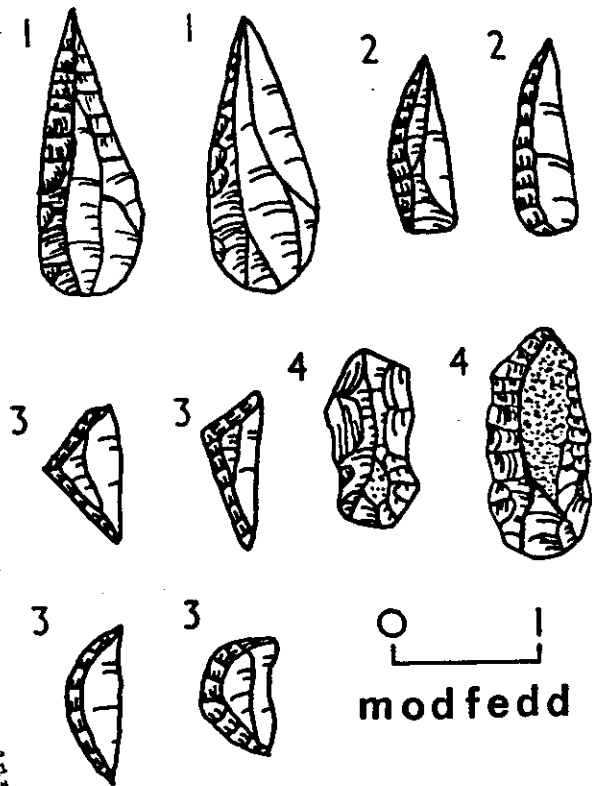
Arwain ymgyrch

Arweiniais ymgyrch¹ i Dasmania yr haf diwethaf, rhwng Rhagfyr 1963 a Mawrth 1964, i ddechrau gwaith archaeolegol ar yr ynys. Ein nod oedd darganfod safleoedd cynhanesol er mwyn astudio hen ddiwyllianau cerrig asglodiedig, ac os yn bosibl i geisio dosbarthu'r rhain i'w manau ecolegol ac economaidd.

Cawsom ogof yn agos i 'Gilfach y Chwiorydd' (Jones, Rhys, 1964) ar yr arfordir gogleddol (gw. y map). Yr oedd yr ogof hon ar ochr clogwyn, rhyw 100 troedfedd uwch ben y môr. O flaen y clogwyn, ac wrth lannau'r môr, yr oedd lle ardderchog i gasglu pysgod cregyn. Y mae digon o bysgod yn y môr, a thu ôl i'r ogof mae gwastatiroedd gyda chreigiau a choedwigoedd yn llawn o anifeiliaid gwylltion, hyd yn oed yn awr. Yn yr ogof yr oedd tomen gregyn—gweddillion bwyd cynoesol—a dechreuasom gloddio ynddi. Torasom bwl sgwâr, pob ochr yn bum troedfedd o hyd, ac ar ôl mynd trwy ddyfnder o bum troedfedd o domen, cyraeddasom dywod diffrwyth. Yr oedd gwaddod y domen yn gyfoethog iawn mewn esgyrn anifeiliaid, ac asglodion ac offer cerrig, ac felly ehangasom ein pwll nes yr oedd gennym ffos 30 troedfedd o hyd. Rhaid oedd cloddio yn fanwl iawn gyda thrywel, ac wedyn rhidyllasom y baw er mwyn gwahanu'r offer a'r esgyrn oddi wrth y gweddill. Cymerodd y gwaith chwech wythnos i'w orffen.

O'r gloddfa, cawsom gasgliad helaeth o asglodion cerrig. Er mwyn bod o unrhyw ddefnydd i'r crefftwr, rhaid i'r garreg fod yn galed, ac yng Nghilfach y Chwiorydd defnyddiwyd amryw fathau, sef cwartseit, cwarts, a basalt. Yr oedd y rhan fwyaf o'r cerrig yn wastraff, ond cawsom ryw saith ganran o'r gloddfa yn offer wedi eu hail-

F fig. 2

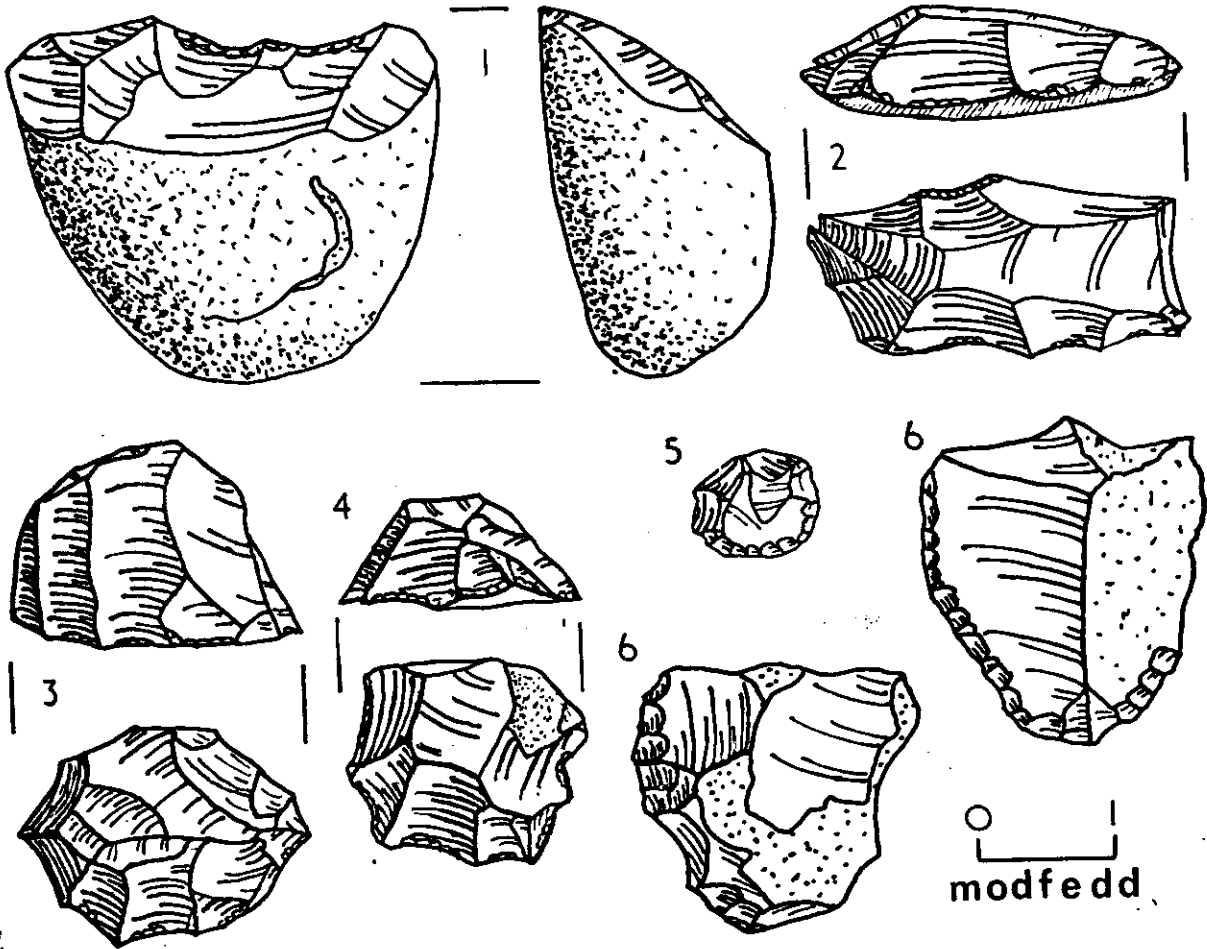


Offer cerrig o Awstralia

weithio i ryw ffurf arbennig (Ffig. 3 (6)). O astudio'r niwclews, medr y teipolegwyr ddarn canu techneg gweithio'r garreg, ac y mae'r dechne hon yn holl bwysig ym mhenderfyniad siap y asglodion, ac yn y pen draw nodweddiad y diwydiant. Edrycher ar y niwclei (Ffig. 3 (3))—gwelir bod yr asglodion wedi eu taro o un llwyfan taro. Y mae eraill gyda'u creithiau asglodion yn dangos eu bod wedi eu hasglodi bob yn ail o gyfeiriadau gwrth wynebol. Y mae'r ddau ddull hyn yn ddiwastraff iawn gyda'r defnydd crai, a gellir cael llawer mw

¹O dan nawdd yr *Australian Institute of Aboriginal Studies* ac Adran Anthropoleg, Prifysgol Sydney, De Cymru Newydd.

Ffig. 3



Offer cerrig o Dasmania

o asglodion o un telpyn o garreg na thrwy daro'n ddamweiniol. Gwelir felly bod gan y cynfrodorion hyn dechneg nodweddiadol yn eu diwylliant cerrig, rhywbeth na welodd yr ethnyddwyr.

Y mae'n bosibl dosbarthu peth o'r offer. Y mae gennym gerrig crynion mawrion sydd wedi eu hasglodi o un ochr. Rhydd y driniaeth hon yml finiog i'r garreg, ac mewn rhai enghreifftiau medrwn weld eu bod wedi eu defnyddio i dorri neu i falu rhywbeth (Ffig. 3 (1)). Galwyd y rhain yn *choppers* mewn llenyddiaeth, ac y maent yn un o nodweddion talaith balaeolithaidd De-Ddwyrain Asia (Movius, 1948).

Y mae gennym ddsbarth o offer gydag ail-waith cafnog. (Ffig. 3 (4))—hwyrach fod y rhain wedi eu defnyddio i naddu ac i lyfnhau corsennau y gwaywffyn a'r picelli. Hefyd y mae rhestr o offer crafu—o'r crafwyr bach fel ewin bawd (Ffig. 3 (5)) hyd at y crafwyr â chefn uchel (Ffig. 3 (2)). Fe ddefnyddid y rhain fel bwyell cam i weithio ac i lyfnhau coed, i flingo anifeiliaid, i grafu croen, ac i gafnio mēr o ganol esgyrn.

Ar gyfandir Awstralia nid oes llawer o esgyrn wedi eu darganfod mewn safleoedd archaeolegol, ond yn Nhasmania yr oeddem yn fwy ffordus. Cawsom gannoedd o esgyrn pob math o anifeiliaid

yng Nghilfach y Chwiorydd, a bydd yn rhaid eu hastudio er mwyn ail lunio ymborth y brodorion. O'r pwysigrwydd pennaf, yr oedd presenoldeb llw o esgryn pysgod, genau ac esgryn cefn, ac y mae hwn yn anghytuno â thystiolaeth yr ethnyddwyr.

Cawsom garreg feddal, gyda thwll trwyddi, hwyrach er mwyn ei chrogi o gwmpas gwddf, fel swyngyfaredd neu addurn. Yr oedd hefyd lawer o ocr coch neu felyn: y cosmetic cyntefig!

Dyna ni felly gyda phictiwr o ddyinion yn hela, pysgota, ac yn gwneud defnydd llawn o diriogaeth fras ac amrywiol. Er mwyn amseru'r diwylliant hwn, defnyddir dull sydd yn mesur dirywiad un o'r isotopau carbon, sef y carbon —14, ac y mae sampl wedi ei anfon i'w amseru.¹

Ar ôl gorffen ein cloddio, rhaid oedd archwilio safleoedd eraill ar yr ynys. Ym Mae y Tanau, darganfuom res o 150 o gerrig, 240 troedfedd o hyd. Dyma'r tro cyntaf i adail fel hyn gael ei weld yn Nhasmania, ac wrth gloddio ar draws y rhes, cawsom res arall un droedfedd o dan y llall. Dengys hyn oroesiad traddodiadau yn ddigon hir i archaeolegwyr i'w mesur, ac y mae'n weddol bwysig pan ydym yn ceisio mesur sefydlogrwydd y cyndrigolion.

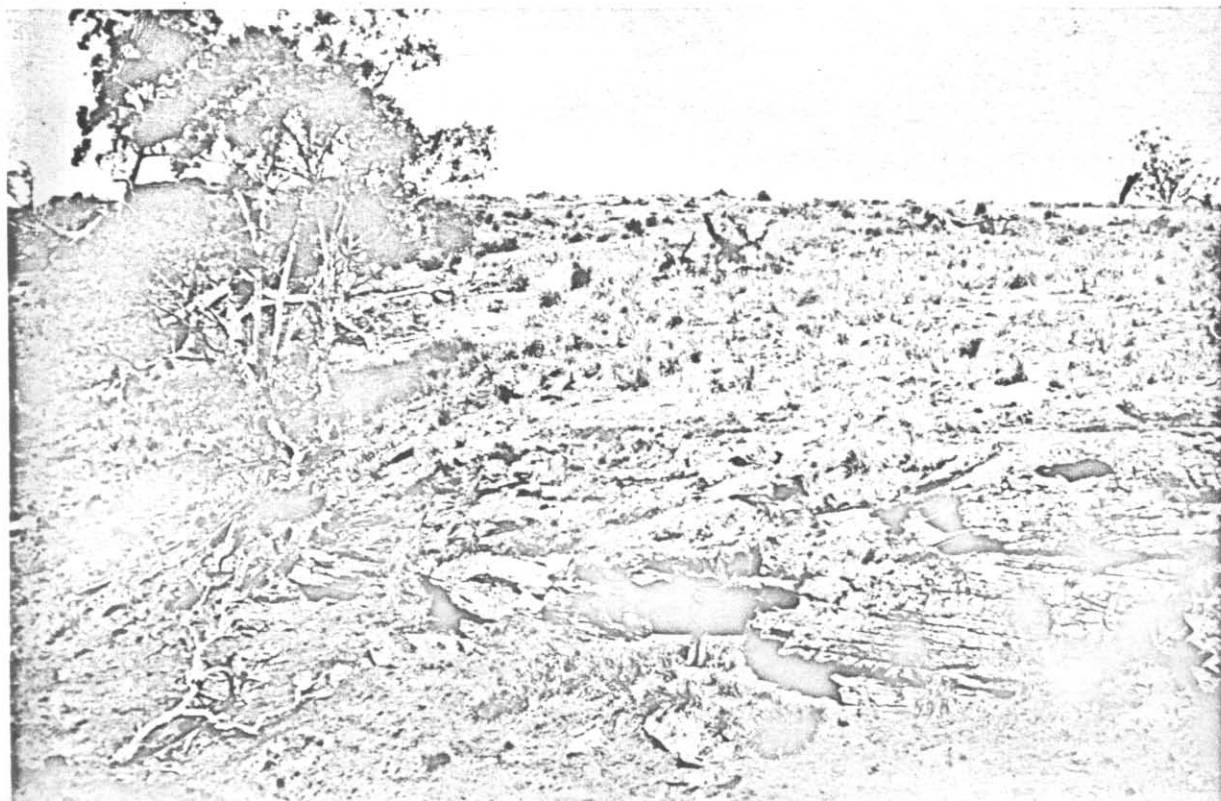
¹ Cafwyd y canlyniadau erbyn hyn a rhoddir y dyddiad fel 4000 c.c.

Yn yr ardaloedd carreg-dywod, y mae digon o ogofeydd bychain, a llochesau dan greigiau, er enghraifft, yng Ngheunant y Llofrudd (Llun I). Ar lannau'r môr y mae miloedd o domennydd cregyn (Llun II), ac ym Mhenryn y Gorllewin² torasom bwl saith troedfedd o ddyfnder yn un ohonynt. Yn ein toriad cawsom lawer o gerrig asglodiedig, ond y peth mwyaf diddorol oedd rhyw ddwy fil o esgryn anifeiliaid. Yr oedd y rhan fwyaf o'r rhain yn dod o ysgerbwdd y morlo, ond yr oedd hefyd esgryn y morfil, y walabi, y Diafol Tasmaniaidd, y posum, ac yn y blaen. Medr astudiaeth roi darlun inni o ddulliau lladd a thorri cig ac o ymborth cynfrodorion yr ardal a gellir eu cymharu â Chilfach y Chwiorydd. Gwelir gwahaniaeth rhwng y ddau le yn y canrannau gwahanol o bysgod a morloi. Dengys hyn ddibyniaeth gref y bywyd economaidd ar yr amgylchiadau ecolegol a daeryddol.

Y mae arfordir y gorllewin yn arw iawn. Nid oes na ffordd na phentref ar ei hyd, ac yn y mynyddoedd mae miloedd o filltiroedd sgwâr o anialwch ddibobl, o goedwigoedd a chorsydd llawn nadredd. Gyda dwywaith cymaint o law ag ym Mlaenau Ffestiniog, a gwyntoedd gwyllt y *Roaring Forties* yn dod dros gefnfor y De o Batagonia, nid oedd

² Darganfuwyd yma yn ddiweddar bydewau corfflogiad.

Lloches dan graig 'Ceunant y Llofrudd'



CYFEIRIADAU

yn lle croesawus i'r brodorion bronnoeth. Cawsom un dant dynol o'r gloddfa, ac yr oedd hwn wedi dirywio oherwydd afiechyd. Yn amlwg, yr oedd yn rhaid dioddef y ddannoedd heblaw poeni am y tywydd yn Nhasmania gynt.

Yn ôl y dystiolaeth archaeolegol, y mae'n debyg i'r 'Tasmaniaid' ddod i'w hynys dros y tir, filoedd o flynyddoedd yn ôl. Ar y llaw arall, nid oes unrhyw arwydd o'r hil Negrityn yn yr ysgerbydau hynafol. Yn wir, dywed Macintosh (1963), fod y penglogau ffosil yn Awstralia yn dangos rhyw berthynas i *Homo Soloensis*, heb unrhyw olion o'r Negrityn. Hwyrach felly nad Negrityn o gwbl oedd yr hen Dasmaniaid. Hwyrach y bydd y gwahaniaethau corfforol a welwyd rhyngddynt hwy â'r brodorion o'r cyfandir yn cael eu hesbonio drwy unigolrwydd genetig ar yr ynys. Os yw'r boblogaeth yn fach, gellir cael gwahaniaethau go eang ar ôl prin 4,000-5,000 o flynyddoedd.

Nid oes gennym ddigon o ffeithiau. Rhaid cael ychwaneg o gloddio, ychwaneg o ddyddio carbon-14, ychwaneg o ysgerbydau hynafol.

Y mae'r gwaith yn parhau.

CYDNABYDDIAETHAU

'Rwyf eisiau diolch i fy nghydweithwyr ar yr ymgyrch i Dasmania: F. J. Allen, I. C. Glover, C. McKnight, R. Reece, ac R. A. Wild.

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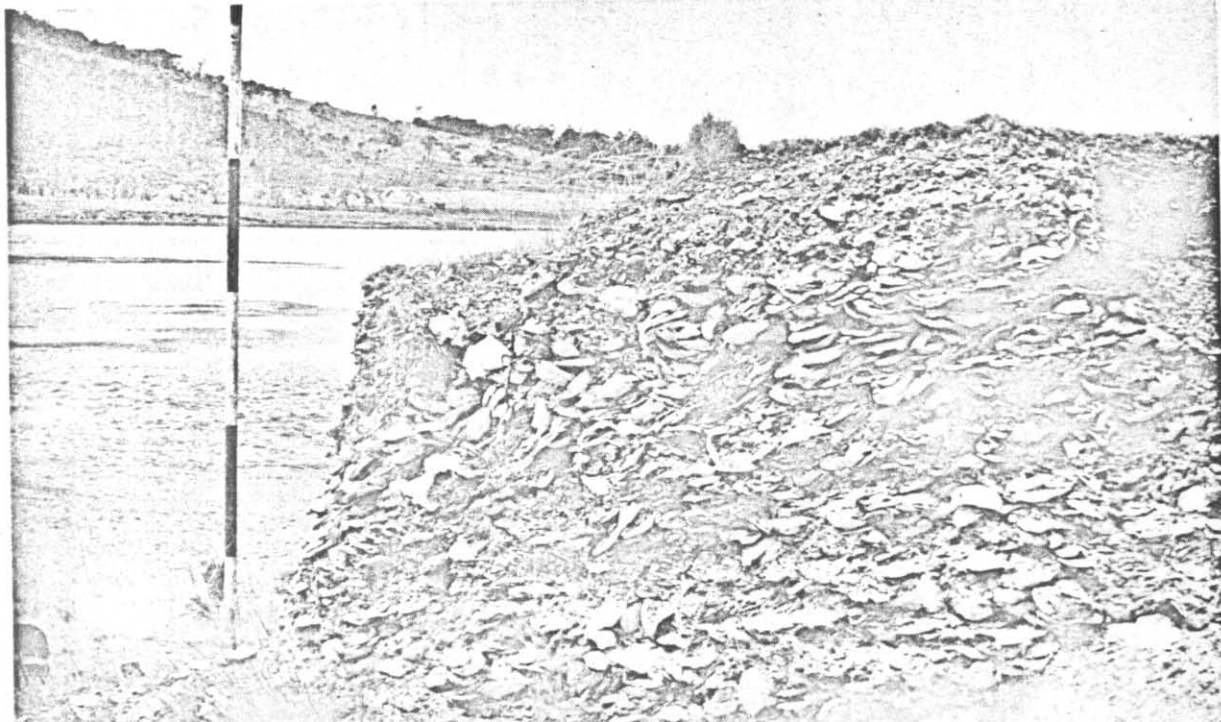
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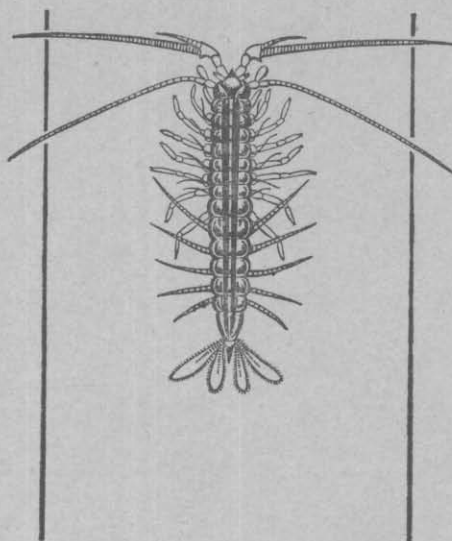
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Tomen gregyn, dwyrain Tasmania



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A SPECULATIVE ARCHAEOLOGICAL SEQUENCE FOR NORTH-WEST TASMANIA

by

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Tasmania is a mountainous island peripheral to the Australian land-mass, and it is in that direction that we must look for most of the physical and biological relationships (Darlington 1960, p. 659; Jackson 1965, p. 30). On the other hand, many elements of the environment reflect its southerly position, and there are similarities between the west coast of Tasmania and other southern temperate regions such as the South Island of New Zealand, and the west coast of southern Chili.¹ If man came to Tasmania from the Australian mainland, it would be interesting to see, in the archaeological record, what cultural changes occurred in response to the new conditions and also what were the effects, if any, of isolation on prehistoric man and his cultures on the island.

In the last sixty years, there has been a great deal of archaeological work carried out in Tasmania, but most of this has been concerned solely with the amassing of surface collections, and field observations of the sites themselves were rarely recorded. Apart from Meston's work at Rocky Cape, there was no attempt made at excavation. Most of the literature consists of general typological descriptions of stone tools (Noetling 1907, 1910 b; Klaatsch 1908; Balfour 1925, 1928; Legge 1929; Meston 1937b; Mitchell 1955), or of speculations concerning the cultural status, origin or antiquity of man in Tasmania (Tylor 1894; Noetling 1910a; Sollas 1911; David 1924; Pulleine 1928, pp. 296-309; Wood Jones 1935; Meston 1937a; Davidson 1937; Tindale 1937, pp. 34-36, 1957 p. 11; Taylor 1950). Mulvaney outlined some of the problems of Tasmanian prehistory (1961 pp. 95-99), and Macintosh and Barker (1965 pp. 1-55) have reviewed the extensive literature on Tasmanian physical anthropology. The standard account of the ethnographic literature has for a long time been that of Roth (1899), but the publication of Robinson's diaries (Plomley 1966) together with new problems posed by archaeological research, calls for a re-analysis of this material. New studies on Tasmanian ethnography have been made by Kemp (brief account in 1963) and Hiatt (1965).

A distribution map of surface collections (Bryden and Ellis 1965) shows that there was prehistoric occupation on all parts of the coastline. The relative paucity of collections from the south west is probably a function of the inaccessibility of

the area to collectors. Inland, there are many surface sites in the midlands and in the Derwent Valley; and artifacts have also been found inland from the east coast, in the highlands around the Great Lake, and near the head waters of some of the north coast rivers. This distribution pattern corresponds well with the map compiled by Hiatt (1965, maps 1 and 2, ff. p. 122) of the locations of direct ethnographic observations on the aborigines, and the similarity of prehistoric and ethnographic patterns suggests that the geographical range of the population had been established for some time. Kemp (1963, p. 243) has suggested from her study of surface collections that there are significant differences between assemblages from the west coast, the east coast and midlands, and the Great Lake areas. There may be chronological as well as spatial factors involved here.

The areas not occupied by the aborigines coincide closely with the distribution of the temperate rain forest (Davies 1964, p. 251). Several authors (Gilbert 1959, p. 143; Davies 1964, p. 252; and especially Jackson 1965, p. 33) have shown that fire frequency is an important ecological factor in the relationship of rain forest, wet sclerophyll and sedgeland forms. Jackson says that "where the frequency of fires is high the forest is replaced by open communities of sedgeland and wet scrub with boundaries of wet sclerophyll". Much of the extensive sedgeland on the west coast is believed to be pyrophytic, the disclimax state having been created and maintained by intense aboriginal fire pressure. The sedgeland would have been a much richer hunting and collecting area than the rain forest, which "is distinguished by its stillness and lack of conspicuous life" (Guiler 1965, p. 37). Penetration through the rain forest would have been effected by use of fire-maintained routes or a chain of 'plains' as described by Hellyer at Surrey Hills in 1827 (Meston 1958, p. 40), or by Robinson at the important ochre mines near Mole Creek (28 April, 1832; 16 July, 1834). Stone tools have been found at such small open grasslands in southern Tasmania (Ridpath 1964, p. 347).

1. There are similarities in climate, littoral ecologies (Knox 1960), temperate rain forest flora (Godley 1960; Jackson 1965, p. 33) and sea mammals (King 1964, pp. 23, 78).

At first sight, there seems to be a great dichotomy between the distribution of occupation on the east and west parts of the island, and this has led some authors including Kemp (1963, p. 243) to postulate marked differences in the diet and movement of peoples on the two coasts. Hiatt (1965, pp. 62-65) tabulated the frequencies of direct observations of various foods eaten, and found that the published literature showed a similarity in the diets on the two coasts. On this evidence, at least for the ethnographic present, it is not possible to postulate a largely marine diet on the west coast compared with a mixed marine and land diet on the east. There are large differences between the environments of the east and west, and the archaeological record may reflect this, but it is possible that by using his artifact, fire, the Tasmanian was able to reduce the adverse effect of the rain forest and to create, in a limited way, a more favourable environment.²

The most common recognisable archaeological sites are the coastal shell middens. These are very numerous and are found in suitable locations all around the coast. On the east coast, they range in type from thin bands of shell stratified in sand dunes as at Anson's Bay and the northeast generally, to the very large solid shell middens on both banks of the Little Swanport River (Taylor 1892; Crowther 1950, p. 86; Jones 1965 b plate 2). There are many middens along the indented shores of Storm Bay and the Derwent Estuary, and Reber (1965) has obtained carbon dates ranging from one to eight millennia from cuts in some of these, though no information was obtained about their stratigraphy or content. The west coast is very exposed and, where overstocking has taken place, there has been severe erosion of the old stable dunes, and the formation of large unstable 'blow out' dunes. Where middens were stratified in the sand, they have been eroded, and there are some areas where the ground is covered with tens of thousands of artifacts and sand etched bones. This is the case on the north part of the west coast between Mt. Cameron West and Sandy Cape, where the excavating activities of the wind have made this a paradise for surface collectors (Pulleine 1928, pp. 310-312; Legge 1928; Crowther 1950, pp. 89-91; and Luckman 1949). On the north coast between Table Cape and Rocky Cape, there are high quartzite cliffs in which there are at least five large caves. The floors and roofs of these caves are respectively about 70 and 100 feet above sea level, and from their position and shape, they are probably old sea caves (Gill and Banks 1956, p. 32; Jennings 1959 a, p. 30; Gill 1961, p. 76; Jones 1965 c). These caves contain large shell middens.

There is a paucity of recorded stratified inland sites in Tasmania, but, nevertheless, some small occupied rock shelters have been found in the sandstone region of the south-west (Heyward 1934; Jones 1965 a, pp. 193 and 198), and more may be found on further search. There are many large stone quarries in the midlands (Noetling 1908, pp. 49-50), and Goede (1965, p. 146) has found a well-made stone tool in gravels near Buckland dated on both geomorphological and carbon dating evidence to the mid-recent period.

Rock carvings have been found on the west coast at Cape Grim (Robinson, 25 June, 1830), Mount Cameron West (Meston 1933; Luckman, L.1951, pp. 25-27; Luckman, J.S.1951, pp. 31-32), Sundown Creek (Ellis and Both, personal comm.), Green's Creek (Robinson, 4 Sept., 1833; Ellis, ms.), Trial Harbour

(Jones, J.F.1938) and Port Davey (Reid 1954, pp. 277-278; Ellis, ms.). These are carved on a variety of rock types, and the motifs consist of circles, barred circles and dotted lines. Together, the west coast carvings form a stylistically consistent group. Elsewhere in Tasmania, carvings have been reported at Devonport by Meston (1932), though their authenticity has been questioned by Scott (1932), and a drawing or stencil of a hand was found by de Teliga and Bryden (1958) in the Derwent Valley. Ellis (1963) thinks that rock markings in Tasman Peninsula and the Derwent Valley believed by Reid (1954, pp. 273-277; 1962) to be aboriginal, are due to tree root activity. At the Bay of Fires, on the east coast, there is a long row of flat stones on a midden, which I interpret as an aboriginal stone arrangement. Excavations showed the presence of a second arrangement stratified one foot below the top one (Jones 1965 d, pp. 78-79).

Some of the small offshore islands were visited and occupied by the aborigines. Archaeological evidence has been found on Hunter Island (Meston 1936, p. 155), Schouten Island (Crowther 1950, p. 87), Tasman Island (Meston 1936, p. 157) and Bruny Island (Reber 1965, p. 264). There are ethnographic accounts of aborigines on Maria Island (Péron 1809, pp. 212-216), Bruny Island (Cook, January, 1777; Robinson, April to Dec., 1829), and De Witt and Mattsukyker Group (Robinson, 16 July, 1831), and the islands of the north west such as Hunter (Robinson, 13 August, 1832). The watercraft consisted of rafts and catamarans of rolled and bound bark (Meston 1936, pp. 158-161; Hiatt 1965, pp. 98-101), and the channels to be crossed, although in some cases only a few miles wide, would have been dangerous. There is no published evidence for prehistoric occupation of the large Bass Strait islands, although this may yet be found (Tindale 1941, p. 145). The lack of shell middens and other archaeological remains suggests that it is unlikely that these islands were systematically visited in recent prehistoric times.

In planning my field work,³ I wanted to find sites with a long period of occupation in order to set up a sequence but, apart from setting up a chronological framework, I was also interested in investigating the content of some of the cultures thus isolated. I concentrated my activities on the north-west corner of the island, where I carried out excavations at the north-west coast cave sites of Sisters' Creek, Rocky Cape North and Rocky Cape South and, as a contrast to these, at the large open midden north of the West Point Lighthouse.

Rocky Cape South (Fig. I, C)

This is an eastward facing cave, inclined at 45 degrees from the vertical, in a bedded precambrian quartzite (Cave Quartzite of Spry 1957, p. 83). There is a midden at the entrance and this extends some 100 feet into the narrow crevice. At the present floor level, the cave is six feet wide and five feet high, though Pulleine (1928, p. 310) records how he had to crawl into the cave.

2. A similar use of fire has been described by Cumberland (1962) for prehistoric New Zealand.

3. Carried out in the summers of 1963-64 and 1964-65, under the auspices of the Australian Institute of Aboriginal Studies, and the Department of Anthropology, University of Sydney.

The midden deposit in the cave has been extensively dug (Meston 1956, p. 197); Gill and Banks 1956, pp. 36-40; Reber 1965, p. 267) but the published descriptions of the site were meagre and confusing, and Mulvaney concluded his section on Tasmanian prehistory (1961, p. 99) saying "systematic excavation at Rocky Cape is highly desirable. Until that time, correlations of mainland and insular prehistory are premature". My aim was to isolate and excavate some undisturbed material, and I particularly wanted to test Meston's claim for a 15-foot depth, and Tindale's theory of a typological sequence (1937, p. 34). There was a large collapsed pit immediately under the entrance, and we emptied this out first and cleaned up the side. We then excavated one corner in order to obtain a straight section, and dug an embayment six feet by three into our straight wall.

The maximum depth of undisturbed midden was ten feet, with two feet of disturbed material above this. Below the midden was a coarse gritty sand containing many sharp edged stones, and the junction with the shells was very marked. This sand was packed tight between large angular boulders, some being up to a ton in weight, and we could only excavate two or three feet down in the crevices between these rocks. The sand did not contain any flakes, bones or charcoal.

The midden itself had a complex stratigraphy (Plate 1), but it could be divided into two major units. The bottom complex was six feet thick and consisted of lenses of shelly and brown earthy midden deposits, which had been laid down horizontally. Among the molluscs represented, the 'dog winkle' (*Dicathais textilosa*), the warrener (*Subnina undulata*), and the limpet (*Cellana solida*), were the most common.⁴ The *Dicathais* shells were complete, but most of the *subnina* were broken. There were many bones, and the animals represented were seal, wallaby, bandicoot, rat kangaroo, bird and parrot fish. Most of the seals were Southern Elephant Seals (*Mirounga leonina*), but there were also some Fur Seals (*Arctocephalus* sp.). In order to try and assess their relative numbers, I have calculated for each animal the minimum number killed, by counting the most common bone and dividing this by the frequency of the bone in the complete skeleton. In practice, I have used mandibles for seals and marsupials, sterna for birds, and premaxillae for the parrot fish. In a preliminary count on six spits out of twenty, I have a minimum number of 146 animals killed, of which there are eight seals, four wallabies, two bandicoots, two birds and 130 parrot fish. I have tried to translate the relative frequencies of animals to those of meat poundage, assuming that each young seal contributed 50 pounds of meat,⁵ each wallaby 15 pounds,⁶ and each parrot fish two pounds. Excluding shellfish, of the order of 55% of the meat came from seal, 10% from marsupials, and 35% from parrot fish.⁷

From the three by six feet embayment in the bottom complex, we obtained artifacts at a density of about 10 flakes per cubic foot, and of these, 7% were retouched implements or cores. Of the raw materials used, 40 to 50% was the local coarse quartzite, 30% a hard red and yellow quartzite, and quartz and basalt each had maximae of 25% in some levels, the quartz steadily replacing the basalt. In the lowest spits, the percentage of coarse quartzite was 65%, and a hard mudstone was also used. All these materials could be obtained from the

immediate locality, namely from the walls of the cave, the beach or from a particularly hard outcrop in the local quartzite.

Typologically, the assemblage was crude and relatively undifferentiated, most of the tools being simple retouched flakes. There were some simple unifacial pebbles, and two large cores with alternate flake scars had been utilised. Contrasting with this simple stone assemblage, were 35 bone tools, some of which had been carefully made. These fell into two groups, long single ended points (115-145 mm. long) and spatulae (one was 150 mm. long). Both groups were made on wallaby fibulae which had been snapped in half, the broken edge being ground and polished until smooth. These tools were comparable with surface finds described by Crowther (1925), Meston (1956, pp. 192-195) and Plomley (1962, p. 14). At Rocky Cape, excellent examples were recovered from the base of the midden.

We located the position of Reber's Carbon-14 sample a foot above the base of the midden. This gave a date of 8,120 ± 160 B.P. (Reber 1965, p. 267).

The top complex had a maximum thickness of four feet, and it lay in a wide depression cut into the deposit of the bottom midden. This may have been done deliberately as an attempt to clean out the cave, the headroom being only six feet above the unconformity. The deposit consisted mostly of hard ash, burnt and crushed shells and large nodules flecked with fine charcoal of a soft white deposit.

The shells were of the same species as in the bottom complex. The bone material consisted mostly of small slivers, many of which were burnt, and most were unidentifiable, though fish was present. There were 1,500 stone artifacts at an average density of 60 per cubic foot, though some spits contained 100 per cubic foot. Most of these were tiny flakes and only 2½% had been retouched. The rock types were the same as in the bottom complex and used in similar proportions, with one important exception that in the top complex there were between 3 and 5% of excellent raw materials including cherts and a fine silted breccia. These are exotic to the area, the only source of one of the cherts being on the west coast. The majority of the tools were simple retouched flakes and flaked pebbles as we had found in the lower levels, but there were also a few well-made tools. These were small high domed pieces with a series of retouched concavities around the periphery, and pieces with very steep step-flaked lateral retouch, or steep retouch forming a concave edge. There were no bone tools, but given the fragmentary nature of bone generally, this need not be culturally significant.

People living on a site may light fires, cook, throw away refuse, make stone tools, use stone tools, etc., often in different parts of the site, and the material residue of these activities can differ markedly from each other. At Rocky Cape South, I think that the bottom complex was largely a refuse dump, whereas the top complex was the residue of

4. For identification and nomenclature of the shells, I have followed Macpherson and Gabriel (1962).

5. King says that the weight of an elephant seal pup at birth is 80 pounds (1964, p. 79).

6. Based on field measurements carried out at West Point by A. G. Thorne.

7. This is a crude calculation and it is only intended to give a general impression of the meat diet.

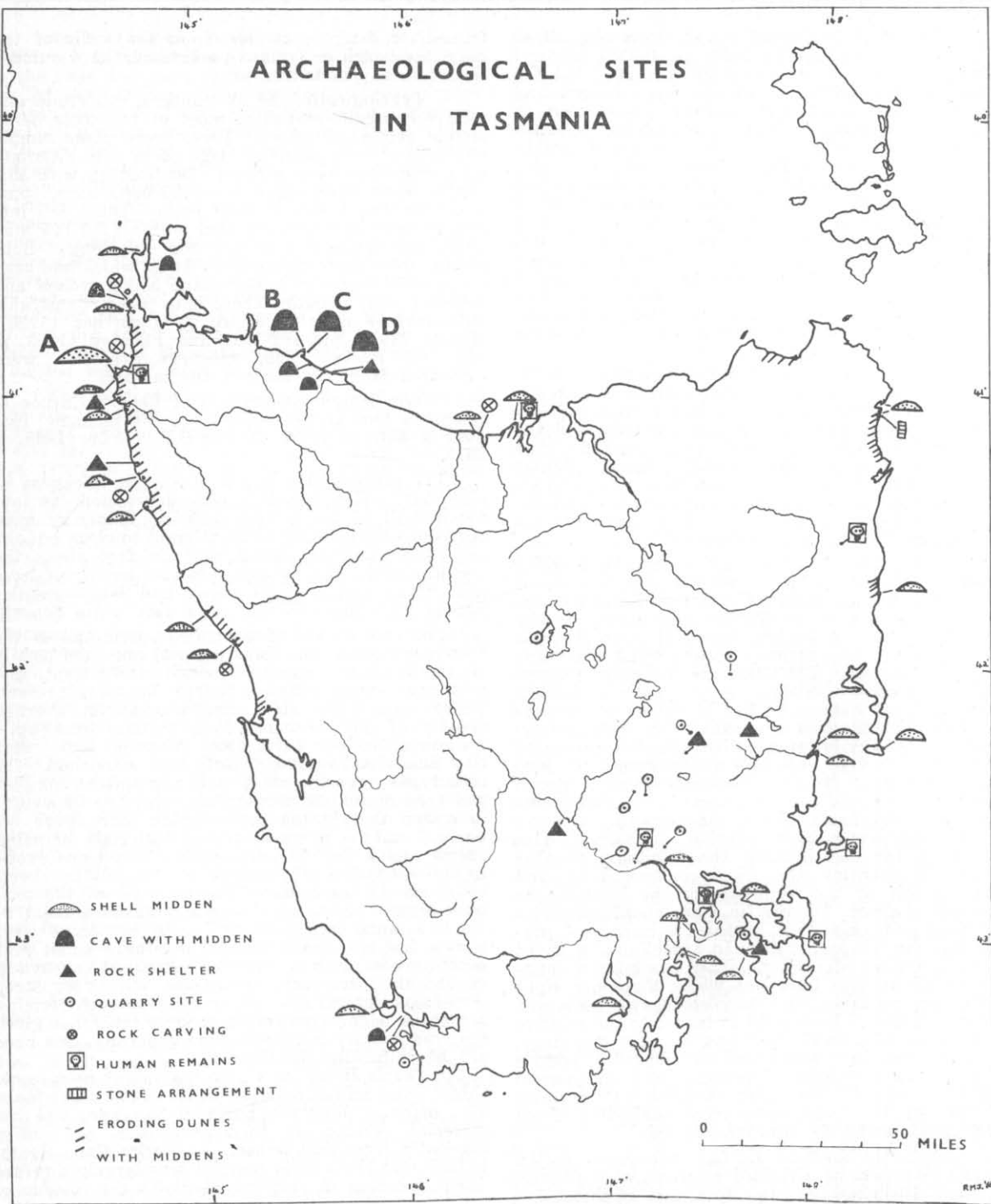


Fig. I. A West Point
B Rocky Cape North
C Rocky Cape South
D Sisters' Creek

Map of archaeological sites which have either been published or which I can verify by personal observation. I have not included surface collection sites (Bryden and Ellis 1965).

a stone tool manufacturing and hearth area. Assessment of the differences between the two complexes is difficult, because in each case we are dealing with a different aspect of the total economic activity at the site. I think that the differences between the two complexes in ash content, condition of the bones and shell, density of stone artifacts, size distribution of flakes, and proportion of retouched pieces, can be explained in these terms. Elements which are similar in both complexes, such as the species of animals eaten, raw materials used for stone manufacture, and the majority of stone tools suggest continuity of culture. However, the introduction in the top of a small proportion of well-made tools manufactured from good exotic raw materials, implies some culture change.

In my excavations, I did not find a patinated and an unpatinated series (Tindale 1937, p. 34), and I cannot support specific cultural correlations with the Kartan and the Tartangan as suggested by Tindale (1937, pp. 34-36; 1957, p. 11). A general similarity between my finds and certain old mainland assemblages remains an intriguing possibility.

Rocky Cape North. (Fig. I, B)

This is a northward facing slit cave 30 feet high and 200 feet deep situated some 1,000 yards north of the South Cave. We excavated a pit eight feet by four feet, and the maximum depth of undisturbed deposit was nine feet. This rested on two feet of a sterile gritty sand on bedrock. In the bottom two feet of the midden, the shells were similar to those in the South Cave, and there were fish bones with some seal and macropod. The stone artifacts were made of quartzites and rough basalts, and there were a few crudely retouched flakes, with one bone tool. This was similar to the lower levels of the South Cave.

The seven feet of midden above this were quite different. The shells consisted of *Dicathais*, *Subnina*, *Cellana*, and also large quantities of *Notohalotis ruber* (abalone or mutton fish). Of my sample of animal bones, half were of seal, and there were also wallaby, bandicoot, wombat, possum and bird. Out of the hundreds of bones excavated, there was only one fish bone. I estimate that some 80% of the non-shellfish meat came from seals. Some of the stone material was of local origin, but 30% were imported cherts and breccias. The density of flakes was only five per cubic foot, but the proportion of retouched pieces was high, rising from 9% in the lower part to 16% in the top. Most of the good tools were made of the exotic raw materials, and given the lack of waste flakes, they were probably not manufactured on the site. This stress on imported specialised tools increased as time went on. Among these tools were little disc-like cores with alternate flake scars, often the sharp trailing edge thus formed had been utilised (Fig. II: 7, 8). There were several small domed pieces with steep retouch around a central axis (Fig. II: 11), this retouch often formed a series of concavities around the periphery. There were some small flat circular scrapers (Fig. II: 9, 10), and also a range of well made retouched flakes. There were no bone tools.

There are differences between the two sites of Rocky Cape North and South which because of their proximity and similarity, cannot be explained by geographical or ecological factors. I think that they are due to cultural change through time. My

chronological hypothesis is that the top half of Rocky Cape North is younger than any deposit in the South Cave, the latter site becoming abandoned when it had filled up. This hypothesis is being tested by carbon dating.

Mulvaney (in Mulvaney and Joyce 1965, table 6, p. 208) claims that unhafted tools were used exclusively at Rocky Cape throughout its period of occupation. The absence of hafted stone tools in the Tasmanian ethnographic collections and literature is strong presumptive evidence for their absence in the Tasmanian prehistoric record, but one cannot ignore the possibility of the loss of a useful art. The diagnostic criteria for recognising nonhafted tools (*op. cit.*, pp. 172, 189), are subjective as Mulvaney admits, and he does not discuss how these always distinguish hafted from unhafted tools. An example of the sort of difficulty which arises is that the *Juan* knife (Tindale 1957, p. 28; Mulvaney and Joyce 1965, p. 190), the ground edge axe, and the retouched flake figured by Tindale (1957, p. 13), could all be "utilised for hand held purposes." (Mulvaney and Joyce, *op. cit.*, p. 172), yet we know that they were hafted. On the other hand spears have been found in Victoria, with a single or double row of hafted flakes, these being "invariably unretouched fragments of primary flakes, which would escape both typological and archaeological identification" (Mulvaney 1961, p. 97). The presence of gum on an artifact implies that it was hafted, but the absence of gum tells us nothing because gum can decay very quickly in an archaeological deposit. Mulvaney (1965, p. 189) says that a flake can be termed an "adze (i.e. hafted) only when the stepped flaking or use fracture is present. It is this functional - technological factor which distinguishes the hafted adze from hand held scrapers, Australian or European", yet steep step-flaking is a common trait of Tasmanian stone tools, and several authors "have commented on the presence of adze-like flakes in Tasmania" (Mulvaney 1961, p. 97).

Until objective criteria can be set up for the recognition of unhafted stone tools, I am unable to confirm or refute Mulvaney's interesting suggestion that the prehistoric inhabitants of Rocky Cape lacked knowledge of hafting devices.

Sisters' Creek. (Fig. I, D)

This cave is situated seven miles east of Rocky Cape. It is over 100 feet above sea level, and at the entrance, it is 35 feet wide with the roof six feet above the surface of the talus. Inside, it opens out into a chamber 30 feet wide and 15 feet high, with a small stream flowing from a crevice at the back. We dug a trench 30 feet long and five feet wide extending from just outside the lip of the cave to the inner edge of the midden inside the chamber. Excavations showed that there was a maximum depth of five feet of midden resting on four feet of sand, itself resting on bed rock (Jones 1965 *a*, pp. 193-196).

The deposit deep inside the cave consisted of bands of shell and ash. The yield of stone was low with less than ten flakes per cubic foot, and there were few retouched pieces. This contrasted with the deposit at the cave entrance however, especially immediately under the lip of the overhang. Here we found thick concentrations of a soft sticky white deposit flecked with finely divided charcoal similar to the top complex at Rocky Cape South. There

was a high density of flakes with up to 100 flakes per cubic foot in some spits, and a large proportion of these flakes was very small. The majority of the good stone tools from the site came from this area. Inspection of the stratigraphy showed that the deposits in both parts of the cave were laid down at the same time, and so the differences between them was a function of their position in the cave. The prehistoric inhabitants had sat under the entrance which was sunny yet sheltered, and had done most of their cooking and stone tool manufacture there, the darker wetter part of the cave being used primarily as a refuse area for shells and bones. The different uses to which the different parts of the cave had been put resulted in large variations in the content of the midden, and I hope to be able to quantify some of these. Such an analysis should aid in interpreting some of the differences between the top and bottom complexes in Rocky Cape South.

In the site as a whole, the shells were mostly *Subnina undulata*, *Dicathais textilosa*, *Cellana solida* and *Notohaliotis ruber*, and there were some lenses which consisted entirely of *Notohaliotis*. The bones of parrot-fish were common, and there were many crab claws. Of the mammals, there was a higher proportion of the small animals such as bandicoot, possum, rat kangaroo and rat, than was the case at Rocky Cape, though wallaby, wombat, seal and bird were also present. The seal remains were much less numerous than at Rocky Cape, and consisted mostly of single teeth and some fragments of other bones. All the teeth were of *Otariids*, probably Fur Seals (*Arctocephalus* sp.).

The raw materials for the stone tools were mostly hard quartzites which could have been obtained locally. There was also a small proportion of cherts and silicified breccias. There were some small cores with alternate flake scars, and other cores with flakes having been taken off a single platform. Among the tools were simple unifacial and bifacial pebbles, small domed pieces with steeply retouched concavities around the margin, flakes with steep step-flaked retouch, often with a concave working edge, and a series of flakes with flat retouch (Jones 1965 a, pp. 194-195, figs 1 and 2). The best made tools were of cherts and breccias. The majority of the implements however, were flakes or pieces of angular rock with a small amount of retouching or utilisation marks. There were two bone tools, one which had been flaked, and the other had a smooth convex end.

A carbon sample from the base of the midden gave a date of $6,050 \pm 88$ B.P. (N.S.W. 17).

Comparing the Sisters' Creek material with my proposed sequence for Rocky Cape, I think that it resembles most the top levels of Rocky Cape South. In both, parrot-fish were common, together with land mammal and seal. A large proportion of the stone tools were crude and made on locally obtained raw materials, but there were also typologically comparable specialised tools made on new imported raw materials, and bone tools were present.

West Point. (Fig. I, A)

The midden at West Point forms part of a grass covered hill 300 feet long, 150 feet broad and 20 feet high, and it is situated along the northern margin of a small rocky inlet. There is an extensive intertidal rock platform, and the numerous reefs

and offshore islands give some protection against the heavy swells, although the site is exposed to the prevailing westerlies. Inland are several marshy lagoons behind which is a rocky terrain covered with dense coastal scrub.

We dug a transverse trench 40 feet long across the midden, and another at right angles to it (Plate 2). Our maximum depth of shell was eight feet. The deposit consisted of two midden complexes separated by an intermittent sandy band, and these had been laid down on top of and to the seaward side of an old dune. The top midden consisted of dense dark grey midden material with numerous charcoal and ash lenses, and the bottom midden was sandier, though here too, there were lenses of shell and ash (Plate 3). There is some evidence of differences in the diet and stone tool manufacture in these two deposits, but they were not as marked as in the Rocky Cape sites, and for the sake of clarity, I shall confine my comments to the top complex.

About 30,000 stone artifacts were recovered from the whole excavation at a density of up to 50 flakes per cubic foot in places. In the top complex, 95% of these were made from an excellent sponge chert. The source of this chert has never been found, but it could only have come from a few confined localities of Tertiary limestones, possibly in the mountains near Balfour, or near Mt. Cameron West (Spry and Banks [ed.] 1962, Geological map; Sutherland). About 5 to 8 per cent of the flakes had been retouched, and the large number of small flakes suggest that stone implement manufacture took place on the site. Among the implements were disc cores (fig. II: 1, 2), circular and semicircular scrapers (fig. II: 3, 4), steeply flaked concave scrapers and flat slightly curved retouched flakes. Many tools were multipurposed, having two or more working edges on them, and in this situation it is more meaningful to base one's typology on an analysis of the various traits such as concave edges or steep step-flaked edges rather than to try and study the shape of the whole tool (see Mellars 1965, pp. 231-232). These implements from West Point are similar to those from the top levels of Rocky Cape North, and bearing in mind the industrial differences to be expected in such dissimilar sites, I suggest that the two assemblages belong to the same industry (fig. II). At West Point we found a few pieces of utilised bone, but there were no well made tools as in Rocky Cape South.

Throughout the midden, by far the most common shells by weight were of *Subnina undulata* and *Notohaliotis ruber*. These were supplemented by a wide variety of other molluscs. The prehistoric molluscan fauna was the same as the present one, but the different proportions of species in the midden and on the shore show that there was a very strong cultural preference for *Subnina* and *Notohaliotis*. Both these species live in the lower part of the intertidal zone (Bennett and Pope 1960, pp. 194-198) and below the low tide. They would have to have been dived for most of the time, and this accords well with the descriptions of Labillardière (12 February, 1792) and Robinson (9 June, 1829) in south-east Tasmania of women and girls repeatedly diving into deep water for large 'sea ears,' which they separated from the rocks with wooden points or spatulae. Almost every *Subnina* had been broken, and in some hearths there was a large number of burnt operculae.

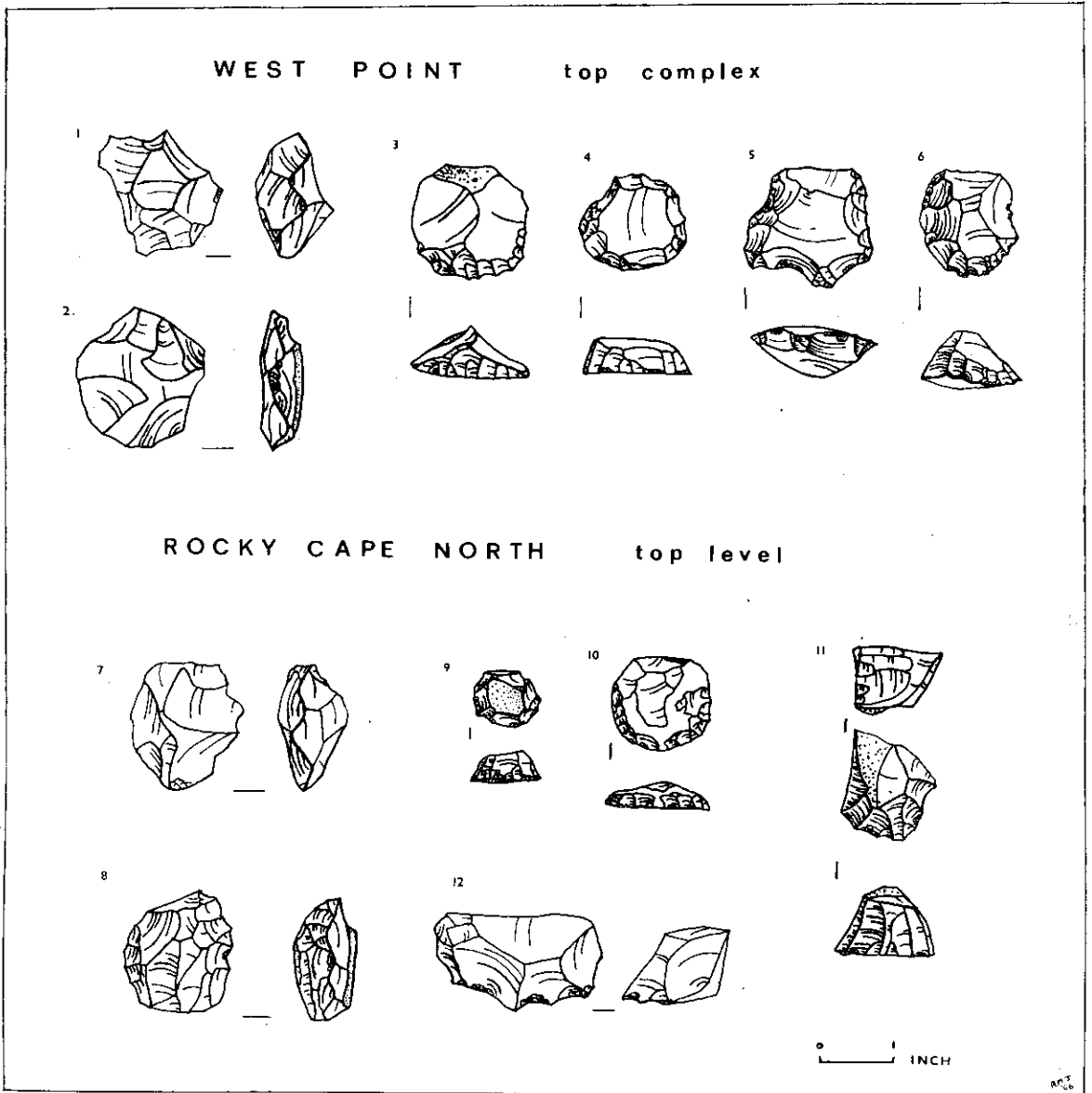


Fig. II.

Drawings of some stone artifacts recovered from a stratified context.

(Side view of specimen 5 inadvertently drawn upside down).

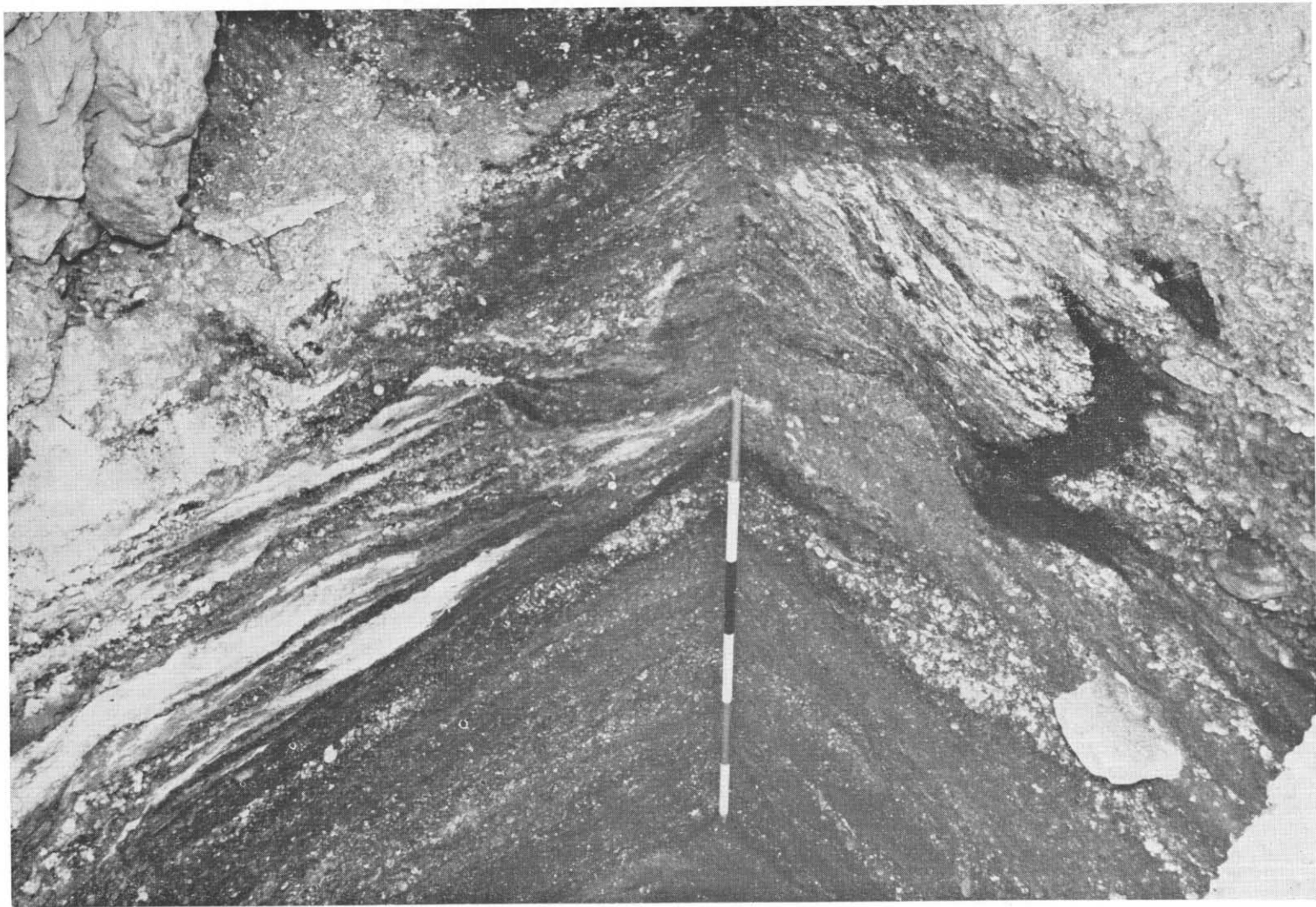


Plate 1. Rocky Cape, South. Looking at the north corner of the excavations. The bottom five feet belong to the "lower complex" and the top four feet belong to the "top complex."



Plate 2. West Point. General view of the trenches, looking north-west.



Plate 3. West Point. Close-up of a corner between my two trenches. The bottom five are sandier than the top three feet at the corner.

I have sampled 10% of my spits for a preliminary study of the bones. In the top complex, from a minimum number of 118 individuals, 45% are bird, 23% seal, 17% macropod, 7% lizard, and below 4% each of rat kangaroo, possum, bandicoot, rat, native cat, Tasmanian Devil and whale. If we calculate roughly for meat poundage, using the same figures as for Rocky Cape, we find that seal contributed 75% of the meat, macropod 20% and bird 3%. The seals here were much bigger than at Rocky Cape, and a figure of 100 pounds of meat per animal is a conservative estimate. Using the latter figure, seal would have contributed over 80% of the non-shellfish meat.

Almost all of the seals at West Point were Southern Elephant Seals (*Mirounga leonina*),⁸ but there were a few jaws and teeth of Fur Seals (*Arctocephalus* sp.). The elephant seals have a wide distribution across the Antarctic ocean, and the closest they are found to Tasmania at present is at Macquarie Island (Carrick and Ingham 1962 a, p. 90). Their past distribution has been noted on King Island in the Bass Strait (Péron and Lesueur 1807-1816, plate XXII), and a single breeding female has been reported on the west coast (Davies undated, p. 6), but at West Point, there is direct evidence of former large numbers of elephant seal on the Tasmanian coast.

In order to get an idea of the age of the individual elephant seals, I have compared some of the canine teeth from the excavations with photographs of equivalent teeth from known aged individuals (Carrick and Ingham 1962 b, plates 2 and 3). All the specimens from West Point and Rocky Cape were of young animals. There were some teeth corresponding to animals less than three months old, but there were also teeth from older animals of up to three or even five years old. The teeth of both males and females were present. At Macquarie Island, where the annual cycle of the elephant seal has been studied (Carrick, Csordas, Ingham and Keith 1962), each age and sex has its own regular sequence of seasonal activities, (pp. 130-131), and there is a well marked ebb and flow of the population throughout the year. In general, the shore population has three peaks, namely a breeding season for adult females and breeding bulls in spring between August and early November, the pups being born in September and going to sea in December; a moulting season first for immature animals and later for mature animals from November to April; and a winter "haul out" for immature animals from March to August. This seasonal cycle is closely adhered to throughout the present geographical range of the species (*op. cit.*, p. 151), though Paulian (1954, p. 377), quoting early records, suggests that the breeding season at King Island was between July and August. At West Point all the animals killed were immature so, if we assume that the annual cycle was basically similar to that outlined above, then the available periods for hunting would have been in early summer for the newly born pups, mid-summer for moulting immature animals from two to four or five years old, and early and mid-winter for hauled out immature animals from six months to about three or four years old. From the teeth of very young pups, the site was at least occupied in early summer, though it is probable that the young seal population was also exploited at the other available periods.

In my excavations, there was a minimum number of 300 seals and, extrapolating to the whole

site, there must have been several thousand seals killed at West Point. Inspection of many wind-eroded middens along the coast, shows a similar high density of seal bones. Thus on the west coast, we have evidence of large scale prehistoric sealing activities based on the elephant seal. At the north coast sites, elephant and fur seals were an important item of diet at Rocky Cape, and fur seal supplemented the diet at Sisters' Creek. This contrasts sharply with the ethnographic literature, where there are only two published eye witness reports of Tasmanian aboriginal sealing, namely those of Kelly in January 1816 at Georges Rocks (Bowden 1964, pp. 40-41, 106-108), and Robinson on 10 February 1830 at Cox Bight, though Robinson also records story telling of sealing exploits in south west Tasmania (15 July and 15 December, 1831).

It is possible that the European sealing activities in the Bass Strait begun in 1798 had totally disrupted the aboriginal sealing economy by the time that the aborigines were observed by Robinson and his contemporaries. Most of the European sealing records refer to the taking of fur seals, over 100,000 seal skins being brought back to Sydney between 1800 and 1806 (Bowden 1964, p. 5), and Plomley (1966, p. 1006) says that the elephant seal was not of local importance because "the hunting of seals for their oil was largely neglected in the straits". However, Boys (1959, p. 28) says that in 1799, a vessel called the *Martha* reached King Island and "obtained a good return of skins and sea elephant oil". Crowther (1937, p. 79) says that by the time of Kelly's voyage to the Bass Strait in 1813, "the sea elephants of King Island had been practically exterminated". Certainly on Macquarie Island, sealers such as Kelly extensively exploited the sea elephants for their oil (Crowther 1933; Bowden 1964, p. 14). Possibly the Bass Strait sea elephant population became extinct very quickly under the combined impact of Aboriginal and European exploitation. Another possible explanation for the discrepancy between the archaeological and ethnographic accounts, is that the aborigines themselves had caused the extinction of the elephant seal on the Tasmanian mainland in prehistoric times. We need carbon dates for the latest phase of aboriginal sealing to help solve this problem.

The bird remains at the site were mostly coastal birds, including gulls, petrels, albatrosses and mutton birds. Also present were hawks and ducks. There was a notable absence of fish from the midden, for out of over 20,000 bones recovered, only four or five were of fish.

Together with the exploitation of marine foods, there was a steady significant contribution from the land,⁹ and all the species of land animals found in the midden can be found at the present day in the immediate vicinity. This fauna belongs to the coastal sedgeland environment, and the evidence from the excavations suggests that the sedgeland, be it a pyrogenic artifact of the Tasmanians or not, has existed at West Point at least since the time of formation of the midden.

On all the criteria that I have used at Rocky Cape, I can correlate the cultural remains from West Point with those from the top levels at Rocky Cape

8. I wish to thank Mr. Basil Marlow of the Australian Museum for identifying the seal bones.

9. According to the ethnographic record, vegetable foods from both the land and the sea were a significant part of the diet (Hiatt 1965, table C, ff. p. 79), but unfortunately no traces of these were found in the midden.

North. I suggest that in general terms, these two were contemporary. Reber (1965, p. 266) dug a small slit trench on the north west side of the midden at West Point. From the base of this, seven feet from the surface, he took a carbon sample which gave a date of $2,350 \pm 266$ B.P. I have not correlated Reber's trench with my own excavations. South of the lighthouse is another similar midden, from the base of a four foot deep trench cut into the side of which Reber obtained a date of $2,600 \pm 120$ B.P. From what I could judge by inspection of the section of this cut, its contents were similar to the first midden.

Human Remains.

In the present state of speculation concerning the racial affinities and origin of the Tasmanian aborigines (Birdsell 1949, p. 120; Macintosh and Barker 1965, pp. 47-55), there is an urgent need for prehistoric human remains from Tasmania. We were fortunate to discover some at West Point. There were several single teeth in the midden, and a lower right second molar described by Macintosh and Barker (1965, pp. 56-66) belonging to an adult, probably male, was heavily worn, and had severe erosion of the roots due to periodontal disease. In the sand between the top and bottom complexes, we found two small pits filled with burnt and broken human bones, and at the base of the lower complex, there was another similar pit. There were fragments of skulls and post cranial material. Some of these, although burnt, were in good condition. Altogether, there were several individuals represented, and a detailed anatomical description is being prepared by Mr. A. G. Thorne¹⁰. Apart from their anatomical value, these finds give some information about prehistoric burial customs at the site. The evidence points to burning under conditions which did not allow complete incineration of the bone. The bones were then in some cases broken systematically, and collected together with charcoal, and deposited in little pits eighteen inches wide and twelve inches deep dug into sand or sandy midden. This may have occurred on the site, because there was a wide scatter of burnt human fragments, charcoal and black sand near two pits, and in most cases, the edges of the burnt broken bones were unabraded. In one pit were the foot bones of several wallabies, and the claws of a large hawk. In another were 30 small and two large shells, each pierced with a small circular hole. Following ethnographic specimens (Plomley 1962, p. 10-12; Ling Roth 1899, p. 132), I suggest that the shells and also the animal's feet were parts of necklets of some sort, placed with the ashes of the diseased as grave goods.

There seems to have been some variety in the burial customs of the Tasmanian Aborigines. In some cases, bodies were buried or abandoned without any visible treatment (Crowther 1939; Lord 1919; Crowther 1942, p. 91), in other cases relatives carried desiccated flesh or ashes in little bags (Ling Roth 1899, p. 64; Puleine 1924; Plomley 1962, pp. 10-11). There is also evidence for the widespread occurrence of cremation. According to Robinson's magnificent descriptions (e.g., 31 May, 1829; 30-31 July, 1832), the body was arranged or bound in a flexed position, placed on a small frame with firewood all round, and then burnt. The unburnt fragments were broken and poked with poles and then [they] "carefully scraped the ashes together and mixed sand with it, and then laid some grass over it." (Robinson, 31 July, 1832). Labillardière

(12 May, 1792) found the ashes of a fire with burnt and broiled fragments of human bone and flesh in it. In 1802, on Maria Island, Péron (1807-1816)¹¹ found a wigwam of bark under which was a circle of stones holding down a flattened cone of plaited grass. This grass covered a circular pit 15 to 18 inches in diameter and 8 to 10 inches deep, containing burnt and broken fragments of human bone, some still containing calcined blood. The following day, he found a similar grave, with drawings on the inside of the bark wigwam but, in this case, the structure had decayed a great deal, and Péron noted that in a short time these graves would look like old fireplaces. Crowther (1934) found burned fragments of human bone in little black depressions in sand at Sandford, and he said that "it is difficult to account for the broken down condition of these bones, except by deliberate fractures following partial incineration". Digging further, he found part of the left side of the skeleton, flexed and unburned, and he inferred that the body, having been treated as in Robinson's account (31 May, 1829), had fallen over before incineration.

The finds from West Point are fully consistent with this evidence for cremation, and in turn extend the traditions back to the time of the foundation of the midden.

Conclusion

By correlating the preliminary analyses of the contents of the four sites just described, I am in a position to set up a speculative sequence for the north-west corner of Tasmania. It is a hypothesis based on two major assumptions: firstly, that my excavations are a good sample of my sites and my sites a good sample of the area and, secondly, that my relative dating scheme is in general confirmed by radio carbon dating.¹²

At about eight or nine thousand years ago, the sea in its post glacial rise reached approximately the present coastline on the north coast near Rocky Cape (Godwin, Suggate and Willis 1958; Hails 1965, p. 67; Jennings 1959 b, map p. 50). People living in a fairly confined coastal strip arrived at the cave and occupied it for the first time. They had a coastal economy, eating shellfish, seal and parrot-fish, but some land animals were also eaten. The stone industry was unspecialised, involving the manufacture of only crude cutting and smashing implements. For raw materials, they used readily available, rough, raw material. They had a sophisticated bone industry. This phase is represented by the lower complex in Rocky Cape South, and the lowest two feet of Rocky Cape North.

Some time after this, we begin to see some changes especially in the exploitation of better stone raw materials, the knowledge of which would have involved a great deal of casual exploration. In addition to simple retouched flakes and pebbles, some well made tools were used. The dietary economy had not changed very much with shellfish, parrot-fish, seal and land animals being eaten. Sisters' Creek cave was first occupied during this phase about 6,000 years ago, and Rocky Cape South was filling up.

10. Department of Anatomy, University of Sydney. I wish to thank Mr. Thorne for the information concerning the human anatomical material.

11. Chapter XIII, pp. 265-278; see also Roth 1899, pp. 116-118.

12. My carbon samples are being dated by Miss A. Birmingham, Institute of Applied Science, Melbourne.

The next phase is represented by the top levels of Rocky Cape North and the West Point midden. By this time fish had dropped out of the diet, and well finished bone tools were no longer made. The meat dietary economy was still orientated towards the sea, although a wide range of land animals was actively exploited. Sealing was of great importance, especially on the west coast where very large sites such as West Point implied a specialised exploitation of young seals, probably seasonally. Quarries of good raw material were well known and the tool makers were very selective in their choice of raw materials, using only the best material in sites close to the sources, and importing either blanks or finished tools in sites far from the source. The range of small, well-made tools implies specialised uses for them, and possible functions may include cutting and wood scraping. During this phase, people were cremated, and their remains broken and buried in little pits. In some cases, these were accompanied by pierced shells and animals' feet. Dates from the west coast middens suggest that this phase might be at least 2,000 years old. The last phase was the "ethnographic present" which, with its diet, seasonal exploitation of foods, exploitation of good ochre and stone material, and burial practices, seemed to be similar to the latest prehistoric phase. One difference was the absence of sealing, which had probably been disrupted by European sealers.

If this hypothetical sequence is supported by carbon-14 dating and further analysis, the next question to ask is how general is it. Is it valid for the whole of Tasmania, or only for the north-west corner?

In the sequence, both parrot-fish and bone tools are present in the lower part, but are absent

in the top part. Ethnographically, there is not a single reliable observation of the Tasmanian Aborigines eating scale fish (Hiatt 1965, pp. 53-57), and no bone tools were seen either being manufactured or used.¹³ It is interesting to speculate whether or not this absence may be explained in terms of discontinuity through time,¹⁴ and here the sequence may have validity throughout Tasmania. On the other hand, given the fact that well differentiated stone industries are known on the mainland which are older than 10,000 B.P., and which bear some morphological resemblance to Tasmanian assemblages (Mulvaney and Joyce 1965, p. 207), it is highly unlikely that all the first migrants to Tasmania were ignorant of sophisticated stone tool manufacture, and then independently invented their own traditions. It is more likely that the traditions of stone tool making continued unbroken in some part of the island, and in this respect, possibly because of the effect of the rain forest, the north-west might have been a fringe zone to the main area of early occupation.

I see the sequence in the north west as documenting a gradually improving exploitation of an environment which may have been unfamiliar and inhospitable to the first comers pushed back into new territory by the post glacial rising sea.

13. There were, however, wooden points and spatulae.

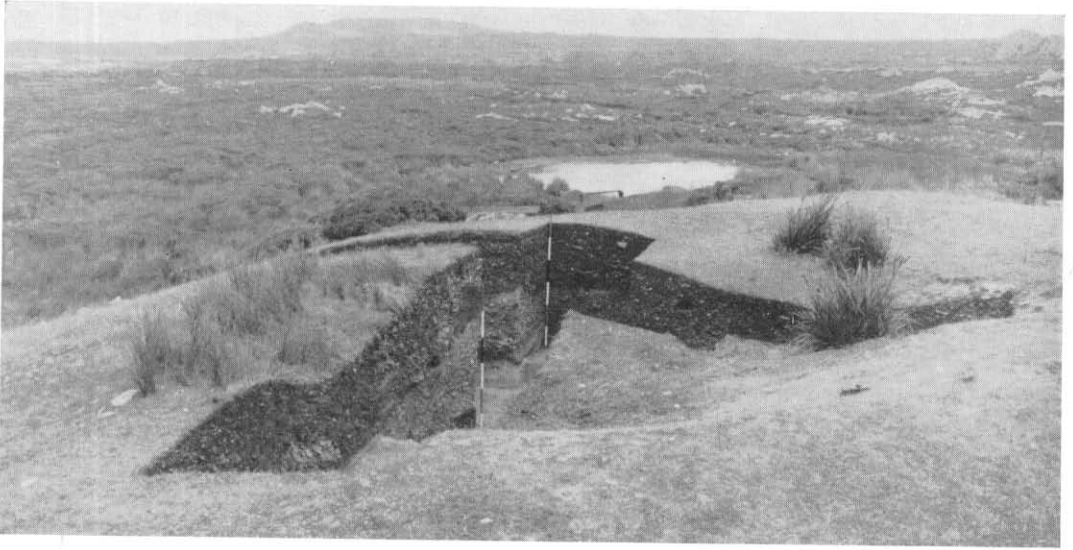
14. The dichotomy between the presence of fish bones at Rocky Cape and the absence of references to fish in the ethnographic record, has also been explained in terms of a taboo against fish eating in most parts of the island except in the north-west (Gill and Banks 1956, p. 33; Meston 1956, p. 198; Plomley 1966, p. 36 note 22). Another explanation offered was that the parrot-fish had been carried up to the midden by chance, e.g. by people collecting mutton-fish, crayfish or kelp (Kemp 1963, p. 243).

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The excavation of a large Aboriginal shell midden at West Point, on the west coast of Tasmania.
[Photo: Author.]

Middens and Man in Tasmania

By RHYS JONES

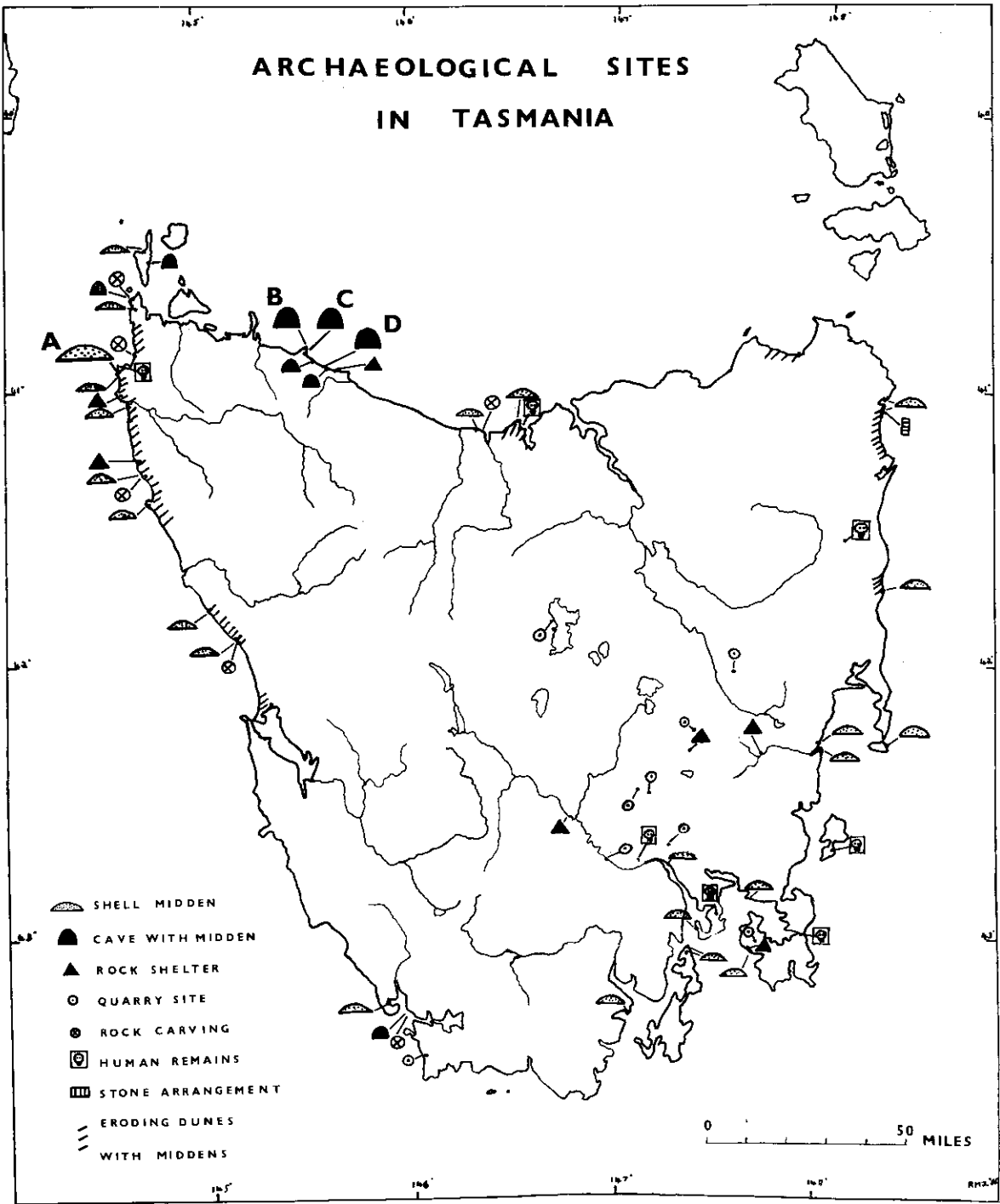
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THE Tasmanian Aborigines are dead. In their brief period of contact with European culture some records of them were made but these, regrettably, have only given us a limited picture of their way of life. The Aborigines themselves, however, have left their own mark on the Tasmanian landscape. The farmer following his plough, or the walker on the seashore, can, if he is lucky, see evidence of past human activity. The archaeologist looking at the countryside is obsessed with certain features. A ridge of sandstone may contain rock shelters, a patch of loose sand may have stone tools lying on its surface, or an eroding dune may reveal a prehistoric skeleton. In his mind's eye he sees women eating shellfish in the shelter of some dunes, or a group of hunters travelling slowly across a marsh and setting fire to the reeds and low bush as they go, or a small cave with the half-gnawed bones of a wallaby scattered around a fireplace, with the ashes

still warm. From a study of the physical manifestations of past human culture, the archaeologist attempts to write history, and in the case of Tasmania before the arrival of literate Europeans he has to rely completely on the resources of his own discipline.

Field archaeology

Tasmania has a varied coastline, and archaeological sites are common along it. These are middens, consisting mostly of shells and containing animal bones, charcoal and stone tools. Middens are sometimes found on the shores of an estuary, or on a rocky headland close to a rich source of food, but often their presence or absence is dictated by the uncertain chances of conservation. A small midden may be preserved by a protective covering of sand for thousands of years, while a neighbouring large site may be destroyed by a couple of heavy winter storms.



Archaeological sites in Tasmania. This does not include localities of surface collections. A, West Point; B, north cave, Rocky Cape; C, south cave, Rocky Cape; D, Sister's Creek. [Reproduced by courtesy of the Queen Victoria Museum, Launceston, Tasmania.]

Some sites consist of thin bands of shells representing a single meal; others are huge piles of shells covering an acre of ground and up to 8 feet thick, laid down by large groups of people who regularly came there to exploit a particular food source, year after year, for thousands of years.

In many places on the west coast the wind is eroding the dunes, thus exposing and eventually destroying the middens contained in them. This is especially true in the northwest between Cape Grim and Sandy Cape, where, after a gale, tens of thousands of artefacts and bones are exposed on the sand. The Aborigines often took advantage of the natural shelter afforded by overhanging rocks or caves, and many coastal caves contain large shell middens. On the north coast, between Table Cape and Rocky Cape, are several old sea caves formed by a past high sea-level, and I have excavated three of them. Many of the offshore islands, such as Hunter, Bruni and Maria Islands, have shell middens on them, showing that they were often visited in prehistoric times. The watercraft of the Aborigines were efficient enough for them to travel across often treacherous coastal waters, but the lack of sites on the large Bass Strait islands, such as King and Flinders Islands, shows that longer journeys were not successful, or were not made in recent prehistoric times.

Collections of stone artefacts have been made in Tasmania for over 60 years, and, by plotting the distribution of these surface finds, we can make a fair guess as to the parts of the country occupied by the prehistoric Aborigines. Such a map was published by Mrs Belleau Kemp in the December, 1963, issue of *Australian Natural History*, and from it we can see that in the west the occupation was restricted to the narrow coastal plain, whereas in the east there was occupation not only along the coast but also inland in the midland plains and in the river valleys such as that of the Derwent. The absence of surface artefacts corresponds closely with the distribution of the temperate rainforest, and it is likely that this dense vegetation formed a considerable barrier to communications.

Some botanists have put forward a theory that the present floristic distribution in Tasmania has been greatly affected by past burning activities of the Aborigines. The extensive areas of sedgeland and mixed

Eucalypt-Notofagus forest in the west are believed to have been enlarged by intensive burning by the Aborigines over thousands of years. Now that the Aborigines have gone, the rainforest has crept back, and Mr W. F. Ellis tells me that he found great difficulty in cutting his way through coastal scrub on the southwest coast in areas described by Robinson in 1830 as being fairly open country. Similarly, open grassy plains noted by Hellyer and others at Surrey Hills, in the northwest highlands, are now covered by dense rainforest. It is likely that the Aborigines, using fire, kept open the western coastal plain and there are accounts of fire-maintained routes penetrating the rainforest. Travel through the *Eucalypt* forests in the eastern part of the island would have been much easier, not only because of the ease in setting fire to them, but also because of the richness of game there.



An Aboriginal stone quarry in the eastern highlands, near Lake Leake. The ground is covered with cores and flakes. [Photo: B. Hiatt.]

The majority of stone artefacts in the museums have come from surface collections, but it is also possible to find stratified sites inland as well as on the coast. I have seen several rock shelters with signs of occupation in them in the sandstone country in south-east Tasmania, but none of these had large depths of deposit. A future rich source of sites in the midlands may be associated with the inland sand dunes, believed to have been formed in a drier post-glacial period. Modern erosive "blowouts" uncover stone tools, and I have made collections in such sites at Grimes Lagoon, Crown Lagoon, and on the shore of Lake Dulverton. Some artefacts in situ show that these, at least, date from the end of the period of sand deposition and immediately prior to the formation of the topsoil horizon. The Aborigines carefully selected the raw materials for their stone tools and usually exploited limited outcrops of suitable rock. Many of these quarries have been found, and, where the outcrop itself occurs, the ground is covered for hundreds of yards with large quantities of smashed boulders, cores and flakes. In the midlands, near Ross and at St Peter's Pass, for example, the raw material is a metamorphosed mudstone or hornfels. On the northwest coast, a sponge chert was used, the exact source of which has not yet been found, but tools of this material have been discovered up to 100 miles away along the north and west coasts.

I have described industrial and habitation sites, but there are also the remains of intellectual activities. On the west coast there are several places where the designs of circles and lines have been carved on the faces of rocks. The most complex group is at Mount Cameron West, where the designs have been engraved in a soft sandstone. Near Anson's Bay I found a row of flat stones arranged in a straight line on the surface of a midden, and there was a second row stratified about a foot below the top one. Perhaps these marked a site which was important to the Aborigines for ceremonial or other reasons. When a person died, there was a variety of burial procedures. Sometimes he might have died alone, his skeleton covered by drifting sand, but often elaborate burial practices would have been carried out. Bodies were placed in a flexed position on a pyre and burnt, the bones then

being broken and placed in little pits. Some such pits have been found.

These prehistoric remains could be any age between the time of the arrival of the Tasmanians and the time of their extinction. If we wish to place them in a chronological order we have to excavate sites under controlled conditions and date the deposits, using radio-carbon dating techniques.

Excavations at Rocky Cape

The three caves which I have excavated at Rocky Cape and Sisters' Creek contained shell middens, and in each case beneath the shells there were sand and decayed rock completely sterile of cultural remains. I think that the deposition of the basal layers of middens in the caves marks the beginning of their human occupation, and perhaps the first arrival of man in the immediate locality.

The first phase of occupation began at about 7,500 to 8,000 years ago. In the basal layers of the South Cave at Rocky Cape, the majority of the bones are of seal, but parrot fish bones are also common. Those of sea birds and land animals are present but rare. The bones of animals associated with the sea constitute 95 per cent of the total weight of dry bone, and if we add the contribution of the shellfish to the diet, which would have been at least as great as the total meat from the vertebrate animals, we see the almost complete dependence on the sea and its littoral as a hunting area for meat. In the case of seal, the high preponderance of flipper bones and jaws suggests that these choice bits were cut off the carcasses, perhaps on the shore, and carried up the steep cliff to be eaten in the cave. The stone tools were made from local materials, such as pebbles on the shore or the quartzite of the cliffs, and consist of rough unsophisticated retouched flakes and utilized cores and pebbles. We found thirty-five bone tools, most of which were sharp points made from the fibulae of wallabies.

Later on, at about 4,000 years before the present, we see essentially the same protein diet with perhaps an increase in the importance of fish. Most of the stone tools are crude flakes made from local materials as before, but we also get well made tools manufactured from raw materials which are foreign to the area. This reliance on exotic raw materials increases as time goes on, so

that in the top layers of the North Cave at Rocky Cape, dated to about 450 years ago, most of the finished tools were manufactured from cherts and silicified breccias which had been carried over a long distance to the site. The tools consist of well made concave and steep straight scrapers and alternate-flaked cores. In these levels I found no bone tools, and I suggest that they were no longer being made here. There are some marked differences between the diet of this latest phase and that of the preceding ones. Parrot fish were no longer eaten, and there was a decline in the relative importance of seals. Conversely, sea birds and marsupials became more important. In the top levels of the North Cave at Rocky Cape the weight of bones of land animals constitutes 30 per cent of the total dry bone weight, and those of sea birds up to 40 per cent in some spits.

West Point

As a contrast to these caves, which are situated on cliffs overlooking the relatively sheltered Bass Strait, I also excavated a large open shell midden on the exposed west coast near the West Point lighthouse. This site, with a basal date of $1,850 \pm 80$ B.P., and a top one of $1,330 \pm 80$ B.P., corresponds in general to the latest prehistoric phase of the cave sequence, and its contents are similar in many respects.

The midden contains a large quantity of flaked stone, and the profusion of cores and unretouched flakes shows that stone tool manufacturing activities were carried out at the site. The raw material used in the top half of the deposit was almost exclusively a fine sponge chert, which was probably quarried locally. The tools consist of scrapers with both concave and convex working edges on them, finely retouched flakes and utilized cores. There were also many small pebbles with heavy battering around their periphery, and these seem to occur commonly on the western coast of Tasmania. The shells of the midden were mostly *Subnivalia undulata* and the Abalone *Notohaliotis ruber*, but a wide variety of other littoral shellfish were also collected. There was a large quantity of animal bones in the site, most of the meat being provided by seals. These have been identified by the Curator of Mammals at the Australian Museum, Mr Basil Marlow, as Southern

Elephant Seals (*Mirounga leonina*). Most of the animals killed were young and it is probable that the site was occupied during summer at least, when the seals were breeding and moulting. Land animals such as wallabies, bandicoots, possums, native cats and Tasmanian Devils were eaten and sea birds also provided a major source of food. A curious absence is that of fish, and this corresponds with the contemporary deposits at Rocky Cape.

We found several small pits filled with burnt and smashed fragments of human bone. Several individuals are represented, and it is probable that, after they had died, they were cremated in the same way as described by Robinson in 1832. In one pit, the bones were accompanied by several dozen small shells with holes in them, and these may be the remains of some sort of necklace.

Sequence for northwest Tasmania

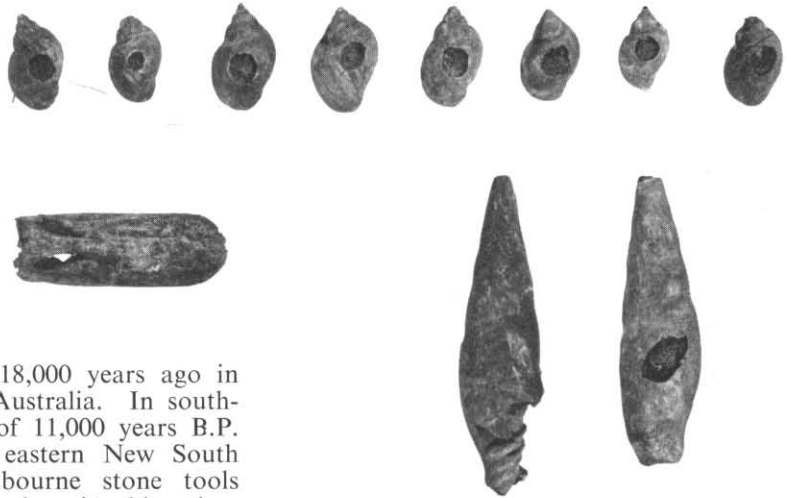
Thus, for northwest Tasmania we have a cultural sequence from about 8,000 to 500 years ago, with some elements showing change and others conservatism. On the one hand, the eating of fish and the making of bone tools were discontinued, and, on the other hand, there was a gradual improvement in the selection of the raw materials for stone tools and in the technique of their manufacture. The complete dietary dependence on the sea in the early phase became supplemented by the killing of land animals later on, and it is likely that rich sources of food such as the Elephant Seals would have been intensively exploited whenever they were available.

I do not think that this sequence will hold in its details for the whole of Tasmania; in particular, I do not think that the relatively crude stone tools from the basal levels represent the standard of workmanship all over the island at that time. In the early phase, northwest Tasmania may have been a peripheral area to the main zone of occupation, and we require parallel sequences in the midlands and southeast Tasmania to test this.

Mainland archaeology

How does this fit in with the archaeological picture on the mainland? The oldest dates for occupation so far found on the mainland

Pierced shells and a duck's bill which accompanied burnt human fragments in a pit at the West Point midden. The vertical shell at the right is 3 inches long. [Photo: R. French.]



range from 24,000 to 18,000 years ago in northern and western Australia. In southeast Australia, a date of 11,000 years B.P. has been obtained in eastern New South Wales, and near Melbourne stone tools have been found in a deposit older than 8,000 years. It is reasonable to assume, therefore, that about 12,000 to 10,000 years ago man had arrived in southeast Australia. The sea-level was over 200 feet below its present level and this meant that the island we now call Tasmania formed part of a mountainous southward-pointing peninsula, with the coast in places up to 40 miles out to sea from the present shore. The warmest summer month was some 9° F lower than at present and the high mountains in Tasmania and the Southern Alps contained glacial and periglacial zones. As the climate became warmer and the ice-covered and treeless areas in the highlands contracted, the sea-level rose until Tasmania became an island. If we assume that in this inhospitable country—especially in the west, which may have had a dense rainforest cover—the first human settlements were closely tied to the coast, then these would have been covered by the rising sea. The inhabitants, if there were any, would have been forced back onto higher and perhaps unfamiliar ground. This is surmise, but what is clear is that, as soon as the sea arrived at its present coastline, men with a strongly littoral economy first occupied the old sea caves on what was again the north coast of Tasmania.

Some 30 years ago, N. B. Tindale pointed out the similarity between Tasmanian stone tools and certain ancient assemblages on the mainland, and this has been demonstrated stratigraphically by D. J. Mulvaney at Kenniff Cave in south Queensland. In the lower levels, dated from 16,000 years to

about 5,000 years ago, were steep retouched cores, and a variety of convex and concave scrapers which in general terms are similar to tools found in Tasmania. Above these, dating from 5,000 years until the present, were unifacial points, backed blades, adze flakes and ground edged axes, none of which have been found in Tasmania. Sequences similar to this have been found in Cape York, the Northern Territory, eastern N.S.W., and South Australia, with the new and diverse industries replacing the old ones around about the third millennium B.C. (In this brief report, I have not taken account of Mrs C. White's very old dates for ground edged axes in Arnhem Land.)

Man arrived on the continent over 20,000 years ago, making certain kinds of stone tools, and he was occupying Tasmania when it became an island. In Tasmania the style of stone technology continued relatively unchanged until European contact. On the mainland, however, new cultural elements appeared, probably derived from Asia, which swamped the old culture, at least in the sphere of stone toolmaking. These new influences never reached Tasmania, however, because of the barrier of Bass Strait. At the period of contact, Tasmanian Aboriginal culture had retained (through isolation for over 8,000 years) technological elements which had once been widespread over the continent several thousands of years ago.

The Geographical Background to the
Arrival of Man in Australia and Tasmania

BY RHYS JONES

THE GEOGRAPHICAL BACKGROUND TO THE ARRIVAL OF MAN IN AUSTRALIA AND TASMANIA

By RHYS JONES*

PART I. THE COLONIZATION IN ITS ENVIRONMENTAL CONTEXT

AUSTRALIA and the Americas were both colonized for the first time during the last Ice Age by a physically modern man, employing advanced Palaeolithic technologies. In both cases, man entered a new continent, adapting his own culture to deal with unfamiliar country, animals and plants, and conversely subjecting the environment to the ecological pressures of his own technology to which it had never before been exposed. The colonization may be seen as part of a general geographical expansion carried out by late Palaeolithic man, the move into Australia predating that into the Americas by at least 10,000 years. Their completion left the polar ice caps, and some islands of the Pacific and elsewhere, as the only significant areas of land still to be claimed. To get to America, the first colonists derived from the Gravettoid cultures of northern Eurasia, would have had to negotiate glacial or periglacial conditions, but their journey could have been carried out overland, and many of the plants and animals in the new region would have been familiar to them. Australia, however, could only have been reached by sea, the several water barriers of Wallacea (Darlington 1957: 462) providing the shortest crossings, and the continent beyond, isolated since the early Tertiary, contained a largely endemic and highly distinctive flora and fauna. Most of the early Australian stone industries are characterized by flat convex edge, steep concave edge and high domed "scrapers", with considerable regional variation. Their closest analogues are found in the late Palaeolithic "Middle Stone Age" industries of sub-Saharan Africa and India from which they were probably derived. The paucity of information about the Palaeolithic succession in the Asiatic neighbours of Australia does not yet permit closer comparison.

A. The arrival of man on the Australian Continent

In Arnhem Land, C. White has obtained dates of over 20,000 B.P. from the basal occupation levels of two neighbouring sites containing similar stone industries characterized by edge ground axes and "chunky scrapers" (C. White, 1967). In view of the unexpectedly high antiquity of the edge ground axes, several samples, collected in successive seasons were checked against each other with consistent results (*A.I.A.S. Newsletter*, October, 1967: 27-31). At Malangangerr, dates of 24,800 ± 1600 B.P. (A.N.U. 77a) and 22,900 ± 1,000 B.P. (A.N.U. 77b) were obtained

* Department of Anthropology, University of Sydney. This paper was presented to Section F, A.N.Z.A.A.S. Conference, Christchurch, New Zealand, January, 1968.

from the same sample treated differently (Polach, 1967; White, 1967), and the basal date at Nawamoyne was $21,450 \pm 380$ B.P. (A.N.U. 51; Polach, 1967).¹ On the Nullarbor Plain, some thirteen hundred miles south of these sites is the large karstic sink hole of Koonalda Cave. Excavations located 400 feet inside the cave and 200 feet underground, have revealed 18 feet of deposit in two stratigraphic units containing artifacts, mostly quarrying debris (R. V. S. Wright: personal communication). A date of $13,700 \pm 270$ B.P. (GaK 510) was obtained a foot or so below the surface, and one of $18,200 \pm 550$ B.P. (GaK 511) nine feet below the surface² (A.I.A.S. Newsletter, Jan., 1966: 23-4) both from the top stratigraphic unit. The stratigraphy and age of the basal artifact bearing layers are being currently investigated, but an antiquity of over 20,000 years is expected (Wright: pers. comm.).

On the shores of the intermittent Lake Menindee, N.S.W., erosion revealed a succession of sandy beds, (Tindale 1955: 273-276), from which surface collections of artifacts and the bones of numerous extinct marsupials had been made. Two flakes (Tindale 1955: 284-285), and several bones and anatomically undisturbed skeletons of extinct marsupials were found *in situ* in Bed B (Tedford 1955: 302; 1966: 53). Fresh water *Unio* shells from Bed B in Area I were dated to $6,570 \pm 100$ B.P. (N.Z. 66), but *Unio* shells from the same bed in Area II were dated as "modern" (N.Z. 67; Tindale 1957: 36-38; Grant-Taylor and Rafter 1963: 127-128). Sample N.Z. 66 was supposed to have come from a "food hearth in the top part of horizon B" (Tindale 1957: 36) but it is clear from the field notes of L. F. Marcus (quoted by Tindale: 37) that there were only "one or two shells in place in the B horizon", the bulk of the sample taken from the surface; sample N.Z. 67 was also a surface collection with only one or two shells in place. In view of the discrepancy and "the fact that modern unionid shells are common litter in this region" (Hubbs *et al.* 1962: 210), Tedford collected a charcoal sample *in situ* from the top of Bed B, Area II, from which a date of $26,300 \pm 1,500$ B.P. (L. J. 204) was obtained (Hubbs *et al.* 1962: 210). A date of $18,800 \pm 800$ B.P. (GaK 335) was later announced by Tindale (1964: 24) for a charcoal sample collected "from a fire hearth in Area II at the top of layer B". Tindale's earlier claims that the $6,570 \pm 100$ B.P. date was archaeologically acceptable on the basis of the ascription of the associated artifacts to the Tartangan culture (Tindale 1957: 37), have little force following Mulvaney's demolition of that cultural term on the basis of lack of definition (1961: 72-75). By comparison with excavated industries from stratified sites so far studied, all that can be said at present of the assemblage figured by Tindale (1955: 283-284) is that it is likely to be older than 5,000 years. While it is probable that one or two stone artifacts, some extinct marsupial bones, and the charcoal sample of $26,300 \pm 1,500$ B.P. are in true stratigraphical association, it is clear that controlled excavations must be carried out at this fascinating site to allay any suspicion of contamination following the inconsistent results so far obtained.

¹ Originally calculated with an error of 600 years (White 1967: 151).

² Both samples collected by Dr. A. Gallus.

Further east, several sites near the watershed of the Great Dividing Range attest to man's arrival on the Western Slopes over a wide front by late-glacial times. A shelter at Laura, Cape York, yielded a date of about 7,000 B.P. from a depth of 6 feet (R. V. S. Wright: pers. comm.) and rich occupation levels were found 6 feet below this, suggesting a basal date of at least 10,000 B.P. Further south, Mulvaney obtained a date of $16,130 \pm 140$ B.P. (N.P.L. 68) from basal levels at Kenniff Cave (1964): 265; 1965: 168-171), and dates of $11,600 \pm 400$ B.P. (GaK 334) and $12,550 \pm 185$ B.P. (V. 35) have been announced from Noola, N.S.W. (Tindale 1961; Bermingham 1966: 514). In both sites there were inversions and Mulvaney (1965: 170) suggests several possible causes in the case of Kenniff Cave.

In 1940 a cranium was accidentally discovered in a commercial pit at Keilor near Melbourne. The literature dealing with its provenance and dating has been summarized by Macintosh (1965: 41-6; 1967: 94-5), Gill (1966) and Mulvaney (1964: 266). Gill (1966: 582) has shown that the probable location of the cranium was near a zone of secondary carbonate depositions in the silt of the Keilor terrace. Stratigraphically, he believed that the cranium came from a level slightly lower than a carbon sample (W. 169) dated to $8,500 \pm 250$ B.P. obtained from the Keilor terrace a few miles away (Gill 1955a), and on this basis assigned an age to it of between nine and ten thousand years (Gill 1955c; Macintosh 1965: 44). A sample dated to $15,000 \pm 1,500$ B.P. (N.Z. 366) was obtained from about the level of the cranium near or at the cranium site, and it seems that this is the order of age that Gill now assigns to it (Gill 1963: 264; Macintosh 1967: 95), though it is worth remembering the remarks of the dating laboratory, that as the "sample is combined carbon and carbonate, date represents order of magnitude only" (Grant-Taylor and Rafter 1963: 159). A date of $7,360 \pm 105$ B.P. (R. 1742) has been obtained for the carbonate crust from the cranium itself (*A.I.A.S. Newsletter* October 1967: 23), and Macintosh (1967: 95) suggests that such crust formation might occupy 1,000 to 1,500 years. A charcoal sample some five to six feet below the presumed position of the cranium gave a date of $18,000 \pm 500$ B.P. (N.Z. 207). In view of the uncertainties surrounding the exact provenance of the cranium, and the inconsistencies in the attempts at dating it, it would be best to refer to its age in general terms as late-glacial to early post-glacial, probably younger than 18,000 years and older than 7,000 years. The 18,000 year old date came from a small lens of discoloured earth with charcoal and a few randomly orientated animal bones. There were no artifacts associated with it.³ Gill calls this a "midden" (1966: 584) (quoted as "aboriginal fireplace" in Grant-Taylor and Rafter (1963: 143) and "hearth" in Hubbs *et al.* (1962: 211)), accepting it "as adequate evidence for human occupation" (1963: 264). For unequivocal proof of human occupation however, we must be satisfied with nothing less than artifacts or human remains found *in situ* under controlled conditions, and the complications to the literature resulting from similar circum-

³ Mulvaney (1964: 266) said that he saw a core and a flake in the wall of the section below this, but was unfortunately unable to confirm it by excavation, due to a flash flood.

stantial evidence at Santa Rosa Island and Tule Springs, U.S.A. (Willey and Phillips 1962: 82-6; Shutler 1965; and pers. comm.), should make us wary of less stringent criteria.

Recently, stone artifacts and parts of two skeletons in a single burial were discovered in a terrace at Green Gully, some two miles south of the Keilor cranium site (Bowler *et al.* 1967; Macintosh 1967). The skeletons with a collagen date of $6,460 \pm 190$ B.P. (R. 1904/2) and a carbonate date of 1781 ± 115 B.P. (R. 1904/1) (Macintosh 1967, 91-2) had been dug into deposit from which two dates of $8,155 \pm 130$ B.P. (V. 63, 64) and one of $8,990 \pm 150$ B.P. (V. 64) were obtained. Flakes and some retouched implements were found *in situ* extending to eleven feet below this, and a charcoal sample obtained six feet below the lowest artifact gave a date of approximately 17,000 B.P. (Mulvaney: pers. comm.).

The established antiquity for human occupation on the New South Wales coast and in Tasmania, is significantly less than in the areas discussed above, all the sites dating from post-glacial times. This may be due to insufficient sampling, but as there has been more excavation carried out here than in any other region in Australia, the contrast may turn out to be a real one. In New England, McBryde's oldest date is $6,444 \pm 74$ B.P. (V. 27) from Seelands (1966: 286), and in the Sydney district, the basal date of Curracurrang is $7,450 \pm 180$ B.P. (GaK 482) (Megaw 1965: 203). Sites in Tasmania, discussed below, date back to 8,000 years.

In New Guinea, Bulmer and J. P. White have found sites close to each other in the Eastern Highlands (J. P. White 1965); the basal date from Kiowa being $10,350 \pm 140$ B.P. (Y. 1366) (Bulmer 1964), and at Kafiavana $10,730 \pm 370$ B.P. (A.N.U. 41b, bone collagen date, White pers. comm.). A greater antiquity may be forthcoming from the Highlands, as stone artifacts have been found at Kosipe in a buried soil dated to $16,300 \pm 1,200$ B.P. (GaK 624) and $19,350 \pm 600$ B.P. (GaK 625) (Dury 1966: 162 and J. P. White: pers. comm.).

The last five years have seen the carbon-dated antiquity of man in Australia steadily increased from 8,000 years to its present value, and given the fact that archaeologically we have only nibbled at the problem, there is every likelihood that significantly higher values will be obtained. For the present, an antiquity of 30,000 years is a reasonable claim. The oldest dates for various regions have been plotted on Fig. 1. There is a gradient of antiquity with the oldest dates in the west, the middle range in the Tablelands (and in Highland New Guinea), and the youngest ones on the east coast and south in Tasmania. This west to east gradient (also mentioned by McCarthy (1966: 27) is in contrast to a north east to south west one which might be expected from the arrival of man across the Pleistocene land bridge from New Guinea (Golson 1967). During last glacial times, Australia and New Guinea would have been one large island, and to reach it, man would have had to cross several stretches of water from the Asiatic land mass. Water is an extremely effective biological barrier (Darlington 1965), but once having mastered the technology to ride on it, a journey of several hundred miles need not of necessity

be more difficult to achieve than one of a few dozen. Within the time limits set by the buoyancy of the craft, the provisions on board, the endurance of the passengers and the random occurrence of disasters, the factors which govern the distance travelled, are the length and direction of the winds and currents and the configuration of land falls (Heyerdahl *Kon Tiki*; Macintosh 1949, 1965: 36-40).

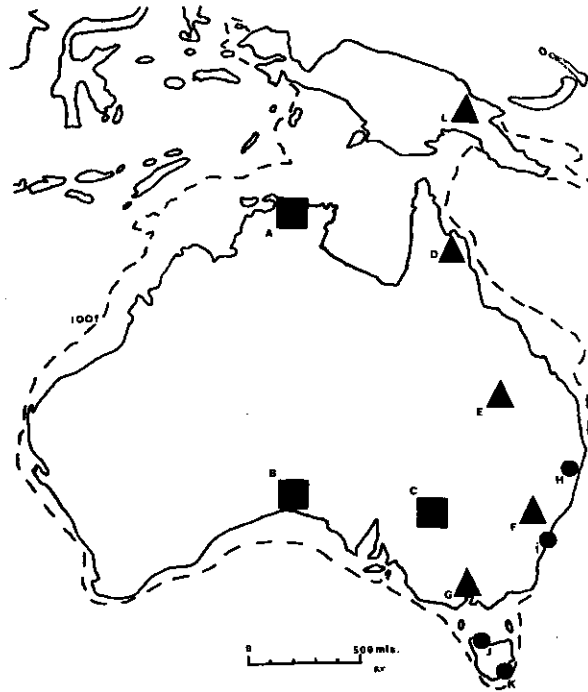


Figure 1.—Map of Australasia showing oldest carbon dates for human occupation in various regions: squares indicate dates between 20,000 and 30,000 B.P., triangles between 10,000 and 20,000 B.P., and circles between 5,000 and 10,000 B.P. (A) Malangangerr, Nawamoyrn. (B) Koonalda. (C) Lake Menindee. (D) Laura. (E) Kenniff Cave. (F) Noola. (G) Kellor, Green Gully. (H) Seelands. (I) Curracurrang. (J) Rocky Cape, Sisters' Creek. (K) Carlton River. (L) Kiowa, Kafivana. Dotted line represents the 100 fathom line (see also Mulvaney, 1961: 61).

We must not be obsessed with the route to Australia involving the shortest water crossings. Land falls could have been made anywhere along the entire north east to south west coast of "greater Australia", from the northern tip of New Guinea to the west coast of Australia. The claims of Western Australia as a potential bridgehead for Palaeolithic migrants are enhanced by the distribution of the later backed microlithic industries. These are found across the southern half of the continent, with a marked and significant absence in the north (Mulvaney 1961: 81;

Glover 1967 : 415), strongly suggesting diffusion from Western Australia, possibly derived from similar industries which were widespread in India, Ceylon and sub-Saharan Africa (Allchin 1966 ; Inskoop 1967). The coarsely flaked stone industries of Highland New Guinea show conservatism over ten thousand years (J. P. White 1967 : 408-12 and pers. comm.), lacking the varied innovations which enter the mainland Australian sequences about 5,000 years B.P. and it may be that, at times the north of Australia has acted as a barrier as well as a gateway to the continent.

The arrival of man in Tasmania cannot be seen outside the context of the colonization of the Australian continent. An antiquity of over 8,000 years for human occupation in Tasmania, coupled with the affinities of Tasmanian stone tool assemblages to those excavated from deposits older than 5,000 years B.P. on the mainland (Mulvaney 1965 : 206-10) and the similarities between the material cultures, economies and physical forms of the ethnographically observed Aborigines of Australia and Tasmania (Davidson 1937 ; Hiatt 1967, 1968 ; Macintosh 1965 : 49-55 ; 1967 : 97), renders any other derivation unnecessary.

B. The Australian environment in late glacial times

It is worth attempting to see this colonization within its geographical context. Pleistocene ecological studies in Australia are not yet well developed, and we do not have the detailed picture of glacial and post-glacial environments which is available for Northern Europe, Africa and North America as a background to our studies. The exploration of culture change in terms of the pressure of the environment and adaptations to it, such as has been done skillfully with the post-glacial hunter-gatherer cultures of north-western Europe (Clark 1936, 1952) and with the origin of American agriculture (McNeish 1964), would be premature in Australia except in the most localized sense. Nevertheless, a number of broad ecological changes are known to have occurred in Australia and Tasmania, during the time that the continent has been occupied by man. The most important are those associated with the last ice age and its deglaciation.

Temperature

From a study of Tasmanian glacial deposits, Lewis (1945) suggested three separate glaciations of decreasing severity, correlated tentatively with the Mindel, Riss and Würm, and by Flint (1957 : 432) with the Riss and two phases of the Würm. More recent work has shown that the great majority of glacial and periglacial features in Tasmania and in the Snowy Mountains belongs to a single glacial phase (Derbyshire *et al.* 1965 : 1-2 ; Galloway 1965 : 603 ; Davies 1967 : 6). Paterson's discovery of two separate tills in the Mersey Valley, Tasmania (1965), and the long glacial sequence established in New Zealand (Suggate 1965) makes it likely that in Australia as in the northern hemisphere, there has been a complex history of multiple glaciations. The last glaciation has obliterated most of the evidence for previous ones, and "For the time being... it is necessary to discuss the

geomorphic effects of glaciation in terms of one stage" (Davies 1967 : 7). Various studies of palaeo-temperatures of the ocean surface (Emiliani 1958 ; Rosholt *et al.* 1961 ; Ericson and Wollin 1956 ; Conally 1967), and dated last glaciation climatic sequences in North America (Flint and Brandtner 1961), Europe (Woldstedt 1962), equatorial South America (van der Hammen and Gonzalez 1960), sub-Saharan Africa (Bakker 1967 : 134-5), New Zealand (Suggate 1965) and southern Chile (Auer 1960), have shown that the major temperature fluctuations during the last glacial period were synchronous and of the same order of magnitude all over the world (Dury 1967 : 234). On the basis of the freshness of the deposits, and a C.14 date of $26,480 \pm 800$ B.P. for the Linda moraine, Tasmania (Gill 1956), the major glacial and periglacial features of south-east Australia and Tasmania have been assigned to the last Würm/Wisconsin glaciation (Galloway 1965 : 603 ; Davies 1967 : 6). Analogy with the New Zealand sequence suggests several glacial advances, with the last major retreat beginning about 14,000 years B.P. (Suggate 1965). Peterson (1966 : 127) has obtained a date of $8,720 \pm 220$ B.P. for the last stages of deglaciation in the western Tasmanian mountains. Man arriving for the first time in south eastern Australia would have been faced with the arc of the Snowy Mountains and beyond that, the mountainous peninsula of Tasmania in the grip of full glacial conditions.

Tasmania had several centres of glaciation (Derbyshire *et al.* 1965 ; Davies 1967 : 7) with ice covering thousands of square kilometres during the glacial maximum (Galloway 1965a : 607), contrasting with an area of only 50 square kilometres on the mainland in the Snowy Mountains (Galloway 1965a : 603 ff ; Davies 1967 : 7, 11-18), Fig. 2. In Tasmania, the lowest limit of solifluction lay between 600 metres and 450 metres above sea level in most places (Davies 1967 : 12). Caine (1966 : 278) has recently found periglacial deposits down to 300 metres in north eastern Tasmania, and thinks that even this may be too high for the limit of Pleistocene solifluction. This limit becomes steadily higher further north in south-eastern Australia, being 1,000 metres in the Snowy Mountains and 1,400 metres in New England (Galloway 1965 : 605).

The tree line at present is about 100 metres below the limits of active solifluction, and extrapolating into the past, Galloway (1965 : 605) suggests that at the height of the last glaciation, the tree line in Tasmania was less than 500 metres above sea level, and Caine (1966 : 278) suggests 200 metres in the north-eastern region a drop of 1,000 metres from its present height. In Fig. 2, I have tried to plot this hypothetical tree line by assuming its average height to have been 300 metres (1,000 feet) above sea level. Tasmania is mountainous, and even with lower glacial sea levels, this would have left only a narrow forested fringe around the coast, with the bulk of the interior tree-less under glacial or periglacial conditions. At that time, the mean temperatures were at least 9° C. lower than at present in the Snowy Mountains and 5° C. lower in Tasmania (Galloway 1965 : 605-6). Dury (1967 : 234) suggests a depression of 8° C. to 10° C. in south east Australia in general. The oceanic climate would have had an ameliorating effect in Tasmania (Darlington

1965 : 98), but even so Caine (1966) shows that a temperature drop of this magnitude would have resulted in continuous freezing conditions for about half the year in the hills of north-eastern Tasmania and few districts would have had a more equable climate.

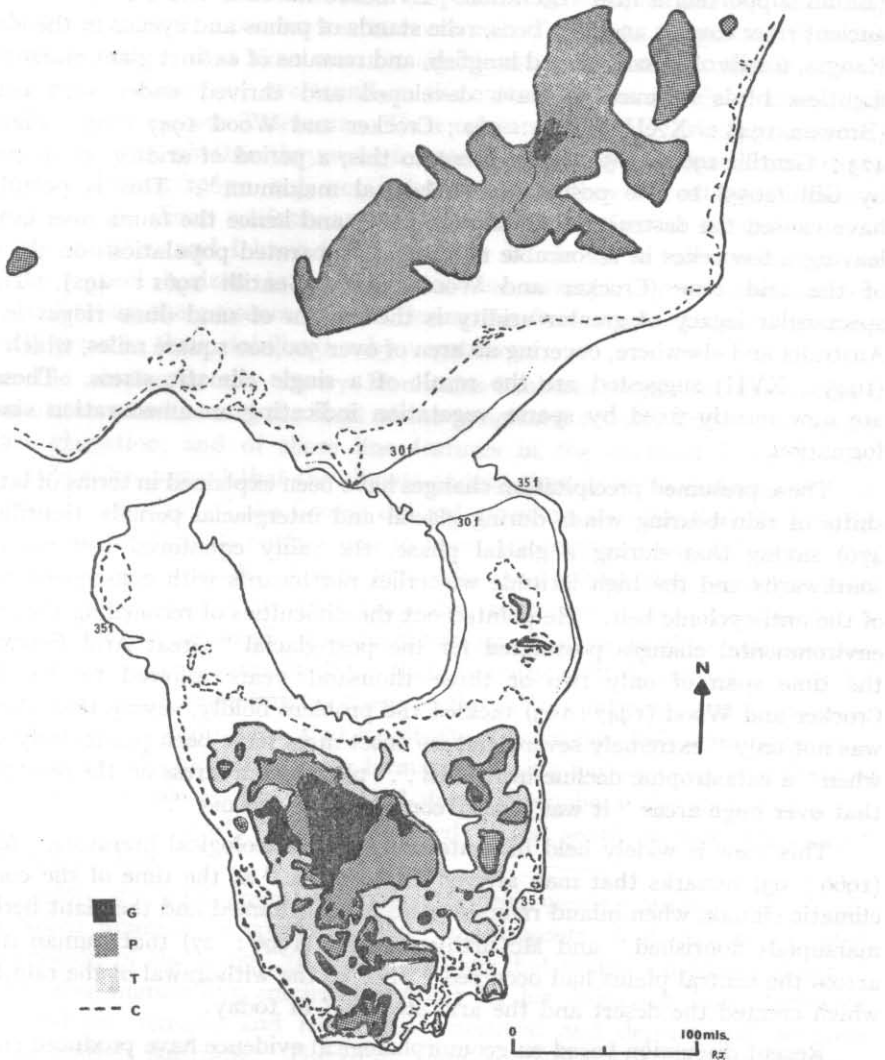


Figure 2.—South east Australia and Tasmania during the last glaciation. (G) glacial deposits. (P) periglacial deposits and processes (after Galloway 1965a, Davies 1967). (T) zone above treeline. These refer to the time of the glacial maximum. (C) present coast line. The 30 fathom and 35 fathom lines (after Jennings 1959, Fish and Yaxley 1966), represent coasts at 11,000 B.P. and 15,000 B.P. respectively.

Precipitation

The problem of the nature of precipitation fluctuations during the Pleistocene in Australia has not yet been solved. The classic view put forward by Crocker, Wood and Browne is that during the last glaciation, the interior of Australia had a high rainfall supporting a lush vegetation. Evidence for such wet conditions have been ancient river courses and lake beds, relic stands of palms and cycads in the Macdonell Ranges, fossils of crocodiles and lungfish, and remains of extinct giant marsupials and flightless birds believed to have developed and thrived under such conditions (Browne 1945 : XXII ; 1963 : 267 ; Crocker and Wood 1947 : 95 ; Flint 1957 : 473 ; Gentilli 1961 : 475). Subsequent to this, a period of aridity set in correlated by Gill (1955) to the post-glacial "thermal maximum". This is postulated to have caused the destruction of the vegetation and hence the fauna over large areas leaving a few relics in favourable refuges and separated populations on the margins of the arid zone (Crocker and Wood 1947 ; Gentilli 1961 : 492). The most spectacular legacy of greater aridity is the system of sand dune ridges in central Australia and elsewhere, covering an area of over 500,000 square miles, which Browne (1945 : XVII) suggested are the result of a single climatic stress. These dunes are now mostly fixed by sparse vegetation indicating an amelioration since their formation.

These presumed precipitation changes have been explained in terms of latitudinal shifts of rain bearing winds during glacial and interglacial periods, Gentilli (1961 : 476) saying that during a glacial phase, the rainy equatorial belt would move southwards and the high latitude westerlies northwards with consequent reduction of the anti-cyclonic belt. He pointed out the difficulties of reconciling the enormous environmental changes postulated for the post-glacial "Great Arid Period" with the time span of only two or three thousand years allowed for its duration. Crocker and Wood (1947 : 103) tackled the problem boldly, saying that the aridity was not only "extremely severe, but its onset must have been particularly sudden" when "a catastrophic decline in rainfall . . . placed such stress on the pre-arid flora" that over huge areas "it was almost completely wiped out".

This view is widely held in contemporary archaeological literature. Mulvaney (1966 : 93) remarks that man arrived in Australia "at the time of the continent's climatic climax, when inland rivers flowed, lakes brimmed and the giant herbivorous marsupials flourished" and McCarthy suggests (1966 : 27) that human migration across the central plains had occurred "prior to the withdrawal of the rain belts . . . which created the desert and the arid steppes" of today.

Recent discussion based on geomorphological evidence have produced conflicting conclusions regarding precipitation during the last glaciation. In Tasmania, there is a marked contrast in the present climate with a high rainfall in the west and a low one in the east. The rise of the snowline at the time of the glacial maximum from 600 metres in the south western mountains to 1350 metres on Ben Lomond in the north east, shows that a similar precipitation gradient also existed then (Davies

1967: 7-9). Davies (1967: 24) has pointed out that "in the wetter part of the island, changes in temperature are likely to have been of most significance, while in the drier east, changes in precipitation are likely to have most effect". Caine (1966: 278 ff.) shows that the post-Pleistocene rise of the solifluction limit (dependent on temperature) and snowline (dependent on temperature and snowfall) were both of the order of 1,000 metres in north east Tasmania, suggesting that the precipitation regime at that time was not significantly different to what it is now. Valley dunes and "lunettes" are found on the eastern (leeward) side of rivers and shallow lakes in dry eastern Tasmania. Their origin requires dry windy conditions, but it is not yet clear whether they were formed during glacial or post-glacial times (Nicolls 1958; Davies 1967: 22), nor indeed whether they are all contemporary. Whatever their age, stone artifacts are common on the surface of modern "blow-outs" in the lunettes, and I have found artifacts *in situ* up to two feet below the base of the topsoil horizon in several sites—for example Crown and Grimes' Lagoons—indicating the presence of man during the final stages of their formation immediately prior to their stabilization by vegetation.

From the studies in the Snowy Mountains-Canberra region of the relative depression of the snowline and the limit of the periglacial activity during the height of the last glaciation, and of shore line features in the enclosed Lake George, Galloway (1965a) has argued that the climate at that time in south eastern Australia was cold, windy and dry. Lake George did not overflow, showing that the greatly reduced evaporation from its surface due to lower temperatures was balanced by a corresponding drop in rainfall. A late high lake level within this basin has been dated to $15,100 \pm 300$ B.P. (GaK 962; Galloway 1967: 477). The dune fields of central Australia must be largely Pleistocene in age because of their size and the long sequence of events documented for their formation (Mabbutt 1967: 177-8). Galloway (1965a: 615), extending his thesis to the entire continent, quotes evidence from Fairbridge (1961) and others, that longitudinal dunes pass below intertidal mud in north west Australia indicating their formation during low sea level glacial times and suggests a "glacial age for the inland dunes throughout the continent... in accord with the dry, windy climate deduced... for south eastern Australia" (Galloway 1965a: 616).

Dury (1967: 235-240) argues the opposite view, quoting studies carried out, mostly in North America, he concludes that "main onsets of pluviation coincided with main episodes of glaciation" (p. 236). He says that similar conditions obtained in Australia also, marshalling empirical support for his deduction from studies of dry lakes, underfit streams and rivers, and erosional and depositional features especially in eastern Australia. There has been a controversy over the climatic conditions which formed the large scale depositional features associated with rivers of the Riverina plains such as the Murrumbidgee, where one former system has been dated to $\geq 11,000$ B.P. and another to $\leq 4,700$ B.P. (Langford-Smith 1966: 508). Butler (1961) and others correlate sedimentation with aridity which they say reduced the vegetation cover with consequent increased erosion, the rivers being unable to

transport the load to the sea. On the other hand, Langford-Smith (1960; 1962) and Dury (1967: 238-40) correlate sedimentation with pluvial conditions, particularly those operating during the waning of a pluvial episode, when a large river laid down a vast flood plain into which the present river is incised. One of the problems is that deposition occurred some hundreds of miles away from the catchment area, and correlation of rainfall to run off may be complicated by such factors as the annual snow melt, which could have resulted in spring floods out of all proportion to the flow during the rest of the year. Studies of analogous phenomena in the Derwent Valley, Tasmania may help to elucidate the problem, for here, the catchment and depositional areas are close to each other and stratigraphic correlations of glacial and fluvial features may be hoped for (Davies 1967: 18). Dury (1967: 238) says that even allowing for reduction of evaporation during a glacial period, the Pleistocene high lake levels of Lake Eyre imply a two-fold increase in precipitation, the same figure obtained for underfit streams in the Northern Hemisphere, and for old lake levels in the Great Basin, U.S.A.

Neither Dury nor Galloway explain each other's specific field evidence in terms of their own theory. Galloway asserts that the glacial aridity in Australia was part of a world-wide reduction in precipitation due to decreased evaporation from the oceans under lower temperatures (1965*b*), whereas Dury says (1967: 238) that for Australia, as for the U.S.A., a post-glacial depluviation "has affected all areas from the (east) coast to the Centre". Bakker (1967) however, warns us against overgeneralizing, saying that in Africa "pluvial and non-pluvial periods were not synchronous over the entire continent. Each region has apparently its own pluvial-non-pluvial chronology" (p. 145). It is likely that Australia is also big enough to have shown considerable regional variation both in the magnitude and even in the direction of precipitation changes during the Pleistocene.

A Case for Relative Stability of Climatic Conditions

What would have been the nett effect of changes of such magnitude on the continental environment that faced the first colonists? Whereas changes in precipitation of the order of twice, or half the present, would result in marked changes in the vegetation of large areas of country situated in a broad arc from north western Queensland to South Australia, it is unlikely that fluctuations of these magnitudes would have radically altered the desert core of central and western Australia. Mabbutt (1967: 179) sees deserts in general as regions of conservation of land forms, and in central Australia there is a long record of intercalated aeolian and fluvial deposits, representing drier and wetter phases, but "superimposed on a general dessication" (*op cit*: 173) setting in from the Tertiary onwards (*op cit*: 166, 170, 176). The pattern of the great longitudinal dunes conforms to the present system of winds, indicating a "stable, anti-cyclonic desert core, subject to periodic strengthening . . . and weakening . . . but not to major latitudinal shifts" (Mabbutt 1967: 178), thus bringing evidence contrary to the theory of shifting wind belts required for the glacial-pluvial correlation (Gentilli 1961: 475). On biogeograph-

ical grounds, Darlington (1965 : 97) suspects that for Australia "both the amplitude and the effect of Pleistocene fluctuation of rainfall have been overestimated". The existence of a distinctive and rich desert fauna and flora argues for an arid habitat of long duration, so that large parts of the continent must have been dry, even during periods of highest rainfall. An illustration of the stability of a desert region is given by Butzer's map (1967) of hypothetical vegetation in Africa at 50% (Map 8) and 150% (Map 9) of the present rainfall, which when overlaid on each other, show the arid zone of the Sahara essentially unchanged.

Distinctive species of forest-living beetles (carabids) in south west Australia imply isolation from the forests of eastern Australia since Tertiary rather than Pleistocene times, so that since that period it has not been wet enough to have allowed "formation of a continuous strip of even moderately wet forest across the continent" (Darlington 1965 : 97). Support comes from Jennings' study of retarded karst development in the semi-arid Nullabor Plain, where he concludes that since the Miocene emergence, there has been no long period much wetter than at present in the area, "There has been enough time, but not enough water" (1967 : 283).

We must conclude that when man arrived in Australia in the late Pleistocene times, the continent was colder than at present. Following Galloway, the climate was cold, windy and dry, with active dune formation in the Centre; following Dury and others, the precipitation was about twice the present, with large river systems in eastern Australia. In both cases, it may be unwise to exaggerate the effects of these changes on the vegetation of the continent as a whole. The broad pattern of vegetation zones probably had a similar configuration to that of the present day, though the relative extent of various habitats would have been different. It may have been in Tasmania, due to changes in temperature rather than precipitation, that the contrast with today was most pronounced.

C. *The arrival of man in Tasmania*

Some time during the last glaciation, the sea was at least 350 to 400 feet lower than it is now (Shepard 1961 : 31; Hails 1965 : 65-6), and it rose steadily from minus 250 feet to about its present level in the period 17,000 to 6,000 years ago (Godwin *et al.* 1958 : 1518; Shepard 1961 : 31) (Fig. 3). The post-glacial emergence of up to 10 feet recorded in southern Australia and Tasmania (Gill : 961; Gill and Banks 1956 : 35; Davies 1959; Jennings 1961 : 83-4) may be due to local warping (Shepard 1961; Hails 1965 : 74). The shallowest water between Tasmania and the mainland is between 30 and 35 fathoms deep (Fig. 2), situated over a broad, gently sloping saddle between Wilson's promontory and north east Tasmania (Jennings 1959). Fig. 3 shows that before about 15,000 B.P., this would have been above water, affording a flat land bridge some fifty miles wide into Tasmania. The coast would have been ten to fifty miles north of the present north Tasmanian coast, and Flinders and King Islands would have been mountain ranges rising from the plain. Elsewhere around Tasmania, deep water is found close to the present shore, and

the 35 fathom line even comes close to the base of modern plunging cliffs in southern Tasmania (Yaxley and Fish 1966: 168-71). The final severing of Tasmania from the mainland would have been rapid, for a sea rise from the 35 fathom mark of only five fathoms, would have formed a shallow strait some forty miles wide. This event occurred between 15,000 and 11,000 B.P. (see Fig. 3.)

The relative dating for a sequence which I proposed for north west Tasmania on the basis of excavations in four coastal sites, (Jones 1966), has been confirmed by radiocarbon dating (Fig. 4). The basal levels at the South Cave, Rocky Cape (Jones 1966: 2-5), have been dated to $8,120 \pm 165$ B.P. (GxO 266) (Reber 1965: 267) and

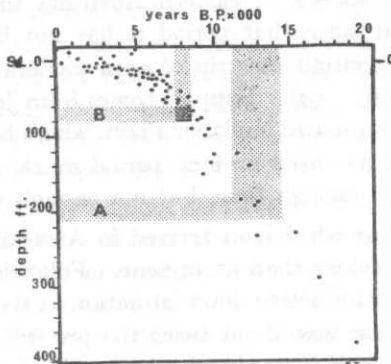


Figure 3.—Late and post glacial rise in sea level (after Shepard 1961).

- (A) Submergence of land bridge between Australia and Tasmania—sea rise from 35 fathoms to 30 fathoms, (Jennings 1959).
 (B) Arrival of sea at foot of cliffs at Rocky Cape, Tasmania.

$7,465 \pm 150$ B.P. (V. 86). A nearby cave at Sister's Creek has a basal date of $6,050 \pm 88$ B.P. (N.S.W. 17), and at the North Cave, Rocky Cape, my oldest date is $5,425 \pm 135$ B.P. (V. 89), though on stratigraphic grounds I suspect that this is not the oldest deposit at this site. In all three caves, coastal shell middens were laid on a deposit consisting of gritty sand and decayed rock on bed-rock (Rocky Cape, North; Sisters' Creek), or on large angular boulders and gritty sand on decayed bed-rock (Rocky Cape, South). These basal deposits were completely devoid of any cultural material. The cliffs at Rocky Cape plunge below water to depths of about ten fathoms (60 feet), the fifteen fathom line (90 feet) being about half a mile to a mile from the shore. From Shepard's curve (1961: 31), the sea reached the minus ten fathom line sometime between seven and a quarter and nine thousand years ago, which corresponds well with the basal dates from the South Cave (Fig. 3). Thus as soon as the sea had reached the present coast at Rocky Cape, and only since then, was the South Cave occupied. The sea deepens less quickly immediately off the cliffs containing the Sisters' Creek cave, and this site was first occupied when the sea level was twenty feet or less below its present level.

In the oldest phase about six to eight thousand years ago, seal and fish account for over 95% of the non-shellfish meat, calculated both from the weight of dry bone and from minimum numbers of animals. If we add to this an equal contribution from marine molluscs, we see an almost complete dependence on the sea and especially the inter-tidal zone, for protein. The stone artifacts used were crude retouched flakes and flaked pebbles, the raw materials being obtained from the cave walls or from the beach in front. Bone points were present, manufactured from wallaby fibulae, and as there are far more animals represented by these artifacts than in the food refuse, the bones for the points must have been obtained elsewhere where land animals were caught.

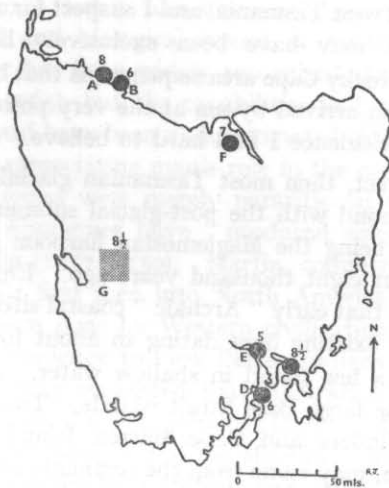


Figure 4.—Earliest archaeological sites so far discovered in Tasmania. Numbers indicate for each site, the approximate antiquity in thousands of years B.P.

(A) Rocky Cape, South Cave. (B) Sisters' Creek, Blackman's Cave. (C) Carlton River. (D) Kelly Point, Bruny Island. (E) Derwent Estuary (the last three after Reber 1965). (F) Flowery Gully Cave (E. D. Gill, pers. comm., to be published). (G) last stages of deglaciation in the Frenchman's Cap mountain range.

Around Storm Bay in south east Tasmania (Fig. 4), one open shell midden has a basal date of $8,700 \pm 200$ B.P. (I. 323) (Reber 1965 : 266), another on Bruny Island (Storm Bay) has a date of $6,050 \pm 350$ B.P. (I. 316) (Reber 1965 : 265) and two others on Bruny and on the Derwent Estuary have antiquities of just over five thousand years (Reber 1965 : 1967). In glacial times, the Derwent flowed in a trench some 150 feet below sea level, and there are several submarine features in Storm Bay related to lower sea levels (Fish and Yaxley 1966 : 168-71). The sea would have reached its present coast in most places around Storm Bay between eight and five thousand years ago, although it was never far away during the last glaciation.

must have had an enormous effect, the more recognizable in that, like the Americas, Madagascar, Ireland and New Zealand, he arrived not too long ago at a specific point in time. The fact that this impact has not yet been documented in field studies, may be no more than that its effects have not yet been recognized for what they are.

Aboriginal man's most effective ways of changing his environment was through hunting and through the use of fire.

A. *The extinction of Pleistocene marsupials*

Pleistocene fossil deposits attest to a rich and varied fauna of large extinct marsupials, including *Thylacoleo*, *Nototherium*, *Diprotodon*, *Phascolonus*, *Procoptodon*, and large flightless birds *Dromornis* and *Genyornis* (Gentilli 1961: 485; Browne 1945: XXI; Gill 1963: 265). These are found together with representatives of modern fauna. Browne's (1945: XX) and Tedford's (1966: 54) maps of fossil locations, show a wide distribution throughout the continent. There was a great expansion and proliferation of vertebrates in late Tertiary times and giant forms are seen from the Pliocene onwards (Stirton 1955). However in the late Pleistocene, this marsupial fauna was impoverished by a wide range of extinctions, especially of the larger genera. Faunal sequences during the Pleistocene in Australia are poorly documented and dated (Tedford 1966: 53-9), and extinctions may well have been occurring steadily throughout the period, but near the end of it, so many animals died out, that most Pleistocene faunal assemblages can easily be recognized as such and are distinctively different to Recent ones.

The dating of the last phase of this megafauna is not entirely satisfactory. A date of $6,700 \pm 250$ B.P. (N.Z. 206) for the dentine of *Diprotodon* teeth found at Orroroo (S.A.), has often been quoted (e.g. Mulvaney 1961: 63; Gill 1963: 265), but there was also a date of *greater than* 40,000 B.P. (N.Z. 205) for the stomach contents of what, when submitted, was believed to have belonged to the same animal. A *Diprotodon* molar from Yalpara near Orroroo gave a date of $11,100 \pm 130$ B.P. (N.Z. 381) (Grant-Taylor and Rafter 1963: 161). At Lake Colongulac (Vic.), a sample of brackish water *Coxiella* shells yielded a date of $13,700 \pm 250$ B.P. (Y. 170) (Gill 1955: 51). Gill thinks that the deposit from which these come, indicates pluvial conditions (1953: 34), though Galloway provides an opposite interpretation of the same data (1965). It contains numerous remains of extinct marsupials (Gill 1963: 35-41). Above the lacustrine deposits are fossil dunes of loess, found at Colongulac, Lake Corangamite (Vic.) and elsewhere, correlated by Gill (1953: 53) to the same climatic episode, namely the post-glacial "arid period". *Coxiella* shells from fossil dunes at Lake Corangamite gave a date of $28,240 \pm 1,100$ B.P. (Y. 230, Barendsen *et al.* 1957: 916), but a comment is added that the shells had been blown into the dune deposits and did not date them nor the dessication. If this is so, one wonders why Gill submitted the sample in the first place. Gill claims that two wedge-shaped marks on a giant kangaroo's fourth metatarsal, found, not *in situ*, at Lake Colongulac, represent humanly made incisions (1953:

58; 1963: 265), and that a stone pounder found over fifty years ago under uncontrolled circumstances in nearby Pejark Marsh, belongs to the same horizon as the extinct fauna.

Dates from fresh water shells, secondary carbonates and in some cases, bone are notoriously unreliable (Dyck, 1967), especially when they are single dates, and Polach and Golson (1966: 28) warn us that in Australia "where appropriate corrections have not been established, dates from shell must be held provisional and may be quite misleading". The discrepancies between dates obtained from carbonate and collagen for Green Gully skeletons; carbonate, carbonate-carbon, and carbon for Keilor cranium; and shell and carbon at Lake Menindee, are cases in point. Such general considerations apart, the dating discrepancies obtained for the Orroroo specimens and the Colongulac-Corangamite sequence do not inspire special confidence, and must be placed in abeyance pending further investigation. The same must be said for the Yalpara specimen until the date can be checked by some independent means.

At Lake Menindee, we probably have contemporaneity of extinct marsupials and human occupation, although as discussed above, this must be confirmed by re-excavation. The age of this deposit is indicated by the dates $26,000 \pm 1,500$ B.P. (L.J. 204) (and $18,800 \pm 800$ B.P. (GaK 335)). Tedford (1955: 302) and Tindale (1955: 289) suggest that at least some of the bones at the site, represent human food refuse. A charcoal sample collected by A. Gallus from the Arundel Terrace underlying the Keilor Terrace, near the cranium site, has recently been dated to $31,600 \pm 1,300$ B.P. (A.N.U. 65) (*A.I.A.S. Newsletter*, October, 1967: 25). This deposit contains the bones of extinct animals such as *Diprotodon* and *Thylacoleo* (Gill 1967: 30-1). A stone industry has been claimed from this deposit by Gallus (*A.I.A.S. Newsletter*, October 1967: 26) but its authenticity cannot yet be assessed (Gill 1967: 32). Cooper (1959: 57) found surface remains of *Diprotodon* with a hearth, but these lacked stratigraphic demonstration of contemporaneity.

Most Australian archaeological sites so far excavated, do not contain much faunal material, but those which do, such as Devon Downs and Fromm's landing (Mulvaney *et al.* 1964) for the last 5,000 years and the Rocky Cape caves (Jones, 1966) for the last 8,000 years, have yielded a modern fauna. Koonalda Cave deposit dated from 13,000 to about 20,000 years ago, on preliminary inspection, contains no giant forms (Wright, pers. comm.) and the same is true for the Keilor Terrace (Gill 1955a) dating back to at least 18,000 years ago.⁴

If we exclude the dates from Colongulac and Orroroo either as being unreliable or requiring confirmation, the most recent dates for giant marsupials are those from Menindee and Keilor in the time range 25,000 to 30,000 years ago. Where fauna is found in archaeological sites spanning the last 20,000 years it is modern.⁴ I suggest that the major extinctions of the Australian late Pleistocene fauna took place in

⁴ With the exception of Tasmanian Devil (*Sarcophilus*) and Thylacines from mainland sites see e.g. Mulvaney *et al.* 1964.

the period 20,000 to 30,000 years ago, rather than in late glacial-early Holocene times as has previously been postulated (e.g. Hubbs *et al.* 1962 : 211 ; Gill 1963). Twenty thousand years ago man was well established on this continent, and 30,000 years ago, he may have entered it.

The onset of post glacial arid conditions has been invoked in the literature to explain the sudden extinction. Wet conditions in the Pleistocene having favoured evolutionary trends towards gigantism, at the beginning of the " arid period ", the hapless animals were driven to the vicinity of dessicating lakes, where their bones have been found, and they rapidly became extinct (Browne 1945 ; Gentili 1961 ; for a less catastrophic view, see Gill 1963 ; Tedford 1966 : 304). This explanation is not satisfactory, for even if we were to grant a post glacial dry period, there would have been large refuge areas in eastern and south western Australia, as there were for other plants and animals. Having survived a series of previous dry periods, why should the extinct forms have succumbed so dramatically to the last ? There is no evidence that some of these animals were not tolerant to dry conditions. Gentili (1961 : 491) says that the fossil stomach contents of *Diprotodon* at Lake Callabonna showed a vegetation similar to today's saltbush-bluebush communities. The largest surviving marsupial, the red kangaroo (*Megaleia rufa*) thrives in the semi-arid plains of western N.S.W. Indeed, in view of the xerophytic nature of a large part of the Australian biota, it is unlikely that any group of animals, apart from rain forest forms, could have evolved and proliferated here without being to some extent drought tolerant. It is likely that the glacial-post glacial fluctuations in climate have been greatly exaggerated, and anyway, the extinctions may have been most dramatic some ten to fifteen thousand years before the end of the glacial period. The one added factor towards the end of the Pleistocene was the arrival of man.

There is a striking analogy from North America, where the Rancholabrean fauna which included camels, mammoths and giant ground sloths became extinct between 15,000 and 6,000 years ago, the bulk disappearing around 11,000 years ago (Flint 1957 : 468-71 ; Martin 1958 : 375-420 ; 1963 : 64 ff. ; 1966 : 339). Previous theories had attributed this to the onset of post glacial arid conditions, and in a circular argument, the extinction of the animals became the main evidence for a dry altithermal. Martin (1963) has shown that many of the animals were perfectly well adapted to dry conditions, and that " to believe that the entire Pleistocene megafauna of the South West (U.S.A.) could have been wiped out by drought is biologically naive " (p. 65). Pollen analysis showed that the altithermal there, from four to eight thousand years ago, far from being dry, was relatively wet, at least in summer. The Pleistocene fauna had survived all climatic changes until the arrival of man, they disappeared " not because they lost their food supply but because they became one " (Martin 1963 : 70). Large scale extinctions of fauna occurred in Africa in the middle to late Pleistocene, possibly associated with the Acheulean culture (Martin 1966 ; for a critical review, see Leakey 1966) ; and on the islands of Madagascar (Martin 1963 : 341) and New Zealand, the endemic faunas

were devastated within approximately the last thousand years. In New Zealand, the extinction of the large flightless birds, the *Moa*, together with a wide range of other avifauna, coincided with the arrival of man on the island. Early archaeological sites, particularly those on the South Island, dating from about 700 to 1,600 A.D., show the importance of the *Moa* in the diet and technology, and also to their rapid diminution in numbers and species under the human onslaught. (Cumberland 1962a: 120-3; 1962b; Golson 1959; Groube 1967). Hunting and firing brought about their demise, and not climatic change, nor the evolutionary disadvantage of their own bulk as had previously been thought.

Martin (1966: 342) does not see gigantism, typical of the Pleistocene faunas as unusual, rather the survival of the small animals might be "an artificial dwarfing by selective hunting of prehistoric man" (*op cit*: 342). This must surely be the case with the mammalian fauna of western Europe, where extinctions amongst the largest available animals have been going on into late historic times (Matheson 1932). Continents and islands to which man arrived from outside, show a much greater loss of fauna than those where he has been an ecological factor since before he made tools or lit fires. Flint suggests that in the latter areas "animals had gradually developed means of protection and defence, where as the sudden appearance of man (in the New World) found the indigenous large mammals uneducated in these ways" (1957). The dislocation of a few elements in a fauna can have far reaching effects, and the examples of the American bison and the Tasmanian *Thylacinus* (Guiler, 1961) in modern times, have shown how rapidly a population, once depressed below a certain level, can drop from large numbers to near extinction.

Several authors have seen man's role in the extinction of the Australian Pleistocene fauna as contributory (Browne 1945; Tindale 1955: 271; 1959: 44; Gill 1955d: 89; 1963; Flint 1957: 474; Mulvaney 1961; 1966; Tedford 1955: 304), saying that man "might have accelerated the process of extinction... but it seems unlikely that he played the major role". I suggest, by analogy with other continents and islands, and given the lack of alternative convincing reasons, that man's arrival was the decisive factor.

B. Fire

Aboriginal man's most effective tool for changing his environment was fire. Given the fire adapted nature of much of the Australian flora, it is likely that fire has been an ecological factor for millions of years, natural fires being kindled by various agencies (Cleland, 1957: 150; Gilbert 1950: 144). The advent of man increased this frequency by an enormous factor, a comment also made for North America by Martin (1958: 395). Even those advocating the role of man-made fires have shown a certain reluctance to see fire used deliberately by primitive man. Stewart (1957: 118) says that "hunting and gathering peoples... have *allowed* their fires to ignite the landscape, because it did not occur to them to protect the vegetation" [my italics], and Cumberland (1962: 124) imagines the first fires in

New Zealand escaping from camp hearths "through accident and inadvertence, if not by experiment or design". In Australia and Tasmania⁵, fire was used systematically and consciously, and the dry climate and the highly inflammable vegetation would have been especially conducive to the full deployment of the method.

From the first accounts, explorers have remarked on the frequency of fires in Tasmania. Tasman in 1642, observed that "now and then, (we) saw clouds of dense smoke rising up from the land" (Kenihan, 1964, ed.: 26). Peron recorded that as his ship moved up the D'Entrecasteaux Channel between Bruny Island and the Tasmanian coast, he saw that "in every direction, immense columns of flame and smoke arose, all the opposite sides of the mountains... were... burning... for the extent of several leagues". The following day in the Derwent Estuary, "wherever we turned our eyes, we beheld the forests on fire", and later near Mt. Wellington, saw "a new scene of conflagration... (the) country now appeared to be only a large desert, ravaged by fire... the other side of the mountain was still in flames"⁶ (Peron 1809). In his travels throughout Tasmania, Robinson records scores of observations of Aborigines burning, or of burnt-out country, for example on the north east coast, "This part of the country has been fresh burnt by the natives... All the country fifteen miles inland from the coast had been burnt" (July 17, 1831), and even up in the highlands on the central plateau near Lake Echo, "the whole of this country has been frequently burnt by the natives and was a fine hunting ground for them" (Nov. 10, 1831). Fire was carried by means of a fire-stick, and it appears that the bush was set alight as a matter of course as the Aborigines moved through it. Labillardiere (Feb. 14, 1792: 312) describes a group of people, one of whom "carried a piece of decayed wood in his hand, lighted at one end, and burning slowly... he... amused himself now and again by setting it to a tuft, where there were some very dry herbs", and Peron saw a similar occurrence with a man holding "a lighted firebrand in his hand, setting fire here and there to the bushes which covered the land" (Peron 1809: 186).

Fire was similarly used on the mainland (Tindale 1959: 42-3). In Arnhem Land and Cape York during the dry season from July to December, the Aborigines, leaving their wet season camps, broke up into small bands, and moved across the country, burning off the tall dry grass as they went. (Thompson 1939: 214; 1948-9). This is still done in Arnhem Land (B. Hiatt and N. Peterson, pers. comm.), and in August 1966, I saw from the air, smoke from fires extending over fronts of scores of miles, the result of burning by Aborigines from Cape Don and Melville Island. In a description identical to those of the French explorers 170 years ago, Gould (1967: 45-6) says of his recent work in the West Australian desert that, "while travelling from place to place, the natives usually carry fire-sticks of smouldering *mulga* bark, setting fire to the brush as they walk along... This behaviour is most common during the driest months, from about October through

⁵ And, I suspect for hunting and gathering peoples anywhere.

⁶ The disastrous fires of February, 1967, swept across the same area, burning out 1,000 sq. miles, (*Tasm. Tramp*, 1968: 3).

December, when clouds of smoke seem to hang over the country-side in every direction". I have not examined the mainland literature thoroughly, but preliminary inspection confirms that throughout the continent, from the east coast and the Murray Valley, through the tablelands and plains west of the Divide to the tropics and the deserts, that fire was universally used to alter, even if only temporarily, the vegetation over vast areas. A significant fraction of the continent and Tasmania would have been burnt once a year, and I would imagine that few regions would have escaped fire for more than a decade or two.

The effects of not burning were quickly recognized. Mrs. Meredith (1853: 83) pointed out the regeneration of dense scrub and the accumulation of dead wood and bark, which resulted from discontinuing the Aboriginal custom of regular burning. On the barely accessible south west coast of Tasmania, there is thick vegetation in areas described by Robinson as easy walking (W. F. Ellis pers. comm.), contrasting with the coast near West Point, which being burned regularly nowadays, looks the same as Robinson described it in 1830. The *Poa* grass plains of Surrey and Hampshire Hills, described by the explorer Hellyer as open grassy country, have been rapidly returning to forest in the past hundred years (W. D. Jackson, pers. comm.) On the mainland, good savannah woodland becomes forest within fifty years if fires are prevented (Jacobs 1957: 132).

Gilbert (1959: 143) and Jackson (1965) have shown that in high rainfall areas in Tasmania, there is a complex relationship between *Notofagus* dominated rainforest, *Eucalypt* forest and sedgeland. The dominant ecological factors are soil fertility, aspect and fire frequency, the last being the most important (Fig. 5). In places where the climax vegetation would be rainforest, a medium fire frequency produces a "wet sclerophyll" forest consisting of a mosaic of *Eucalypt* and rainforest forms, and a high fire frequency may reduce this to wet scrub or sedgeland. Constant fires may cause impoverishment of the soil due to leaching, and thus the process may not be completely reversible. Jackson argues that under fire pressure, the rainforest does not occupy anything like its full range, and that this disclimax was caused and maintained by the fire-sticks of the Aborigines. The rainforest is inhospitable to man, it is dank and dark and there are few edible animals in it (Guiler 1965: 37). On the other hand, a sedgeland—wet sclerophyll mosaic contains much food, both vegetable and animal, and being easily burnt, affords easy passage to the traveller willing to set it alight.

In Fig. 6, I have combined a map of the locations of stone artifacts with one showing the parts of Tasmania occupied by the Aborigines in the ethnographic present, compiled by Hiatt (1968: 192) from records of direct observations of Aborigines themselves, of their fires, and of their recent artifacts such as huts and baskets. (See also Bryden and Ellis 1965; Plomley 1966: 45; and map of archaeological sites, Jones 1966, 1967). The two distributions are identical, suggesting that the pattern of human occupation of the island had been established for some time. There was widespread occupation around the coast. The inland

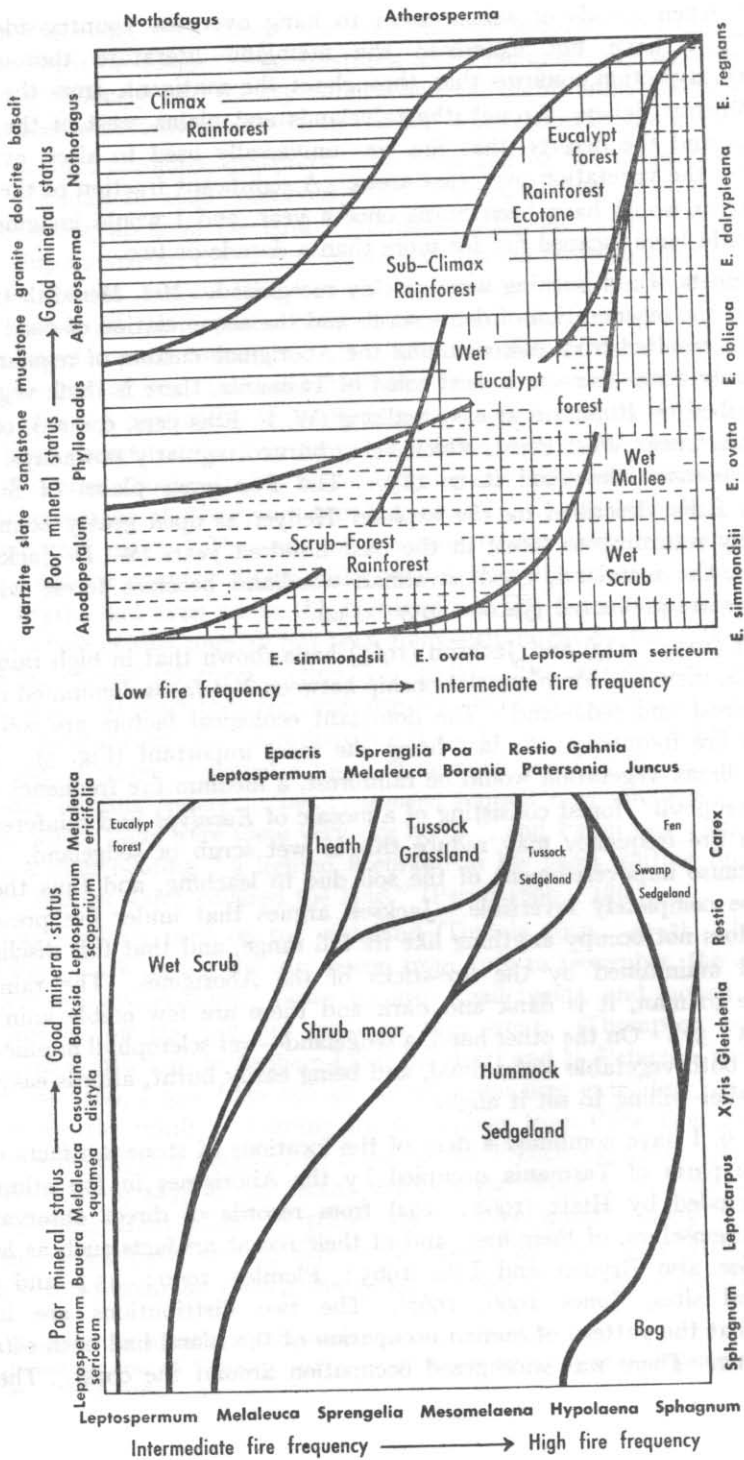


Figure 5.—Ecological relationships of (top) eucalyptus forest and the rain forest forms ; (bottom) scrub and sedgeland forms, as determined by soil fertility and fire frequency. (From Jackson 1965, Fig. 27, p. 33.)

areas of the eastern half of the island were also inhabited, contrasting sharply with the virtual absence of inland occupation in the west. A map of the vegetation (Davies 1964; Jackson 1965) shows that the blank areas on the human occupation map correspond with the distribution of rainforest. (see also Hiatt 1967: 122; 1968: 190-203).

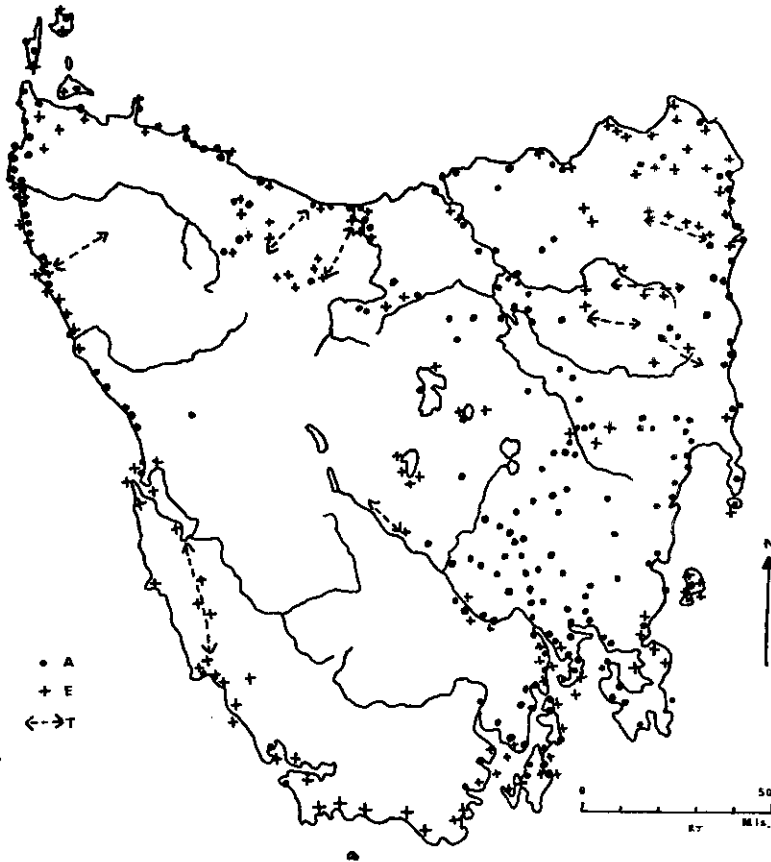


Figure 6.—Distribution of ethnographic and prehistoric man in Tasmania. (A) location of stone artifacts (Westlake coll., Pitt Rivers Mus., Oxford; Amos, Balfour, Bremer, Cooke and Dyer, Heywood, J. F. Jones, Legge, Salter, Whittle, Wilkinson, coll., Q. Vict. Mus., Launceston; and personal observations. See also Bryden and Ellis (1965), Plomley (1966: 45), and Jones (1966, 1967). (E) Direct ethnographic observations (after Hiatt 1968: 192). (T) Fire—maintained Aboriginal tracks, mostly through rainforest (ethnographic information after Hiatt 1968: 192).

Along the west coast, there is extensive sedgeland in an area where the climax vegetation would be rainforest, the maintenance of the sedgeland depending on constant firing. Although there is a great contrast in the environment between the east and west coasts, Hiatt (1967: 119-21) has found a surprising similarity in the ethnographically recorded diets from both areas. This could not be the case if the

sedgeland did not exist along the west coast, and it may be that through fire, the Aborigines had extended and maintained an environment suitable to their economy in an area normally closed to them. Faunal evidence from a midden at West Point (Jones 1966), suggests that sedgeland has surrounded the site for at least 2,000 years

In the eastern part of the island, especially in the Midland Valley, there were large open areas of *Poa* grassland (Ridpath 1964: 347) and open savannah prior to European colonization. Jackson says (1965: 30) that "there seems no doubt that this condition was again produced by a long history of firing by the Tasmanian natives". The maintenance of diverse habitats by selective burning may have been a conscious policy, for Robinson describing open country interspersed with wooded copses, says (April 3, 1829) that this was intended as cover for kangaroos, having "been done by the natives: when burning the underwood, they have beat out the fire in order to form these clumps". With the exception of small areas on the northwest coast and in the Huon Valley, where the forest was cut, the rest of Tasmania now occupied by white settlers had already been cleared by their predecessors, as a map of modern farms overlaid on one of stone implements shows. The sedgeland of the west coast, the "plains" in the rainforest at the headwaters of the north coast rivers and the open savannah and grassland of the midlands are all Aboriginal artifacts, striking examples of the power of hunting and gathering man to alter his environment to his own advantage.

C. Discussion

There are three ways in which hunting and gathering man might be expected to affect the climatological record. (Table 1). Through hunting, he has the same effect as other successful predators, altering the composition of a fauna and in some cases causing a wide range of extinctions. Increasing the fire frequency by a large factor, he produces widespread ecological changes in the vegetation, and hence the animals (e.g. see Ridpath 1964). Disclimax equilibria are maintained, and intensive firing may produce irreversible changes due to soil impoverishment.

Destruction of the vegetation cover through firing exposes the soil to potential erosion by water and wind, with consequent redeposition and dune formation (Butler 1967: 249-50). In south east Tasmania, Goede (1965: 146) and Davies (1967: 18-21) have found extensive post-glacial deposits in valley floors. These gravels contain much charcoal, and a stone scraper was found in one dating to about 4,000 years B.P. (Goede 1965: 146). Davies (1967: 20-1) suggests that these deposits may be the result of erosion following the burning activities of prehistoric man. In addition to the changes which human activities themselves initiate, they may also serve to amplify or to dampen the effects of natural agencies such as climatic change. This may have happened in Tasmania, with the effectiveness of the Aboriginal fire pressure greatly increased by a small oscillation towards a warmer or drier climate in mid Recent times (Davies 1967: 20), and the same pressure tending to dampen the botanical consequences of the return to the slightly cooler

or wetter contemporary climatic phase (Jackson, A.N.Z.A.A.S. conference, Hobart, 1965, Botanical abstracts, and pers. comm.).

In Australia, we should take a hard look at any widespread ecological change believed to have occurred in the period 20,000 to 30,000 years ago, and postulate a climatic change only when man's activity can be discounted. Jennings (1965: 153) has documented some quasi-natural consequences of human action, resulting from prehistoric and historic agricultural and industrial practices. We must not be dazzled by the power of our own technology to underestimate or ignore that of the most primitive one.

TABLE I
Examples of the impact of hunting and gathering man on the environment—(documented in the text)

Activity	Effect	Examples	Causes Previously Postulated
Hunting	Alter frequency of some animals	<i>Extinctions</i> North America—giant fauna New Zealand— <i>moa</i> Australia—giant marsupials? Madagascar—lemuroids Africa—giant fauna? Tasmania—Southern Elephant Seal ¹	Climatic change (dry) Climatic change (dry) Climatic change (dry) — Climatic change (dry) —
	Extinctions	Introduction of dog-dingo	Australian mainland— <i>Sarcophilus</i> and <i>Thylacinus</i>
Burning	A. <i>Direct</i> Changes in vegetation Disclimaxes maintained Destruction of some plants	North America—prairies New Zealand Tasmania—"plains" and sedgeland	Climatic change (dry) Climatic change (dry) —
	B. <i>Indirect</i> Destruction of vegetation cover, increased erosion Re-mobilization of dunes	New Zealand—valley fills and dune mobilization Tasmania—post glacial valley fills	Climatic change (dry) —

¹ Jones (1966: 7).

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Figure 5 was reproduced from W. D. Jackson's Fig. 27 in the *Atlas of Tasmania* (1965), by permission of the Editor and the Surveyor-General and Secretary for Lands, Tasmania.

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recorded from Australia—or even from the Southern Hemisphere. To find closely related genera we must look to North America, Europe, and Spitsbergen, and there, especially in Spitsbergen, the Lower and early Middle Devonian sediments have produced a wide variety of these small arctolepids. The Spitsbergen genera showing the closest resemblance to the Australian form are *Huginaspis*, *Heterogaspis*, and *Arctolepis*, which occur in the lower part of the Middle Devonian (Eifelian). It seems certain, therefore, that the lower part of the Mulga Downs Formation at least is of a similar age, and not from the late Upper Devonian as had originally been thought.

Findings of industrial importance

It follows that there was not a long time-interval between the deposition of the marine Amphitheatre Group (Lower Devonian) and the continental Mulga Downs Formation which followed. Although at first sight such findings may appear to be of minor importance and of interest to a few specialists, this is not the case. Companies seeking natural resources such as oil, natural gas, or mineral deposits require accurate data on the rocks which they are prospecting, and fossils provide such data. Thus it happens that a piece of pure scientific research by Scandinavian palaeontologists in the 1920's on small Devonian fish from Spitsbergen has enabled us, in the 1960's, to accurately date for the first time a very large area of sedimentary deposits in western N.S.W.

Studies on vertebrate and other fossils also provide evidence to support the now widely-accepted theory that the earth's continental masses were once closely associated and that they have drifted to their present positions over a considerable span of geological time. If the southern continents were reassembled as they must have been over 200 million years ago we find that southeast Australia and Victoria Land in Antarctica may have been in close proximity. There is an exciting possibility that the study of vertebrate fossils may help to confirm this in the near future. Devonian fish remains were first collected from Victoria Land in 1911–12 and additional material was recovered by New Zealand members of the Trans-Antarctic Expedition in 1955–58. During the 1968–69 summer season New Zealand field parties returned to the area and

succeeded in locating rich deposits of fish remains in situ. Although they had to sledge in and out of the area, they managed to bring back about 500 pounds of fossil material; however, several fine specimens had to be left behind for future parties to extract, through lack of suitable equipment. This material of Devonian vertebrates, recovered at considerable expense and effort, is to be prepared and studied in the Australian Museum, and since it represents by far the richest concentration of vertebrate remains ever discovered in Antarctica the findings will be of vital significance to workers in many fields all over the world, and may lead to accurate correlation between Australian and Antarctic successions.

[The map and diagrams in this article are by the author; the photo is by C. V. Turner.]

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BOOK REVIEW

KU-RING-GAI CHASE NATIONAL PARK, by Douglass Baglin and Barbara Mullins. Horwitz Publications Inc. Pty Ltd, North Sydney. Price \$1.

This excellent booklet serves as a fine introduction to the beauty and natural history of not only Ku-Ring-Gai Chase National Park, but also of the Hawkesbury sandstone country north and south of Sydney. It will serve as a guide to the uninitiated, and is a good choice for introducing the "Australian bush" to friends and relatives overseas. The balance between word and picture is good and the text is sufficiently informative not to insult the reader's intelligence. The photography and printing generally are of high quality—though a couple of the mammal shots look a bit posed. I am particularly impressed by the effectiveness with which natural history subjects have been blended with human activities to provide a graphic picture of this unique park.—H. F. Recher.

FIRE-STICK FARMING

By RHYS JONES

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IN recent years there has been increasing interest in the effect of man on the Australian environment. Forests have been bulldozed, swamps drained, heaths sown with trace elements, beaches chewed up, and the litter of the mid-twentieth century spread everywhere. That this is deeply affecting the countryside is obvious to all and causes concern to some. G. P. Marsh saw the same thing happening to the face of America during the last century, and doubtless the Roman intelligentsia of the rich provinces of North Africa gave the matter some thought as the wheatfields around their villas turned slowly into desert.

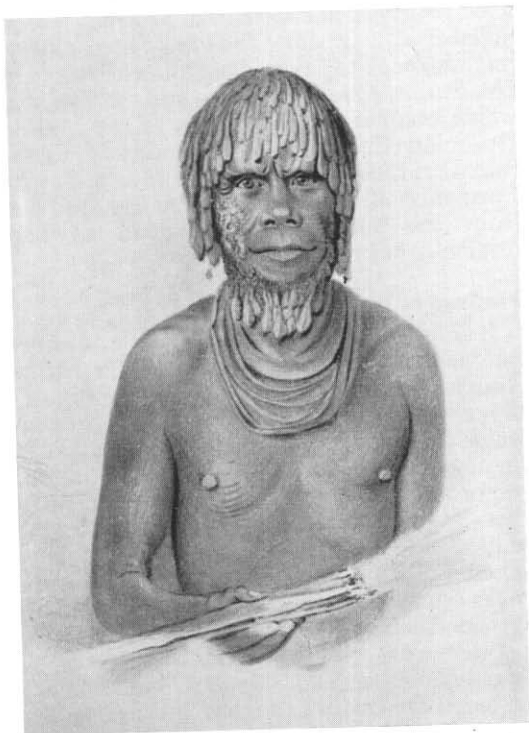
In most discussions a contrast is made between a "natural" environment as opposed to an "artificial" one. We imply that the former represents the climax without the effects of man, and as examples of it we think of bushland around our cities, the national parks, and remote areas. We imagine that the country seen by the first colonists before they ringbarked their first tree was "natural". But was it?

Antiquity of man in Australia

The white man has been on this continent for 200 years in some places and less so in most others. Before he arrived, the continent had been colonized, exploited, and moulded by other men—the Australian Aborigines and their ancestors for tens of thousands of years.

Australian archaeology, in a decade's exciting research, has produced sequences of man's activities back into the Pleistocene in many places. The accompanying map summarizes our present knowledge of man's antiquity in various parts of the continent; it can be seen that by 20,000 to 30,000 years ago he had colonized and extended his range throughout the inland plains of Australia and by 20,000 years ago had reached the southeastern coast.

For a long time there has been a tendency to regard the Aborigines, like most other hunters and gatherers the world over, as

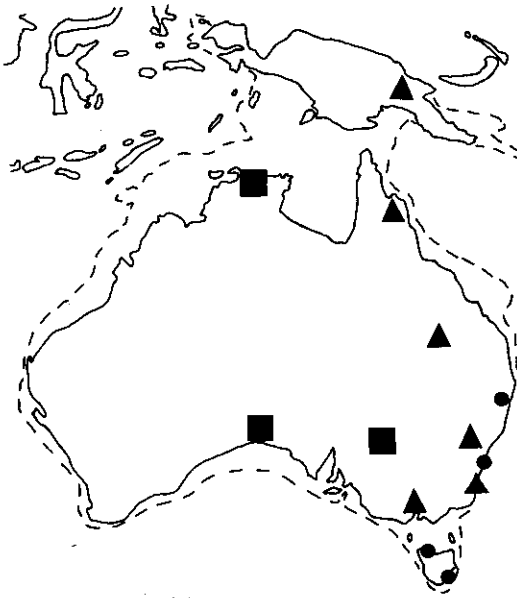


Mannalargenna, an Aborigine from the east coast of Tasmania, holding a burning fire-stick. [Watercolour painting by T. Bock, in the National Library, Canberra.]

passive slaves of the environment, in contrast to the impact of agricultural or industrial man, who is seen as the master of nature, the initiator of ecological change. In recent years, however, the ecological effects of Aboriginal technology have been re-investigated, and work by anthropologists on the living culture and by biologists on the environment suggests that these were enormous. They are still shaping our lives, even in areas where the Aborigines have not roamed free for 100 years.

Fire and the Aborigines

Aboriginal man's ecological impact was mostly due to hunting, gathering of plants, and fire. By far the greatest effects were caused by the use of fire.



Summary of the present knowledge of man's antiquity in Australasia: squares indicate carbon dates between 21,000 and 30,000 years ago, triangles between 11,000 and 20,000 years ago, and circles between 5,000 and 10,000 years ago. The broken line represents the 100-fathom line which would have been the approximate coastline more than 10,000 years ago. [Map by the author.]

A study of Australian ethnographic literature will show that bushfires were systematically and universally lit by the Aborigines all over the continent. Explorers from Tasman onwards, seeing Australia from the sea, reported that the coastlines were dotted with fires. Peron, in 1802, sailing up the Derwent in southeast Tasmania, said that "wherever we turned our eyes, we beheld the forests on fire". When men explored inland, the entire horizon was often filled with smoke haze from Aboriginal fires, and anthropologists have reported regular seasonal firings over hundreds of thousands of square miles in central and tropical Australia.

Tasmania

In Tasmania it was customary for the Aborigines to carry their smouldering fire-sticks with them, and they set fire to the bush as they walked along. G. A. Robinson, who lived with them for the best part of 5 years, has hundreds of descriptions of their setting fire to the bush, of distant Aboriginal fires, and of large areas of countryside freshly burnt by them.

The ecological effects of these burnings have been studied by Tasmanian botanists, who can only account for the distribution of modern vegetation zones in Tasmania in terms of a long history of intensive Aboriginal fire pressure. Many factors are involved in the distribution, such as soil type and aspect and climatic change, but a long history of firing has reduced the *Notofagus*-dominated rainforest in many places through a mixed eucalypt/rainforest phase to scrub and, eventually, to sedgeland and heath. W. D. Jackson sees the coastal sedgeland of western Tasmania as having been largely formed and extended as a result of constant firing, and as such it is a human artefact.

In eastern Tasmania, firing produced and maintained the open savannah woodland or parkland which greeted the first colonists, with their flocks of sheep. Here and there are extensive, open, treeless areas or "plains" covered with *Poa* grassland. These plains have been formed by repeated firing, and once there was a dense mat of grass on the surface it would have been kept clear not only by man but also by the grazing of macropods, native hens, and other animals.

Eastern New South Wales

The savannah woodland, merging into open plains, characteristic of central and western New South Wales, is similar in many ways to that of eastern Tasmania and, again, has been heavily modified by Aboriginal burning. In 1848 Major Thomas Mitchell, the explorer, said with brilliant insight of these park woodlands:

"Fire, grass, kangaroos, and human inhabitants seem all dependant on each other for existence in Australia . . . Fire is necessary to burn the grass and form those open forests, in which we find the large forest kangaroo; the native applies that fire to the grass at certain seasons, in order that a young green crop may subsequently spring up and so attract and enable him to kill or take the kangaroo with nets. In summer, the burning of the long grass also discloses vermin, birds' nests, etc., on which the females and the children who chiefly burn the grass, feed. But for this simple process, the Australian woods had probably contained as thick a jungle as those of New Zealand or America instead of open forests."

Arnhem Land

Arnhem Land, like other areas of tropical Australia, has a marked seasonal climate with a wet and a dry season. The Aborigines organized their life according to this pattern, and the firing of the bush during the dry

season was a decisive part of their economy. In 1853, a visitor to the short-lived British settlement of Port Essington commented: "About the middle of the dry season, the natives set fire to the grass which is abundant everywhere, and at that time quite dry . . . The conflagration spreads until the whole country as far as the eye can reach, is in a grand and brilliant illumination". The Aborigines still do this, and the role of firing in their total economy has been extensively studied. The fires spread rapidly through the tall dry grass to the bases of the trees, and their ecological effects are maintenance of the open parkland appearance and inhibition of the spread and abundance of non fire-resistant plants.

N.B. Tindale accounts for the presence of patches of eucalypt and open plains in the Cape York rainforest as, again, being due to Aboriginal firing.

Why did Aborigines burn the bush?

We can try to answer this question at several levels of sophistication:

- *For fun*: Anthropological friends of mine have asked Aborigines why they were tossing lighted matches into the bush from the back of land-rovers in which they were travelling. The answers have ranged from "it's fun" to "it's custom".

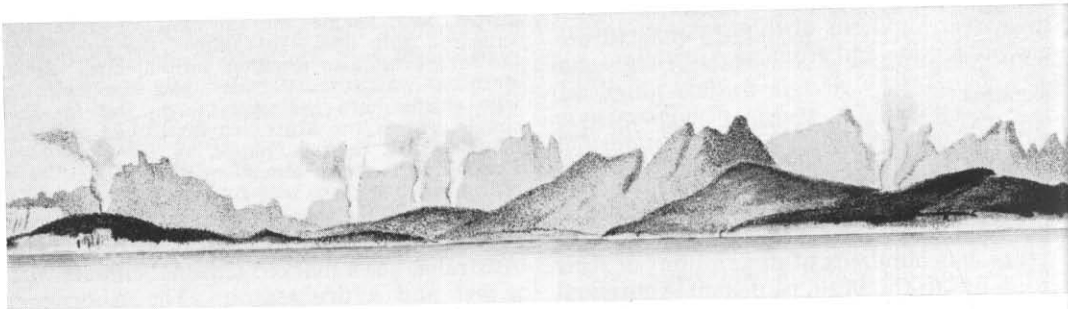
- *Signalling*: In the deserts, fires were used for signalling purposes either between bands or within them, so that the foraging people could know each other's whereabouts. In Tasmania, Aborigines tracked each other for peaceful or warlike purposes by fire spotting, and Robinson records women, abducted by sealers onto offshore islands, signalling to their kinsmen on the mainland by lighting great fires.

- *To clear the ground*: Both in western Tasmanian tea-tree scrub and in Arnhem Land grassland, the best way to clear a path is to set fire to the bush. This removes the undergrowth for easier travelling and also kills snakes and other vermin.

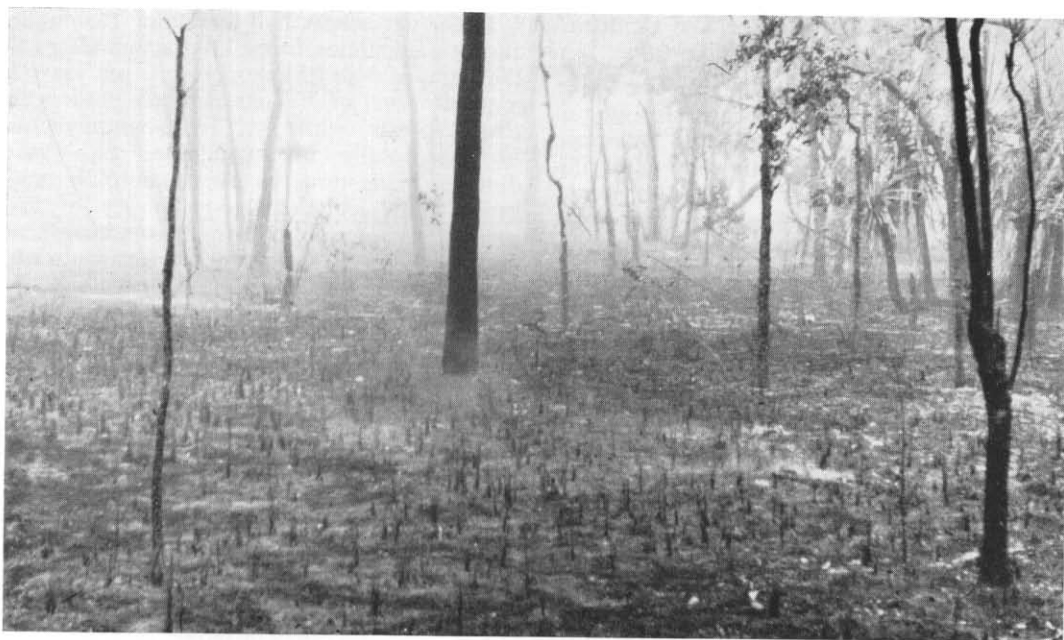
- *Hunting*: In many parts of Australia, a recognized method of hunting was to set fire to the bush and club or spear the animals which broke cover. Foraging over the burnt area also revealed animals such as lizards hiding in holes or burnt to death on the ground.

- *Regeneration of plant food*: After firing, the Australian bush shows remarkable powers of regeneration. Eucalypts throw out new leaves, and grasses grow afresh from the burnt ground. Many of the vegetable foods eaten by the Aborigines are more palatable when young—for example, ferns, bracken, grasses, leaves and shoots of trees. By promoting the regrowth of grasses and young trees, man also provides a food supply for grazing and browsing animals. Aborigines will return to a burnt area after rain in order to hunt the game drawn there by the young plants. This promotion of regrowth through firing is exactly the same process as that practised by modern farmers burning off the stubble in a wheatfield, or by Welsh hill shepherds burning off the mountainside each winter to kill the old bracken. In all cases, whatever the long-term effects may be, the immediate result of burning is to increase the quantity of edible plants for man and his beasts.

- *Extending man's habitat*: It is a thesis of mine that, through firing over thousands of years, Aboriginal man has managed to extend his natural habitat zone. In Tasmania, the climax vegetation along the western coast would be rainforest, which,



The east coast of Tasmania in 1802, showing smoke from Aborigines' bushfires. [Engraving after C. A. Lesueur, from the Nan Kivell Collection, National Library of Australia, Canberra.]



The bush immediately after an Aboriginal fire, northeastern Arnhem Land, 1967. Note the burnt grass, leaving a savannah, park-like distribution of trees. [Photo: Nicholas Peterson.]

according to distribution studies of the Aborigines, was not readily usable by them and was seldom penetrated. By burning, however, aided possibly by post-glacial climatic oscillations, man was able to push back this forest and replace it by sedgeland which is rich in both animal and plant food. In eastern Tasmania, human firing increased the extent of the mosaic pattern of open sclerophyll forest and grassland plains. This is the optimum habitat for some of the macropods, such as the Forester Kangaroo, and the plains provided extra food for the kangaroos, wallabies, emus, and native hens on which the Aborigines fed. Mitchell, in the passage quoted above, clearly understood the symbiotic nature of man, grassland, and kangaroos.

Increased food supply

It is interesting that, through firing, man may have increased his food supply and thus probably his population. At the most general level, firing of the bush, in the same way as clearing a forest to create a field, increased the proportion of solar energy per unit area of the ground that man could utilize.

Perhaps we should call what the Aborigines did "fire-stick farming".

Was this deliberate? In some cases, yes; in others, no. Robinson records that a park-like landscape in Tasmania had been formed so as to give cover for the kangaroos. "This has been done by the natives: when burning the underwood, they have beat out the fire in order to form these clumps", he writes. R. Gould reports that Aborigines in the desert are quite clear that burning will attract kangaroos once rain has fallen.

On the other hand some of the effects take thousands of years to become recognizable, and no primitive people could possibly document these processes. However, it is in some ways as irrelevant to me whether or not the ancient Aborigines knew what they were doing as it is to the palaeontologists whether or not the giraffe knew why his neck was growing. If we are interested in the operations of laws of nature, we have to analyse the effects of certain actions or physical changes and see whether they are advantageous or deleterious to the animal or culture involved. Taking a Darwinian line, according to the "principle of the survival of the fittest economy", to "explain"

the acceptance and development of a cultural trait we have to show its adaptive value.

Firing, because of its great adaptive value to hunters and gatherers, became an integral part of the economy, and its presence throughout most of the hunting and gathering and agricultural economies of the world implies that it has a high antiquity and great importance in human evolution. Fire was man's first "extra-corporeal muscle". Let us not forget that the power released by the disastrous Hobart bushfire on 7th February, 1967, was equivalent to two atom bombs.

Results of the removal of Aboriginal fire pressure

Although fire has been an important factor in Australia for millions of years, natural fires being lit by lightning, etc., the arrival of Aboriginal man increased the fire frequency by an enormous amount. This produced and maintained disequilibria, with the artificial extension of the range of pyrophytic plants. With the arrival of the Europeans, the Aborigines and their fire-sticks were promptly removed, and the effects of the cessation of regular burning were quickly noticed. Settlers in eastern Tasmania in the 1850's commented that open sclerophyll forest became littered with bark and young shoots, with the grass becoming sour and weak. On the open plains of Surrey Hills in highland north Tasmania, the shepherds were increasingly frustrated by the growth of scrub, which, by 1890, had obliterated most of the open land. The rainforest in Tasmania has spread from its gullies, and large areas of southwestern sedgeland have become covered with high, dense scrub.

In New South Wales, foresters have remarked that the maintenance of eucalypts on many high-quality sites depends on fire; otherwise, it would be replaced by other more tolerant genera. The resurgence of the cypress pine (*Callitris*) in western New South Wales may depend on the reduction of fire frequency. Some animals may have become adapted to a high fire regime and are more rare when this is reduced. It is interesting that Leadbeater's Possum, once thought to be almost extinct in Victoria, increased its numbers after several large fires had provided it with its preferred habitat.

In the dry sclerophyll forests of Tasmania, Jackson calculates, forest litter accumulates at the rate of 3 to 25 cwt per acre per year to a steady level of 30 tons per acre. Fires in these forests with full fuel complements become totally uncontrollable, with vast damage being done to plants, animals, and man. It is ironical that a policy of fire prevention may have brought our bush and forests up to their present dangerous state, and the series of catastrophic fires in recent years may be the result of discontinuing the Aboriginal custom of regular burning. I have been interested in recent weeks to read that a policy of burning-off may be initiated as a new method of forest conservation.

Fire and conservation

I am no botanist and would not venture a discussion on the long-term effects on plants and soil of firing or non-firing. However, as an anthropologist, I can state that at the time of ethnographic contact with the Aborigines, and probably for tens of thousands of years before, fires were systematically lit by Aborigines and were an integral part of their economy.

What do we want to conserve? We have a choice. Do we want to conserve the environment as it was in 1788, or do we yearn for an environment without man, as it might have been 30,000 or more years ago?

If the former, then we must do what the Aborigines did and burn at regular intervals under controlled conditions. The days of "fire-stick farming" may not yet be over.

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Tasmanian Aborigines and Dogs

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The possession of domestic animals is regarded as one of the crucial achievements in the history of man. Usually allied with parallel experiments towards increasing the yield of certain edible plants, the two processes resulted in an increase in man's control over his food resources with consequent radical changes in his population level and culture. Once this had been achieved as it was, probably independently, by several groups of people about the end of or just after the last glacial period, a dividing line or 'frontier' existed between them and their hunting and gathering neighbours. The nature of this frontier must have varied enormously at various times and places, ranging from a gradual gradient hundreds of miles wide to a line as narrow as a man can throw a spear across. In dynamic terms it was in a state of flux, the possessors of domesticated animals and plants steadily asserting the success of their economic system.

The last major expansion of agriculturalists and their technology took place during the past 500 years, when European explorers and settlers penetrated into vast areas of the Americas, northern Asia, southern Africa and Australia, previously the undisputed domain of hunters and gatherers. An analysis of the salient features of these contacts should serve as a model in our understanding of similar processes which must have occurred countless times in the past 10,000 years, and of which we have only a palimpsest in the archaeological record. In most cases, the cultures met in fatal confrontation, neither borrowing from each other, until the remnants of the hunters, their culture and population smashed, slipped into the slums of the triumphant farmers.

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Within the world ethnographic literature, however, we do have a few fascinating case studies of hunting and gathering societies adopting domestic animals from their new neighbours, and in so doing, radically altering their economy and sometimes even the structure of their society.

The horse was introduced into the Americas by the Spaniards and others in the sixteenth century, and several American Indian hunting and semi-horticultural societies saw the potentialities of the animal and proceeded to adopt it. The most celebrated examples were the Plains Indians of North America and Pampas Indians of Patagonia, who used horses in remarkably similar ways. Amongst other advantages, horses gave them the necessary mobility to take to the open plains and become full-time hunters of the large herbivores there, particularly the bison in the north and the guanaco in the south (Roe, 1955; Steward and Faron, 1959). The implications of these events both to an understanding of the Indian cultures themselves and to general theories of culture change have been studied in detail by the Americanists (e.g. Ewers, 1955).

In central Australia, large feral populations of donkeys and camels became established from about 1870 onwards, following the escape or release from European baggage trains (McKnight, 1969). Aborigines caught and tamed some of these animals for use as beasts of burden (Meggitt, 1965:9), and this is still occasionally done by the Pitjantjara and their neighbours, as can be seen in Sandall and Peterson's recent film (1969). The rabbit arrived in plague proportions in central Australia about the turn of the century, largely replacing their marsupial ecological equivalents the bandicoots and small macropods. In response to this, the Aborigines rapidly adapted their diet and hunting technology so that rabbit is now one of their meat staples (Cleland, 1966:142).

Hunters and dogs

However, a simple picture of hunters being without domestic animals is not strictly true, for there is one animal—the dog—whose association with man has had a totally different history to that of any other animal. Not only did hunters have dogs as pets, companions, or colleagues in the chase, but searching through the world ethnographic literature, it is hard to find examples of hunting and gathering societies which did not have them. This almost ubiquitous association of hunting man and dog is all the more remarkable when one considers the cultural complexities, the enormous range of geographical locations involved and an ecological spectrum encompassing most of the terrestrial natural habitats of the world. It is sufficient to give the following examples of hunting societies which own dogs to illustrate the point—in the Americas, from the Tierra del Fuegos to the Eskimos; in Australia, all Aboriginal groups and also the semi-hunting cultures of New Guinea; in Africa, the Bushmen; and in Eurasia, from the Siberian hunters of the north to the Chenchu and Veddas of the Indian tropics (e.g. see Kroeber, 1942; Lawrence, 1967; Meggitt, 1965; Bulmer, 1968:307, 315; Lee, 1965; Levin and Potapov, 1964:519, 609; Zeuner, 1963:91; Allchin, 1966:128). There are a few exceptions, for example some of the Indians of the tropical forests of South America (Steward and Faron, 1959:430), and those of the San Francisco Bay region. However, Kroeber (1942:7) says of the latter that they were by no means ignorant of dogs, occasionally obtaining a few from neighbouring tribes, and he speculates that they may have lost the habit of keeping dogs, sporadically re-importing a few 'as something curious and interesting'. Similar kinds of situations may also have been the case with other dogless societies, but I have not researched into the question.

From the ethnographic situation, two points emerge. Firstly there must have been powerful ecological and psychological forces at work binding together hunters and dogs, or at a more general level, man with dog. Secondly on culture historical grounds, given the extremely wide geographical distribution of the association, it must have had a high antiquity.

Antiquity of the domestic dog

In European archaeology it has long been considered that the dog was the first animal domesticated by man. In recent years critical analyses have pointed out the difficulties of defining unambiguous anatomical criteria by which to identify domestic dogs from their wild ancestors, the close similarity between the bones of wolves and early domestic dogs being a case in point (Degerbol, 1962; Clutton-Brock, 1969). Discoveries in the Levant point to the likely domestication of sheep/goat at least 11,000 years ago, as old as, if not older than, the earliest domestic dogs of Western Europe (Herre, 1969:265). Dogs had probably been domesticated in Europe 10,000 years ago and were common as domestic animals about 7,000 years ago. However, there is growing evidence that we must look outside Western Eurasia for older material.

In Jaguar Cave, Idaho, U.S.A., carbon dates of $10,370 \pm BP$ and $11,580 \pm BP$ were obtained from levels containing bones of a relatively short-snouted dog, which Lawrence (1967) identifies as a domestic dog, certainly not a coyote, and she thinks that the antiquity of the dog in America is higher than this. E. W. Haury found remains of a small dog in his excavations at Ventana Cave, Arizona, in levels dated to about 11,500 years BP (A-203) (see Colton, 1970:153). If dogs crossed the Bering Straits with their masters, early immigrants into America, they came from a region which makes such a supposition feasible. From Late Pleistocene deposits in limestone caves in Japan, Shikame and Okafuji (1958: 67, 71, 88-9) identified dog bones (*Canis* sp. aff. *familiaris*), and comment that they cannot find any different characteristics of these specimens from that of the recent dog (89). Lawrence (1967) thinks that these are bones of a domesticated dog. Further evidence in Japan for the domestic dog of the same order of antiquity may come from the occupied rock-shelter of Kamikuroiwa (Ikawa, 1964; Mulvaney, D. J., personal communication).

If these Japanese and American finds are confirmed, then they may be among the oldest evidence for domestic animals in the world. This causes us less astonishment than it may have done only a few years ago,

for with among the world's oldest evidence for pottery in Japan (Ikawa, 1964; Golson, in press), for domestic plants in Thailand (Gorman, 1969) and for ground-edge axes in Australia and New Guinea (White, C. 1967; White, J. P., personal communication; Golson, in press) the southeast Asian and neighbouring regions may prove to have been one of the decisive areas in the history of the 'Neolithic Revolution'.

In Australia, the dingo (*Canis familiaris*) (Macintosh, 1956; Ride, 1970:183-6) must somehow have managed to cross the water barriers of Wallacea in order to reach the island continent, and most commentators think that this was achieved through the agency of man (e.g. Tindale, 1959:44-5). It is certainly significant that man and the dog were the only large terrestrial placental mammals to have managed this feat in prehistoric times, and it implies that the dingo or its presumably Asian ancestor must have been domesticated for this to have happened. Thus the Australian evidence has significant bearing on the history of the domesticated dog in the south Asian region. This is enhanced by the influential opinion that the most likely ancestor for some of the first domestic dogs was the Indian wolf, which is closely related to the dingo and to the south Asiatic pariah; the dingo probably retaining most of the characteristics of the early domesticate (Zeuner, 1963:107-8; Clutton-Brock, 1969:307-8).

Prehistoric dingo bones were found at Fromms' Landing, Lower Murray Valley, dated to between $3,170 \pm 94$ BP and $2,950 \pm 91$ BP (Mulvaney, 1969:65, 181, Plate 19); and Macintosh (1964:507) could find no anatomical difference between these and modern dingoes. Recently in a cave at Mt Burr in South Australia, Campbell and Edwards found dingo bones in basal levels dated to between $7,450 \pm 270$ BP and $8,600 \pm 300$ BP (see Mulvaney, 1969:179).

Although dingoes were found throughout the continent at the time of European contact they were not present on Tasmania, the Bass Strait Islands nor Kangaroo Island, and they have never been found in fossil deposits there either. Tasmania and the Bass Strait Islands were separated from the mainland of Australia by the post-glacial rise of the sea about 12,000 years ago (Jones,

1968:198), and Kangaroo Island probably a short time after, thus isolating the island faunas from further invasions. It is significant that the marsupial carnivores equivalent to the dog, namely the thylacine and the Tasmanian Devil (*Sarcophilus*) were once widespread throughout Australia, surviving in places until Mid Recent or even later times but eventually becoming extinct on the mainland. These animals still survive in Tasmania, the *Sarcophilus* being common, and it is likely that it was competition with the dingo that accelerated or even caused the local extinction of these animals on the mainland. Claims for dog teeth in Pleistocene deposits have not been confirmed. It seems highly likely that the dingo first appeared in Australia after about 12,000 years ago, and in view of the Mt Burr evidence some time before 7,000 years ago.

To review the antiquity of the domestic dog, it seems likely that by about 8,000 years ago they had been fully domesticated and had travelled widely with their masters in a wide swathe encompassing North America, Asia, Australia, the Levant and Europe. Some dogs had been domesticated by about 10,000 years ago, and given that research has only just begun in Asia, this is by no means the last word. Behind this we must consider an enormously long period when man and dog were slowly formulating their relationship; and the situation which existed between the Australian Aborigines and the dingo, what Meggitt (1965:23) calls 'quasi-domestication' is how I imagine the early relationship to have been. From the ethnographic and archaeological evidence, I feel that a good case can be made out for dog being man's first domestic animal, being domesticated by hunters, and that this process has its roots deep in the Pleistocene anything from 10,000 to 30,000 years ago, though on osteological evidence alone it will be hard to document the early stages.

Dogs in Tasmania

For the biogeographical reasons outlined above, prior to the arrival of the Europeans at the end of the eighteenth century there had been no dogs in Tasmania. Thus not only did the Tasmanian Aborigines not use

dogs, they did not even know of their existence. In this total ignorance of the animal they were probably unique amongst the ethnographically known peoples of the world. Yet within a few years of seeing their first dogs, the Tasmanians had recognized the potentiality of the animal, formed close bonds with it, and had incorporated it fully within their culture. This fact and some of its implications have been noted before (West, 1852, 2:21; Ling Roth, 1899:111; Plomley, 1966:16; Taylor, 1967:72; Mulvaney, 1969:133). The present paper stems from an initial statement in a seminar paper given at Canberra in October 1968 where I attempted to look at these events within the context of the 'Neolithic Revolution' in Tasmania.

The publication of the field journals of G. A. Robinson, 1829-35 (edited by N. J. B. Plomley, 1966)¹ has vastly augmented our knowledge of the Tasmanians particularly from within the culture contact period, and they allow us to reopen inquiry on all aspects of Tasmanian culture which for so long was thought to have been a closed book (see Tylor, 1890).

Scattered throughout the journals there is a great deal of information on the relations between the Tasmanians and their dogs, and this paper is largely based on Robinson's work. Many of the observations are on Aborigines accompanying Robinson, and care must be taken to take full account of the effect that Robinson himself may have had on Aboriginal behaviour. However, we must remember that altogether Robinson spent the best part of five years with the Aborigines in the bush so they had ample time to get used to each other's companionship. There are also many observations on natives seen 'wild' in the bush and these can be checked against the behaviour of the Aborigines accompanying him. Altogether, the data add up to a consistent and surprisingly detailed picture. If a future critic complains that the Aboriginal society that Robinson was seeing was in a state of flux,

then let him remember that the acquisition of dogs itself was a product of culture contact and an agent of radical change.

The first dogs ever to set paw on Tasmania were probably those belonging to Bass in 1798 (West, 1852, 2:4), though some of the earlier expeditions might have had dogs aboard, as did Cook's first Pacific voyage. The sealers who poured into the Bass Strait as soon as its large population of seals had been reported, had dogs with them. Péron obtained one trained for hunting kangaroos probably from King Island sealers in 1802 (see Frith and Calaby, 1969:9). Several of the small Bass Strait islands soon had large semi-wild dog populations on them (e.g. Robinson, 12.11.1830:272). If, as seems likely, the Tasmanian Aborigines had their first contact with dogs from these sources between 1798 and 1804, there is unfortunately no record of it.

British settlement of Tasmania was established in 1803-4 at Risdon Cove and Hobart in the south, and at Port Dalrymple on the mouth of the Tamar in the north. Rations soon became scarce until a crisis situation was reached so that Knopwood wrote on 23 October 1805 that 'We had only 3 weeks flour in the colony and 5 weeks pork' (1947:81). Things were so bad in the north that Captain Laycock led the first European overland crossing of Tasmania in February 1807 to try to get supplies from Hobart, but to no avail. In order to alleviate the situation, hunting parties composed of convicts and dogs were sent out into the surrounding bush to catch kangaroo and emu, the meat being received into the central store at the rate of a shilling a pound, and in February 1807 at three shillings and sixpence a pound (Knopwood, 1947:73; 1948:74). This was an enormously high price, being more than we pay for kangaroo meat nowadays in spite of the inflation of the past 170 years, and it underlined the gravity of the situation. Some of the local gentry lucky enough to possess dogs and assigned men, soon cashed in on this opportunity. Knopwood records that in the fifteen months between the end of August 1804 and the end of November 1805, his men had killed over 220 kangaroos and 25 emus (1948:124-5). Many of the kangaroos are recorded as having been foresters (*Macropus gigan-*

¹ References to Robinson are given both under the date of the journal entry and to the pagination in Plomley's edition. Reference to Plomley's own comments and work as opposed to transcribing Robinson's text, are made directly to Plomley, 1966.

teus), an identification borne out by the gutted carcass weights of some, ranging up to 120 pounds, but it is likely that red-necked wallabies (*Macropus rufrogriseus*) were also hunted. To carry out this task only one or two dogs were used, accompanied by two or three men who stayed out anything from a few days to a week at a time. In response to this lucrative enterprise, the price of hunting dogs was high, Knopwood buying one in 1807 for £25 (1948:70), more than the annual income of many people in those days. Judging from the few brief descriptions and from early drawings and engravings of hunting scenes (e.g. Smith, 1960:Plate 119), the dogs were large, looking rather like well-built greyhounds, and they were trained to flush and follow game,

cornering them for the kill, either by the dog itself or by the sportsman.

I am sure that further research could identify both the training methods and breeds of these 'kangaroo dogs' as they were called, and they were probably similar to the deer hound and other sporting dogs used by the British gentry for hunting large game.

This invasion of their territories was soon noticed and resented by the Aborigines. They began to attack the hunting parties, driving them off and seizing the game that they had caught (Knopwood, 1947:119; 1948:74). In June 1806, at Pitt Water, a man was speared and wounded by the natives, who also killed two dogs and wounded one, and took away three kangaroo carcasses (Knopwood, 1947:103). Other

TABLE I
TASMANIAN ABORIGINAL GROUPS AND THEIR DOGS

'Tribe' or area	Reference no. on map	Date	Number of people	Number of dogs	Ratio of people/dogs	Reference
TASMANIA		1800		0		
<i>A. EAST</i>						
Eddystone Point	1	1816	200(?)	50	4:1	Kelly (in Bowden, 1964:176)
Port Sorell	2	1830	8+	20	1:2.5	Robinson, 20.9.30:214-16
Near Eddystone Pt	3	1830	7	30	1:4	Robinson {1.11.30:261 2.11.30:264
Gun Carriage Is.— Aboriginal women with sealers	4	1830	4	50	1:12	Robinson, 12.11.30:271-2
Near Cape Portland	5	1830	6	7	1:1	Robinson, 15.11.30:274
Pipers River	6	1831	7	14	1:2	Robinson, 29.8.31:415
Remnants of Big River and Oyster Bay 'Tribes' near Great Lake	7	1831	26	100	1:4	Robinson, 31.12.31:570
<i>B. WEST COAST</i>						
Port Davey 'Tribe' at Port Davey	8	1830	26	3	9:1	Robinson {18.3.30:132 29.3.30:140
West Point 'Tribe' near Mt Cameron West	9	1832	23	2	12:1	Robinson {19.6.32:618 17.7.32:633
Low Rocky Point	10	1833	12	4	3:1	Robinson, 5.6.33:733
Macquarie Heads— Point Hibbs	11	1833	16	2	8:1	Robinson, 12.7.33:752
Pieman River 'Tribe' near Trial Harbour	12	1833	11	0?	11:0	Robinson, 22.7.33:764-6
Arthur River	13	1834	8	5	1.5:1	Robinson, 28.2.34:853
Arthur River	14	1834	3	1	3:1	Robinson, 14.3.34:863

attacks where the kangarooers were wounded or killed and dogs speared are recorded by Knopwood (1948:73, 74, 81, 91, 110), his own dog Spott being wounded in 1807, dying from its wounds a week or so later (1948:91, 99). Several Aborigines were shot dead in these encounters. Convicts absconded from the settlement to become gentleman of the bush, taking with them dogs, including a Miss Philis; and some dogs either became lost or took to the bush themselves (Knopwood, 1947:78, 122; 1948:91, 92).

Thus within two years of European settlement, the Tasmanians in the neighbourhood of both Hobart and Launceston had ample opportunity to acquaint themselves with dogs and to see them being used for hunting according to European methods. They also had opportunities of acquiring dogs at least through force. The crucial point when the Aborigines stopped killing the dogs that they captured, and began to cherish and to use them, has not been recorded, but from the evidence below this appeared to have happened quickly.

Thus the history of man and dog in Tasmania began with a curious quirk of fate. Tasmania's first agriculturalists were forced for a while to take to the chase in order to survive, and from these hunting farmers the Aborigines took the opportunity to carry out their first experiment in domestication.

Bands and packs

Only ten years after these events, some Aboriginal groups had large packs of dogs accompanying them. In 1816, Kelly remembered seeing a large group of Aborigines possibly 200 strong, accompanied by a pack of at least 50 dogs, on the coast of north-eastern Tasmania (TABLE 1; FIG. 1:1) (Bowden, 1964:40); these figures may not be strictly accurate but give a general impression.

Robinson was actively searching for Aborigines in the bush, and fortunately for us he counted the number of people and dogs accompanying them for most of the groups that he encountered. His journals pertain to the period 1829 to 1834 and as he travelled all over the island, meeting Aborigines in the northeastern, central and western parts,

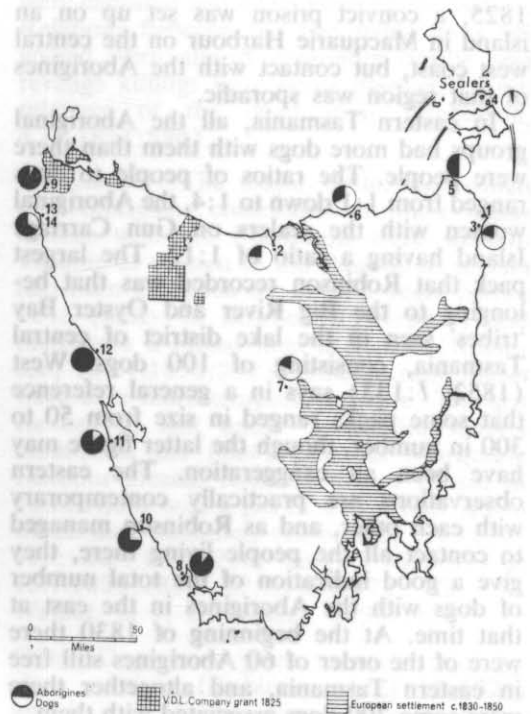


FIG. 1 Groups of Tasmanian Aborigines and their dogs, 1830 to 1834

they allow us to assess the degree to which dogs had been adopted by Aboriginal groups right across the island at that time. I have collated his counts of people and dogs in TABLE 1, and have plotted the locations of these observations on the map (FIG. 1). On this map, I have also indicated the extent of European settlement by the early 1830s, data being based on Scott's map (1824) and Scott (1965:42). The Van Diemen's Land Company was given a large land grant on the northwest coast in 1825, and by 1830 there were establishments at Woolnorth (Cape Grim), Circular Head, Emu Bay and the Surrey and Hampshire Hills, but the density of occupation in these areas was significantly lower than in eastern Tasmania. Although there had been no European settlement in northeastern Tasmania, the numerous sealers of the Bass Strait islands, especially the Furneaux Group, used regularly to visit that coast and there had been considerable contact, mostly hostile, between them and the Aborigines there. In

1825, a convict prison was set up on an island in Macquarie Harbour on the central west coast, but contact with the Aborigines of that region was sporadic.

In eastern Tasmania, all the Aboriginal groups had more dogs with them than there were people. The ratios of people to dogs ranged from 1:1 down to 1:4, the Aboriginal women with the sealers on Gun Carriage Island having a ratio of 1:12. The largest pack that Robinson recorded was that belonging to the Big River and Oyster Bay 'tribes' seen in the lake district of central Tasmania, consisting of 100 dogs. West (1852, 1:133) says in a general reference that some packs ranged in size from 50 to 300 in number, though the latter figure may have been an exaggeration. The eastern observations are practically contemporary with each other, and as Robinson managed to contact all the people living there, they give a good indication of the total number of dogs with the Aborigines in the east at that time. At the beginning of 1830 there were of the order of 60 Aborigines still free in eastern Tasmania, and altogether there were some 200 dogs associated with them.

In contrast to this, the west coast natives had few dogs. If we combine the two observations of Sandy Cape natives at the Arthur River (13, 14 on TABLE 1), the ratios of people to dogs range from 2:1 up to 12:1. The Pieman River band of 11 people probably did not have any dogs at all, and the Sandy Cape natives alluded to above had acquired five of their six dogs in a fight a few days before Robinson met them. To bring out the contrast between east and west let us compare two equal-sized groups of 26 people at about the same point in time, that is 1830-1. The Big River/Oyster Bay band had 100 dogs and the Port Davey band of the extreme southwest had only three. Altogether, in 1832 there were of the order of a hundred Aborigines living on the west coast and they had with them only about ten dogs. Robinson commented on this paucity several times (e.g. 29.3.1830:140; 17.7.1832:633).

In explaining this contrast we have two alternatives, either (a) an equilibrium situation had been achieved in both eastern and western Tasmania, in which case the differences would have been due to cultural

preferences and/or ecology; or (b) the situation on the west coast was in disequilibrium, the western Aborigines being in the process of acquiring dogs when Robinson met them. I am inclined to the latter view for the following reasons. From the discussion earlier and from FIG. 1, we see that the Aborigines of the east had had extensive contact with the colonists; indeed, the seasonal movement of every band of this region brought it into contact with European settlement at some point of the year. This contact had been in operation for 25 to 30 years by Robinson's time. On the west, however, regular contact between the two societies had been going on for only about five to eight years, and for some groups Robinson was the first white man they had seen at close quarters. In traditional times, the western tribes had relatively little contact with the easterners, so that inter-tribal channels for acquiring dogs would have been limited. How this might have happened had there been enough time is illustrated by the fight between the *Tommyginny* of Surrey Hills and the *Tarkine* of Sandy Cape described below. We can account for the acquisition of about half of the dogs seen on the west coast; five were captured from the *Tommyginny*, one taken from sealers and some from Robinson's party, one obtained by prostitution, and one given by one western band to another. As a reward, Robinson bought three dogs to give to the West Point band on the occasion of their entering captivity (22.7.1832:635; 27.8.1832:644).

We see that whenever an opportunity presented itself, the west coast natives showed as much keenness to get dogs as anybody else, and I think that it would only have been a matter of time before they too would have built up large packs. After some sort of equilibrium had been achieved, then cultural and ecological forces would have come into play, producing small regional variations in the man-dog relationship as it did with most other cultural traits of the Tasmanian Aborigines.

Methods of acquisition

Aborigines acquired dogs in a variety of ways.

Force Raids and ambushes were sometimes carried out on buildings or on stockmen and hunting parties, and dogs were taken as booty, although in these encounters the Aborigines sometimes paid dearly in casualties to their own side. Often subterfuge was used, as when they absconded or escaped from custody taking dogs with them. In northeastern Tasmania, they attacked sealers or raided their boats in order to capture dogs (Robinson, 12.11.1830:272; 15.11.1830:277; 17.11.1831:521-2; 20.6.1832:619; 14.3.1834:863; Plomley, 1966:915 n. 60).

In their attack on Robinson and his party just south of the Arthur River in 1832, the hostile Sandy Cape and Pieman River Aborigines tied up Robinson's dogs, and in the ensuing mêlée they were left in possession of them. Their triumph was however tempered by the fact that several of their women had fled across the river with Robinson, probably because of kinship obligations with people in his party, and they tried to exchange their newly captured dogs, shouting 'give us some women and we will give you dogs' and shaking their spears in impotent rage (Robinson, 4.9.1832:650-3).

Aborigines took dogs from each other also, particularly from traditional enemies. The *Tommyginny* band whose country was inland of Emu Bay at Surrey Hills used to visit the west coast in summer, often living and foraging with the bands there, especially the *Tarkine* from Sandy Cape. These bands had a history of alternating friendship and hostility. A few days before Robinson met the *Tarkine* in February 1834, there had been a quarrel over the refusal of the *Tommyginny* men to give the others ochre, a fight ensued, one man on each side being speared to death, and the *Tommyginny* fled, leaving about five dogs and other booty including the ochre and knives (Robinson, 28.2.1834:853-5; 14.3.1834:863). The dogs were then used by the coastal group and adapted themselves easily to their new masters.

In another account two men belonging to one of the bands of the Oyster Bay tribe were speared by people from the *Tyeranotapanner* band belonging to the Stoney Creek tribe of the north midlands. One man was killed, the other wounded, and their dogs

were captured and taken away by the victors. Relations between the two tribal units involved were almost invariably hostile and revenge killings were being planned by the relatives of the dead man (Robinson, 4.12.1831:538).

Prostitution The major trade item which the Aborigines contributed in their transactions with the Europeans were women. Trading of women to the Bass Strait sealers had been going on for several years before 1816 (Kelly, in Bowden, 1964:36-7) and dogs were a prized item in return (Robinson, 12.11.1830:272). Other arrangements were of a more temporary nature. The girl *Reehleep*, lent under duress for several months to the pilot's crew at Macquarie Harbour Heads, returned to her people at Point Hibbs with a gift of a dog, one of two which they possessed (Robinson, 7.4.1833:713; 28.4.1833:716; 10-12.7.1833:751-3; 15.7.1833:788; 27.7.1833:771; G. W. Walker, in J. B. Walker, 1898:167).

Gifts Dogs were given to each other by close relatives (Robinson, 4.9.1832:652), and it is likely that they had entered the traditional exchange systems. The West Point band in 1832 had only two dogs, one taken from the sealers, and the other given to them by the Port Davey people (Robinson, 17.7.1832:633). Robinson mentions dogs as marriage gifts, given by the hopeful suitor to the parents of the intended bride (21.6.1834:888). Aborigines also sometimes received gifts from Europeans, usually as rewards or bribes (e.g. Robinson, 22.7.1832:635; 27.8.1832:644).

Taming wild dogs Dogs lost, or escaped from European hunting parties and farms, soon established themselves in the bush, so that by the 1830s they had become serious pests, government measures having to be introduced to keep them under check, due to the havoc that they wrought with stock (Robinson, 18.9.1830:213; 10.11.1831:513; 17.11.1831:522; West, 1852, I:133; Plomley, 1966:824).

Aborigines availed themselves of this source. *Kickerterpoller*, an Oyster Bay native, found a litter of two pups in the bush, the bitch being absent. He took the pups which were ferocious at first, but in

a few hours they had been calmed and tamed (Robinson, 20.10.1831:487).

Natural increase Large packs of dogs such as the Aborigines possessed were viable breeding units, and there is no doubt that the tame dog population increased rapidly from natural causes. There are several reports of litters of puppies in the native camps. They were often left behind with the other impedimenta when a sudden flight had to be made. On other occasions the puppies were carried by their owners as they moved camp, one woman from central Tasmania being seen with twelve puppies in her arms (Robinson, 29.3.1830:140; 10.4.1830:149; 24.12.1831:563).

Some control on breeding was exercised, considered by many authorities to be the hallmark of 'domestication' (e.g. Herre, 1969:267). The *Tommyginny* were reported by the *Tarkine* people to tie up their old dogs in the woods to breed, presumably with wild dogs, taking the young ones with them on their peregrinations. Robinson comments that these were the best native dogs that he had seen, being a cross between a greyhound and a brindle terrier (10.3.1834:859). On the other hand, the natives with Robinson made strenuous efforts to prevent their dogs from copulating. When a bitch was on heat, they drove off the dogs 'from smelling or put the fire from their torch upon its urine', and if mating had occurred, they tied string tightly around the belly of the bitch to induce abortion (Robinson, 3.11.1831:501).

Breeds of dogs

As might be inferred from the above, there was a considerable range in the kinds of dogs possessed by the Aborigines. The most specific description by Robinson is that of the *Tommyginny* dogs being 'a cross between a greyhound and a brindle terrier' (10.3.1834:859). Those in the northwest were of 'a very large and fierce description' (1.11.1830:261). However, many of the dogs were small, for example, those belonging to the Port Davey people were 'three little dogs . . . of the cur breed' (18.3.1830:132), a description which would not have improved Robinson's relations with the then manager of the Van Diemen's Land Com-

pany. One of the two dogs belonging to the West Point band was a little white bitch, and the well-travelled 'Bully' was a red spotted dog. Dutureau's painting *Reconciliation* (see reproduction in e.g. Travers, 1968:166), showing Robinson and the Aborigines, has several large retriever-like dogs in the group. Dutureau was not painting from life, so too much reliance must not be placed on the accuracy of his work, but it does give a general impression of what some of the Tasmanian dogs must have looked like and can be compared with Robinson's field sketch (PLATE I), published here for the first time (22.10.1831).²

The major conclusion to be gained from what little we know of the breeds of dogs used by the Aborigines is that there was a wide range, and that it did not seem to matter much what kinds of dogs were used, except that large dogs were probably necessary for hunting the forester kangaroo.

Ownership

In spite of the large packs, the dogs themselves were individually owned, both men and women having their personal dogs. The number of dogs owned by an individual ranged from one up to a dozen or more, as was the case with the women from the Bass Strait islands (Robinson, 12.11.1830:272; 24.9.1833:798; 27.3.1834:866). There may also have been some sort of ownership or at least affiliation to a band or tribe. Tasmanian bands/tribes distinguished themselves from each other by various body insignia such as hair styles and cicatrice patterns. The same may have begun to happen with dogs, for the *Nine-ne* people of Port Davey used to cut off the tails of all their dogs as a distinguishing mark (Robinson, 19.6.1832:618).

The Aborigines were extremely attached

²A few lines describing this scene were accidentally omitted from Plomley's edition, page 489. In the Mitchell Library manuscript for 22 October 1831, following the words ' . . . on each side of us' the text reads 'Soon after halting one of the dogs chased a kangaroo, which run up a steep acclivity and along shelving rocks; at length, falling down a steep, it was caught by one of the natives *Woorady*' (personal observation and N. J. B. Plomley, personal communication, 15.10.1970).

to their dogs, and great sorrow was shown when an animal died or had to be left behind (Robinson, 12.11.1830:272; 24.9.1833). It is said in a general reference by Widowson (in Ling Roth, 1899:111) that women sometimes suckled the pups; they certainly carried pups around with them (Robinson, 24.12.1831:563). The dogs had personal names, both English ones, for example 'Billy' or 'Bully' (Robinson, 11.11.1831:514; 15.12.1831:554; 21.6.1834:888); and Aboriginal ones, for example 'Watterinten', 'Muckerreo', 'Tippo' or 'Tip-po-nar', 'Lac-key', and 'Lac-lay' (Robinson, 4.12.1830:538; 12.11.1830:272; 17.7.1832:633; 18.8.1831:405). The latter two are probably different versions of the same name, which was also one given to people, a boy called Lacklay coming from Port Sorell.

The dog's owner had the meat distributional rights for the game which had been killed by it (Robinson, 7.9.1832:655). The dogs followed their owners throughout the full range of their seasonal movements. A distinctively marked dog once owned by a *Lairmairrener* (Big River 'tribe') woman with Robinson's party was recognized by her near the Great Lake, and a Robbins Island man remembered how he had seen the same dog with the *Lairmairrener* people at Cape Grim, 150 miles away, some time previously, a fact confirmed by the woman herself (Robinson, 15.12.1831:554).

Owning a dog which had once belonged to a dead man had its problems, as he was liable to influence its actions, for example by making it lazy (Robinson, 13.7.1834:900).

Even given the great value of dogs in hunting as discussed below, it is clear that the dozens or scores of dogs in Tasmanian packs were maintained for other than purely utilitarian purposes. Most of the hunters used one or at the most three dogs; more would have been a hindrance. I feel that the large packs were kept mainly for companionship, and also possibly because the Aborigines did not like to kill excess pups. There is no record of Tasmanians ever eating dogs, and even to kill one risked grave consequences (e.g. Robinson, 24.9.1833:798).

Yet in spite of this love of dogs, there was apparent disregard for their welfare. The packs were so big that the dogs sometimes

starved or had to feed themselves, for example on penguins (Robinson, 22.7.1832:635; 26.2.1834:850; 14.7.1834:902). They were also left behind to fend for themselves and keep up with the party, if occasion demanded it (Robinson, 14.3.1834:863). These aspects of the man-dog relationship parallel closely those which the mainland Australian Aborigines had with their dingoes (Meggitt, 1965:16-17). In both cases, they were extremely fond of dogs, had large and often non-utilitarian packs, and yet the dogs sometimes starved or had to fend for themselves.

Hunting

Within Robinson's journals there are scores of references to Aborigines hunting with dogs (PLATE I), and for much of the time his party was living off the bush. I shall give two examples:

Myself and people tolerably hungry, not having much to eat and our scanty supply of flour would not last long. . . . Our tea and sugar gone and our chief dependence was on the animals the forest afforded . . . sent the natives back for kangaroo: we fortunately had with us two dogs. As the sun was setting, the natives returned from hunting bringing with them four kangaroo [12.11.1831:516];³ and Tom (*Kickerterpoller*).

On arriving at this spot set off without acquainting me with his intention with the two dogs to hunt, and whilst I was examining the country I heard the dogs yelping and saw them killing a boomer kangaroo, (*M. Giganteus*) which were plentiful in this place. . . . Not content with this, he proceeded still further hunting; after waiting some considerable time I proceeded, when I met him and Tim returning with two kangaroo . . . our scanty supply required recruiting and the dogs was in a starving state. I therefore ordered them to eat plentifully [7.7.1831:372].

Most of the men he had with him were mature, with high prestige, e.g. *Mannalargenna* and *Umarrah*, all old hands at the art of hunting. Robinson did not interfere with their hunting methods and was in no position to do so, and furthermore these descriptions are confirmed by similar observations on 'wild' Aborigines.

³ Words in brackets added by present author to give contextual information.

Let us now look at the method of hunting in more detail. Robinson went out with *Tunnerminnerwait*, a native from Robbins Island, northwest Tasmania, and saw for the first time how the boomer kangaroo (*M. giganteus*) was caught. They were accompanied by the dog Rodney, which at first was tired and listless.

On reaching the forest . . . my sable friend descried on the ground the impression of a boomer kangaroo. He took the dog to the spot when having got the scent, it followed after the animal. Myself and *Tunnerminnerwait* left after him. Having got sight of the game, the chase began: the animal, which was exceedingly large, took to flight, followed by the dog and us. The dog biting him on the hind leg, the animal would then stop and fight the dog, and the dog, fearful of close attack, would bark at him. This gave us time to come up, but on perceiving us he fled, followed again by the dog, which kept close after him. He would again stop and face the dog, and then run and stop etc, until much tired he allowed myself and *Tunnerminnerwait* to come up to him, and he faced us both. Seeing the dog was quite unable to master him, and he having clawed the dog, I told *Tunnerminnerwait* to throw a waddy (club) at him, but he was afraid and said by and by. Anxious to put him out of his misery, I went to him and threw a stick at his head and hit him, when he made a jump at me. The native called out 'He will catch you'; and which would have been the case had not the chief's dog (*Mannalargenna's*), attracted by the barking of Rodney, come to us and fastened on to the animal, when Rodney caught him by the throat and got his head down. Wearied, the animal laid down panting for breath and the dog beside him; and at this juncture the native beat on his head and killed him . . . having only one dog occasioned us much running and exertion [18.8.1831:404-5].

We see that dogs were used to follow the scent and then chase the game in order to tire it and eventually to bail it up when the accompanying hunter delivered the *coup de grâce* with club or spear. West (1852, 2:86) also says that the Aborigines ran with their dogs and were generally in at the kill. A large bailed-up kangaroo is dangerous, capable of disembowelling a dog, and it possibly requires the aid of the hunter or at least another dog to dispatch it. Sometimes the dogs killed the animals themselves,

particularly if they were the smaller wallabies (Robinson, 28.7.1830:191; 2.11.1830:264-5; 3.9.1832:649). In the last example the dogs belonging to Robinson's Aborigines had killed the wallabies by tearing their throats, but the west coast natives who were also in the hunt ran in as soon as the animals had been killed, then claimed that they had speared them. This was done either because they were unused to hunting with dogs or because they wanted to upstage the others.

Apart from wallabies and kangaroos, wombats and emus were also hunted with the aid of dogs, whose sense of smell was useful in finding wombats in their underground setts (Robinson, 15.11.1831:519; 20.11.1831:522; 23.5.1833:728; 14.3.1834:863). Smaller animals were sometimes caught by dogs, for example possums and kangaroo rats (Robinson, 29.3.1830:140); possibly this is what the women used them for when they went to hunt with their dogs (Robinson, 11.11.1831:514; 5.9.1833:791).

Dogs were trained not to follow the game when they were not wanted, and to remain silent if required (Robinson, 2.11.1830:264). Possibly some of the bush in Bruny Island was selectively burnt so as to facilitate hunting kangaroos with dogs. Small copses were left standing by stamping out the fire at their edges with clear spaces in between; the copses to give cover for the game, and the spaces to give the dogs a good run (Robinson, 2 and 3.4.1829:54; Jones, 1968:205-10).

Were these hunting methods with dogs indigenous inventions? Descriptions of European kangaroo hunts are similar to the ones above (e.g. Evans, 1822:88-9; West, 1852, 1:325-7), the men following on horseback, or in earlier days, as in the case of Knopwood's men, on foot to dispatch a cornered or bailed-up animal, so it may have been that the Aborigines had copied from their observations of the Europeans (cf. PLATE II).

On the other hand, Robinson described Aborigines hunting without dogs, where one or usually several men methodically chased a kangaroo/wallaby until it was exhausted, when it was either held by the tail or bailed-up against a tree and dispatched with spear or club (Robinson, 15.12.1831:

554-6; 19.6.1832:618; 23.6.1832:623). Although a kangaroo is faster over short distances than a man, it has not got the same stamina over long distances. *Woorady* said that young men were not allowed to eat much by their fathers, so that they might be in better condition for the chase, and that the Aborigines kept their dogs hungry for the same reason (Robinson, 15.12.1831:554).

It is interesting that this method of hunting is identical to that carried out by dingoes in Australia, and it may be the 'natural' or 'instinctive' way for dogs to hunt kangaroos. There is a description by Hassell quoted by Meggitt (1965:12) of two wild dingoes systematically chasing a large brown kangaroo until

At last it could hop no longer, so stood with its back to a big tree and tried to fight off its enemies with its feet, but they were too wary to go too close. One would lie down some distance away, while the other worried and snapped at the kangaroo. When it was tired, the one lying down took its place. . . . At last, the dog caught the kangaroo off its guard, and made a spring at its neck; in a second the other dog rushed up and attacked on the other side and the poor beast was pulled struggling to the ground, and in a few minutes was dead (cf. PLATE II).

In western Tasmania, where dogs were scarce or absent, other methods of hunting wallabies were often used: sharpened stakes or tripping devices were left in the animal pads, ambushes were laid in dense scrub, swamps or across natural traps such as isthmuses, and animals were chased into confined areas (Robinson, 24.9.1830:218; 19.6.1832:618; 3.7.1832:626; 7.4.1834:875; Hiatt, 1968:205-6). These may have been the alternative hunting methods all over the island before the use of dogs (e.g. Plomley, 1966:690 n. 61), the technique of ambushing at natural or artificial barriers certainly being used in central Tasmania (Robinson, 19.12.1831:558-9). Alternatively, the small macropods and the dense scrub of the west coast may have facilitated such methods in contrast to the large kangaroos in the open forests and plains of the east. Whichever was the case, the natives with Robinson found no difficulty hunting with dogs on the west coast, and indeed

when the dogs were tired or absent, the party usually went without fresh meat (Robinson, 6.11.1831:506; 22.6.1832:618; 15.7.1832:630).

My own feeling is that dogs were incorporated into the traditional hunting repertoire favouring one of the methods. They replaced men in the role of harriers, thus allowing the armed hunters to expend less energy for the same results. Their ready adoption was probably facilitated by observations of Europeans hunting, and by the initial use of European-trained hunting dogs.

Effect on diet

Whether or not the dogs actually increased the hunters' efficiency, the Aborigines themselves certainly thought so. The natives at the Arthur River confrontation taunted Robinson that with their newly captured dogs they could catch plenty of wallabies (Robinson, 4.9.1832:653), and two years later the remnants of the Sandy Cape Aborigines said that now they had more dogs they were planning to leave the coast and go inland away from the possibility of capture and live on wombat (Robinson, 7.4.1834:875). Robinson comments that because of the depredations of the sealers the Aborigines of the northeast were afraid to forage on the coast, but with the aid of their dogs they could survive on inland foods, even in the margins of the rain forest (Robinson, 18.10.1830:253; 14.7.1831:377).

If the introduction of the dog had increased the efficiency of Aboriginal hunting methods, or at least made them more pleasant, then large game, especially kangaroos, may have been more important in the ethnographically recorded diet (Hiatt, 1967:109-33) than it had been before contact. In the traditional Tasmanian economy, women provided most of the food in dependable items such as vegetables, shellfish and small animals, whereas men contributed a relatively small percentage in the form of spectacular and highly prized items such as large game (Hiatt, 1968:205-11; 214-15). Indeed it is possible that men found it extremely difficult to survive without women, for Robinson says that

An Aborigine of this colony without a female

partner is a poor dejected being. When arrived at the years of maturity his tantamount object is a wife who can provide himself and his family with shell fish (:) and as animal sustenance must at certain periods become scarce even where game is most prolific, that is the only food to which under such an emergency they can resort [28.9.1829:79].

On seeing an old man about 70 years of age at Port Davey, Robinson inquired 'how he lived seeing he had no wife to get him (shell) fish, and was told that he lived on *num-mer* kangaroo apple' (6.4.1830:145). By the 1820s and 1830s most groups in eastern Tasmania were chronically short of women, largely through the raids of the sealers; thus in 1830 there were 72 men in northeast Tasmania and only 2 to 6 women (Robinson, 3.11.1830:266; Plomley, 1966: 439 n. 51). So given the potential or actual shortage of dependable foods which this imbalance produced, the men had to contribute more to the total food supply, and were able to do this with dogs.

As to how long this heavy hunting of kangaroos could have lasted is another matter. The emu, common in the eastern half of Tasmania in 1804, was rare in 1830 and extinct by about 1840. The forester kangaroo or boomer now only survives in small relict populations in northeastern Tasmania, and even by 1830 it had disappeared from the settled districts. The presence of dogs on Kangaroo Island has had similar effects. It is likely that increased Aboriginal hunting pressure on these animals following the use of dogs would have caused their populations to diminish even without the aid of the Europeans, as began to happen with the bison of North America. After a long while a balance would be reached, the marsupial population adjusting itself to the new predation pattern and possibly some species would have become extinct.

The hunting role of dogs with the Tasmanians is in contrast to Meggitt's conclusions as to the role of dingoes and, later, European dogs with most of the mainland Australian Aborigines. Meggitt (1965:23) says that the dingo was only 'quasi-domesticated', fully domesticated breeding populations not being maintained, and that in most places the animals were useless as a hunting aid. Their main uses were as pets,

sentries, or blankets. Personal observation (with N. Peterson) of Aborigines living in the bush at Mirrngadia, northeastern Arnhem Land, and Gould (1969:263) confirm that even the packs of dogs now kept by some bush Arnhem Land and desert Aborigines contribute little to the diet, not even to their own, being dependent on scraps of food thrown to them, and usually being in a state of semi-starvation.

One area of Australia where dogs were useful in the chase was in the heavy bush country of the Queensland rain forest (Lumholtz, 1889:179; Meggitt, 1965:15), a region more similar to the forests of Tasmania than are the deserts or the open plains, so that it may be that hunting with dogs is more effective in such country. For New Guinea, Bulmer (1968:315) also says that dogs were particularly useful for running down and treeing game in forest hunting. Following Meggitt's lead, more detailed regional studies would be useful, especially for those areas of mainland Australia where dogs were used for hunting.

A minor point of interest was the presence of about half a dozen Sydney Aborigines with the roving parties in Tasmania at various times. Did they stick to the Australian pattern or did they follow the Tasmanians in their use of dogs? Further search may shed some light on this.

Other uses

A number of minor ways in which dogs were useful to the Aborigines have been recorded and these are included here.

The large packs, roaming as they did around the camps, acted as excellent sentries, warning their owners of the approach of strangers (Robinson, 20.9.1830:216; 1.11.1830:261). Some dogs could smell the presence of black men, and could be used for tracking (Robinson, 18.8.1831:405), and in the southwest the dogs slept with the people in their huts, thus having the potential function of blankets (Robinson, 26.3.1830:137). Their ability to kill sheep was utilized by the Aborigines of the northwest in their counter-attacks against the shepherds of the Van Diemen's Land Company, and many sheep were killed by dogs in the Surrey Hills and other districts (e.g. Robinson, 17.2.1834:843).

Meggitt (1965) also records mainland dogs as sentries and blankets; and wild dingo populations did exert considerable pressure against the spread of pastoralism in marginal areas.

Cultural adaptations

Some elements of material equipment were adapted for dogs; huts were sometimes enlarged to accommodate them, and in south Tasmania large bark catamarans were built so as to transport the dogs together with seven or eight people and their spears (Robinson, 15.7.1831:379; 11.7.1834:898). The latter gives an intriguing illustration of how dingoes might originally have got to Australia.

In the social and intellectual fields, dogs had entered traditional ownership and exchange systems, thus joining ochre and shell necklaces as the major units of portable wealth of the Tasmanians (Robinson, 17.7.1832:633; 21.6.1834:888).

Dogs were being incorporated into the mythology. The West Point people believed that a fierce dog lived near Macquarie Harbour which devoured human beings who were wearing clothes (Robinson, 3.7.1832:626). Dogs took on properties assigned to them: thus *Mannalargenna* scolded *Woorady* for criticizing his dogs, saying that 'he must no more say his dog was lazy for if he continued to do so, the devil would make him so in reality. He must in future say they are good dogs, fine dogs' (Robinson, 21.6.1834:888). A dead man's dog was liable to having its old master influencing its present activities and personality (Robinson, 21.6.1834:888; 13.7.1834:900). Dances were invented depicting dogs (Robinson, 15.11.1830:278).

Relationships with other domestic animals

The only other experiments in domestication carried out by the Tasmanians was when someone was reported by Robinson to have trained English cats to hunt possums (Robinson, 6.6.1830:170), and one case when a Tasmanian girl jumped onto a horse, bridling it by the tether rope, and riding off at a gallop, eluding her pursuers (West, 1852, 2:11).

Imitations of the horse had also entered

the dancing repertoire, a dance was invented by the Big River people, performed by them and copied by the Aborigines of the north-east. This related the exploits of a Tasmanian man outrunning a mounted white man who was trying to chase him. Robinson described the scene:

Several men perform the parts of horses; they stoop down and lean their hands upon the back of their companion and then walk round the fire singing; sometimes they run to imitate galloping. One man acts as driver and he has a bough for a whip, with which he strikes them and makes them go fast. Another man runs beside the horses in imitation of a dog—and performed his part exceeding well, shaking his head and appearing frightened then stopping, then running etc [15.11.1830:278].

Robinson also drew a sketch of this dance which has been reproduced by Plomley (1966:Plate 8).

The Aborigines showed absolutely no interest in sheep, cattle, or other European food animals. They did not hunt sheep for food, though they occasionally killed them and drove their dogs on to them, as reprisals against the settlers (Robinson, 18.2.1834:843; Plomley, 1966:817 n. 152; Meston, 1958:52). Several attempts were made to introduce the Aborigines to a peaceful and, for their sponsors, a profitable, pastoralism. These attempts, from the hopeful instructions of the London-based founders of the Van Diemen's Land Company (Meston, 1958), through the rewards of sheep given to the 'domesticated' Aborigines (Plomley, 1966:589), to the intensive experiment in forced pastoralism on Robinson's Flinders Island settlement, were all failures.

Conclusion

The historical events described above constitute one of the rare occasions where we can study the reactions of a hunting and gathering people coming suddenly face to face with a wide range of domestic animals. In this particular case, the exotic animals included the dog. There were marked differences in the attitudes of the Tasmanians to the various animals.

Sheep, cattle, and pigs, the European food animals, were ignored, both as creatures with which to set up a close relationship

and even as a casual food supply. The horse, with its human rider, excited their imagination, particularly as it was used to run down kangaroos and Aborigines. Away from the settled districts, Tasmania is densely wooded and is not good horse country, so there was little opportunity for the Aborigines to have experimented with its use.

Dogs, the Tasmanians accepted and sought avidly, incorporating them into their culture with extraordinary rapidity. In so doing, they adapted their hunting methods, and managed to make the profound social and psychological adjustments necessary in setting up an affectionate relationship with the new animal, a relationship radically different from any that they had had with other animals. These changes happened in Tasmania so quickly that even in the most sensitive archaeological record, the process would seem to have been instantaneous.

Discussion on animal domestication usually stems from osteological studies (e.g. Degerbol, 1962), and we are thus led into the paradox pointed out by Higgs (1968:619) in relation to agriculture, that 'a major change in human *behaviour* (is) classified on the basis of plant *morphology*' (my italics). Domestication is also social behaviour, both for the domesticator and the domesticated. It involves the beginning and growth of closer social relationships between two species until something akin to symbiosis is achieved (Zeuner, 1963:84; Downs, 1960; Higgs and Jarman, 1969: 38-40).

In Tasmania, the adoption of the dog required no alteration to man's dietary habits nor to his seasonal movements, whereas to have done the same with sheep would have involved a radical change in the structure of society. Herre's unsupported assertion (1969:267) that 'Modern hunting peoples do not know the use of the dog as a helper in hunting' is not true, as a glimpse at the literature on the Tasmanians, some Australian Aborigines (Lumholtz, 1889:179; Meggitt, 1965:14-19, 24), New Guineans (Bulmer, 1968:311, 315) and Bushmen (Lee, 1965:130-1), to look no further, will show. Apart from its real, marginal, or imagined value as a hunting aid, the other main reason for keeping domestic dogs in Tasmania and Australia was for companion-

ship. Men and dogs are both generalized predators, foraging in structured social groups, and psychologically they are able to form emotional attachments to each other. There is no reference to Tasmanians eating their dogs and this parallels Meggitt's observation (1965:13-14) that the mainland Aborigines only eat wild dingo pups in times of scarcity. Whatever the virtues of Degerbol's theory that dogs were first domesticated by Maglemosian man as a source of food (1962), the Tasmanian and Australian evidence shows that this behaviour was by no means universal amongst hunting and gathering peoples.

Man/dog relationships in Tasmania and Australia have many features in common, and my guess is that a cross-cultural analysis of the relationships between man and dog in various hunting and gathering societies would show the existence of a core of similar behaviour, with a range of local differences. We must ask ourselves, what is there about the social behaviour and psychology of both hunting man and dog which allow them to form such a close social relationship, as opposed to that set up between hunting man and most other animals? The answer to this will go a long way to solving the allied question of why and how did hunting man originally domesticate the dog.

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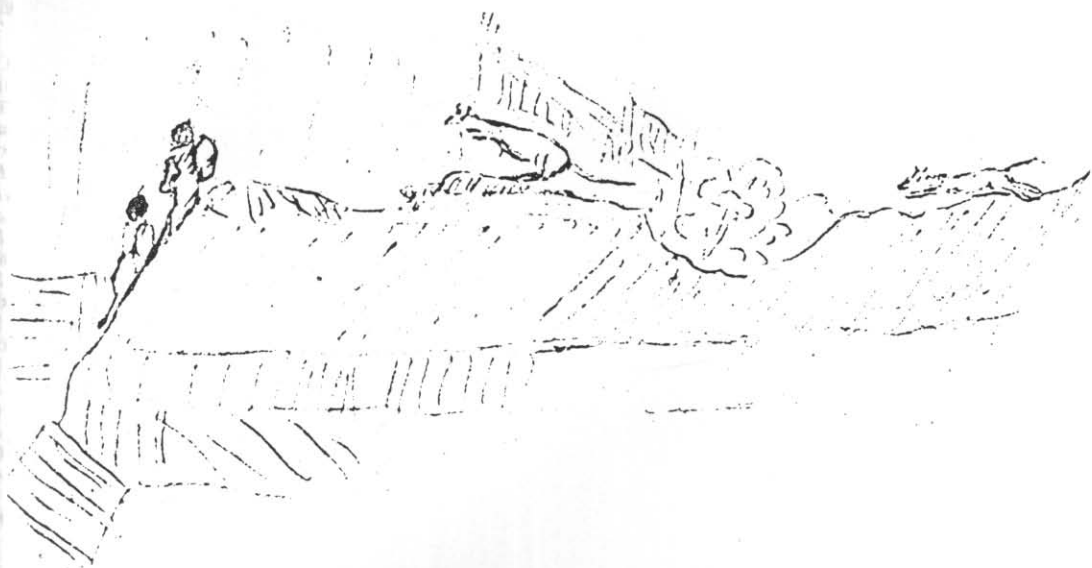


PLATE I Dog chasing kangaroo across defile towards Aborigines. From Robinson (22.10.1831).
Reproduced by permission of the Council of the Library of New South Wales

TASMANIAN ABORIGINES AND DOGS Rhys Jones

PLATE II From 'Kangaroo at bay with dogs' by E. Roper. From the Nan Kivell Collection,
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Pleistocene human remains from Australia: a living site and human cremation from Lake Mungo, western New South Wales

J. M. Bowler, Rhys Jones, Harry Allen and A. G. Thorne

1 Stratigraphy and Chronology (J.M.B.)

During a recent survey of the stratigraphy and Quaternary geology of dry lakes in western New South Wales, I recorded evidence of human occupation on ancient Quaternary strandlines (Bowler 1970). Striking examples are located on lakes which once formed a terminal drainage system on the Willandra Billabong Creek, a distributary of the Lachlan River in the Murray-Darling drainage system (fig. 9). Interest in this area has quickened following the recent discovery of human remains in the eroded core of an ancient lake-shore dune. Radiocarbon dates from this site have established these as the most ancient human bones from a stratigraphically controlled site yet dated in Australia.

TABLE I

Representative radiocarbon dates from events in the Willandra Lakes stratigraphic sequence. Full results are reported by Polach, Lovering and Bowler (1970)

Laboratory No.	Radiocarbon age (years B.P.)	Unit dated	Comments
ANU-312	16,530 ± 400	Zanci	Charcoal from upper Zanci, L. Mungo
ANU-292	16,700 ± 600		Charcoal from middle of aeolian clayey sands in Zanci unit, L. Mungo (fig. 3)
ANU-330	17,670 ± 550		Charcoal from base of aeolian clayey sands, L. Mungo
ANU-310	23,350 ± 550		Lacustrine carbonates from high water deposit, L. Mungo
ANU-303	30,250 ± 950	Mungo	Charcoal from aeolian phase, L. Mungo
ANU-331	32,750 ± 1,250		Unionid shells from high water phase believed to be approximately contemporaneous with human occupation (fig. 3)
ANU-306	38,500 + 2,950 - 2,150		Unionid shells from early high water phase
		Golgol	Beyond range of radiocarbon

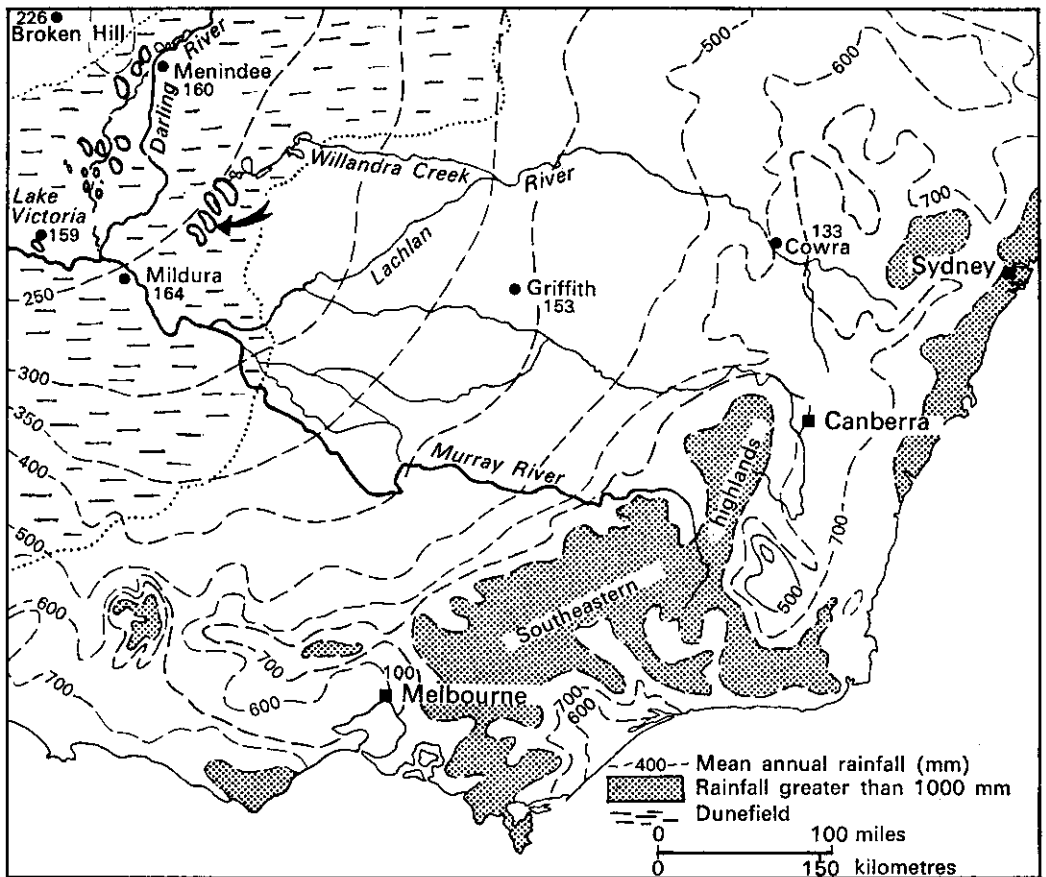


Figure 9. Diagram showing the location of the lakes formerly supplied by the Willandra Creek in the Murray-Darling system, south-eastern Australia. L. Mungo, the site of the most ancient human remains yet dated in Australia, is shown by the arrow

The area is located in the semi-arid eastern fringe of the continental dunefield, through which drainage from the south-eastern highlands passes to the sea. Rainfall, distributed through all seasons, is unreliable and averages 10 in. (250 mm.) per year against 65 in. (164 cm.) pan evaporation. Apart from the low dunes and occasional inliers of Palaeozoic sandstone, the area is one of uniformly low relief between 250 and 300 ft above sea level. The lakes of the Willandra system, when last active in late Quaternary time, covered an area in excess of 420 square miles.

The lake basins, which form large level-floored depressions to 80 ft below the plain, have high sand and sandy clay aeolian transverse dunes (lunettes) developed on their eastern margins. These represent fossil or relict dunes formed when the lakes were last active. In the central lake of the system, L. Mungo (fig 10), the high dune ridge known as 'The Walls of China' is subject to extensive modern deflation which has exposed the dune stratigraphy and structures over large areas. In the stratigraphic succession within this dune, three major aeolian units are present, the upper limits of which are delineated by soils. These units have been named from oldest to youngest, Golgol, Mungo and

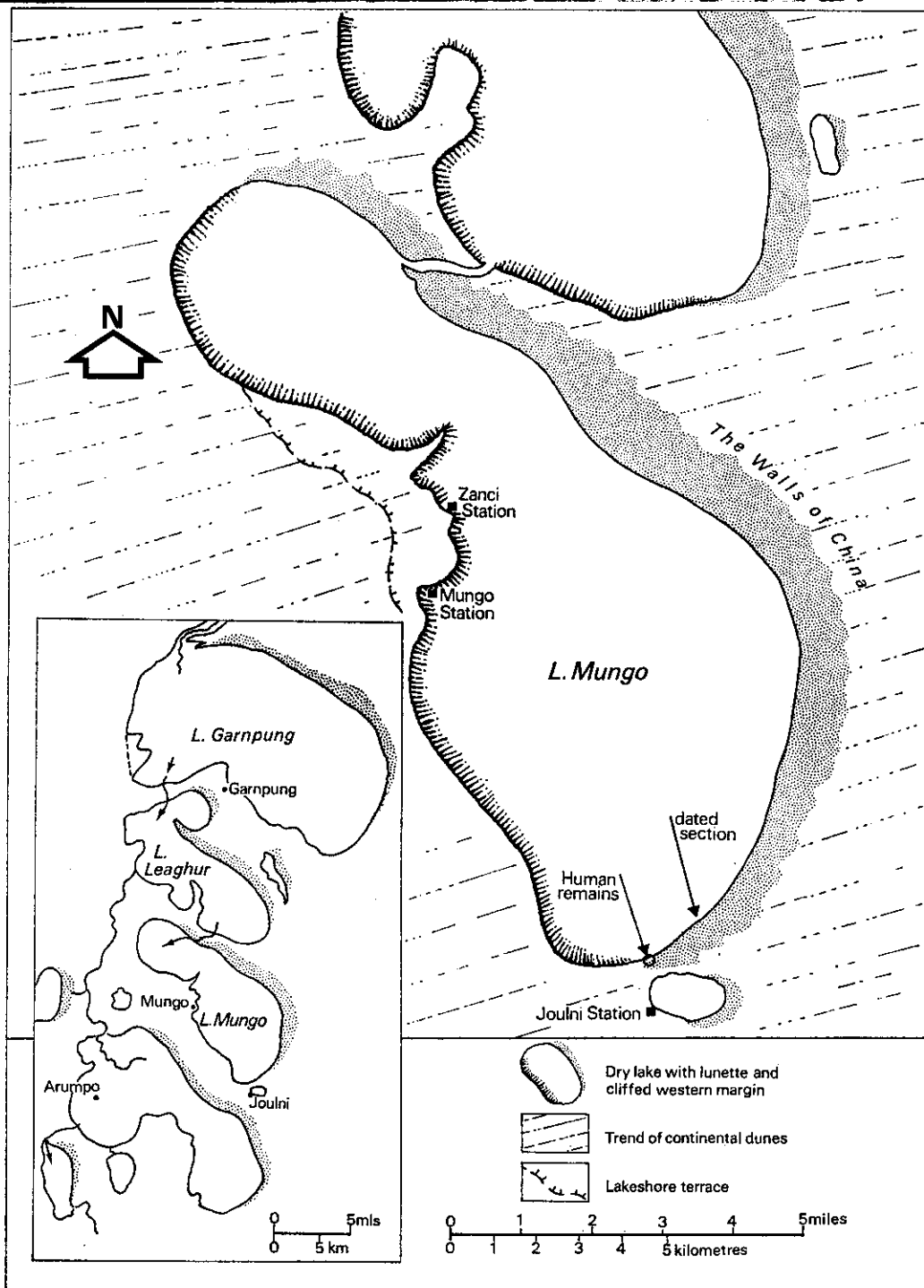


Figure 10. L. Mungo, in the Willandra lakes system, showing the location of the human remains and stratigraphic sections (figs 11 and 12).

A degraded cliff to 80 ft (25 m.) high on the western margin contrasts with the high transverse dune or lunette to 120 ft (37 m.) above the flat lake floor on the east. This west to east asymmetry is typical of lunette lakes across southern Australia

Zanci soil-sedimentary units (Bowler 1970). Radiocarbon dates through the sequence have established a chronology extending from 40,000 to 15,000 B.P. (table 1).

Within the sediments exposed on 'The Walls of China', lacustrine freshwater shells, burnt animal bones, the remains of fires and stone artefacts indicate the presence of man during the latter phases of lake activity. The earliest such evidence is found in the Mungo unit, emphasizing the need to establish the age of this horizon beyond doubt.

Age of Mungo unit and human occupation

In July 1968, artefacts and unionid shells (*Velesunio ambiguus*) bearing an encrustation of secondary soil carbonate were collected on deflation surfaces cut into the Mungo unit. Some *in situ* shells were found but the volume was insufficient for radiocarbon analysis. Shells concentrated on the deflation surface were therefore collected and analysed after leaching in dilute hydrochloric acid to remove outer layers and reduce the possibility of contamination by younger carbon. The date obtained, $32,750 \pm 1,250$ B.P., is in close agreement with a charcoal date from the same unit 7 km. further north along the Mungo lunette (ANU-303, table 1). Charcoal from higher in the same lunette section (fig. 11) dated the bedded Zanci clayey sands at $16,700 \pm 600$ (ANU-292), an age which is consistent with all other dates from that unit elsewhere in the area.

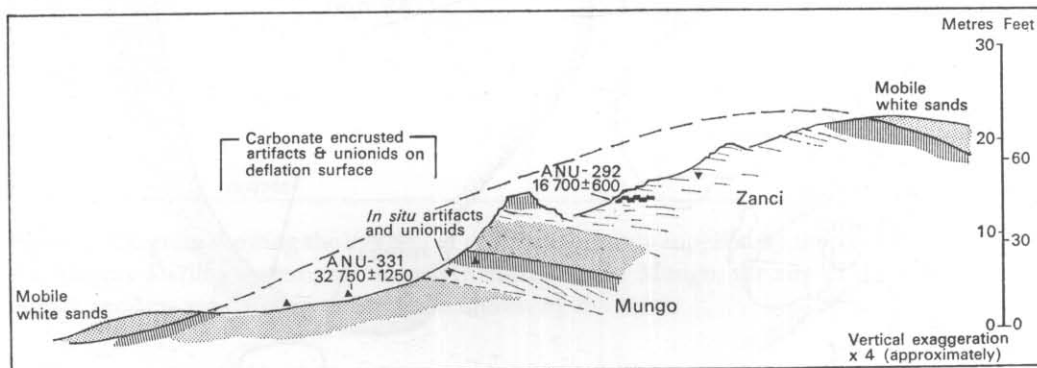


Figure 11. Section through the eroding lunette on the southeastern margin of L. Mungo showing location of radiocarbon samples.

For location of section (see fig. 10).

Legend as for figure 12. Modified after Bowler (1970).

The original stratigraphic location of the shells was determined from their location on the dune and from the evidence of encrusting secondary carbonate. This corresponded to only one horizon in the sequence, namely the calcareous horizon of the soil developed on the Mungo unit and buried beneath the younger Zanci aeolian sediment. The dated shells when collected were still lying on the eroded B_{ca} horizon of the buried soil. Subsequently, both carbonate encrusted unionids and artefacts were located *in situ* close to the horizon from which the shells were collected. The presence of the large unionid shells in the dune as well as their association with artefacts is difficult to explain without attributing them directly to human transport.

On 5 July 1968, I recorded and photographed a deposit of burnt carbonate-encrusted bones within the Mungo unit $1\frac{1}{2}$ km. south-west from the site dated by ANU-331 and ANU-292 (plate 3). This deposit, in the form of a calcrete block undergoing disintegration after exposure on the deflation surface, was first thought to contain food bones burnt by early man. Its location within the Mungo unit provided presumptive evidence of human occupation of great antiquity thereby establishing it as important evidence. I marked the site with an iron peg and left it intact for detailed excavation by archaeologists.

In March 1969, a party of earth scientists including archaeologists from Canberra, accompanied me on a visit to the Willandra Lakes area. On inspection of the bone deposit at the Mungo site, the archaeologists of the party (H. Allen, R. Jones, C. Key and D. J. Mulvaney) immediately suggested their human origin, an identification which was later

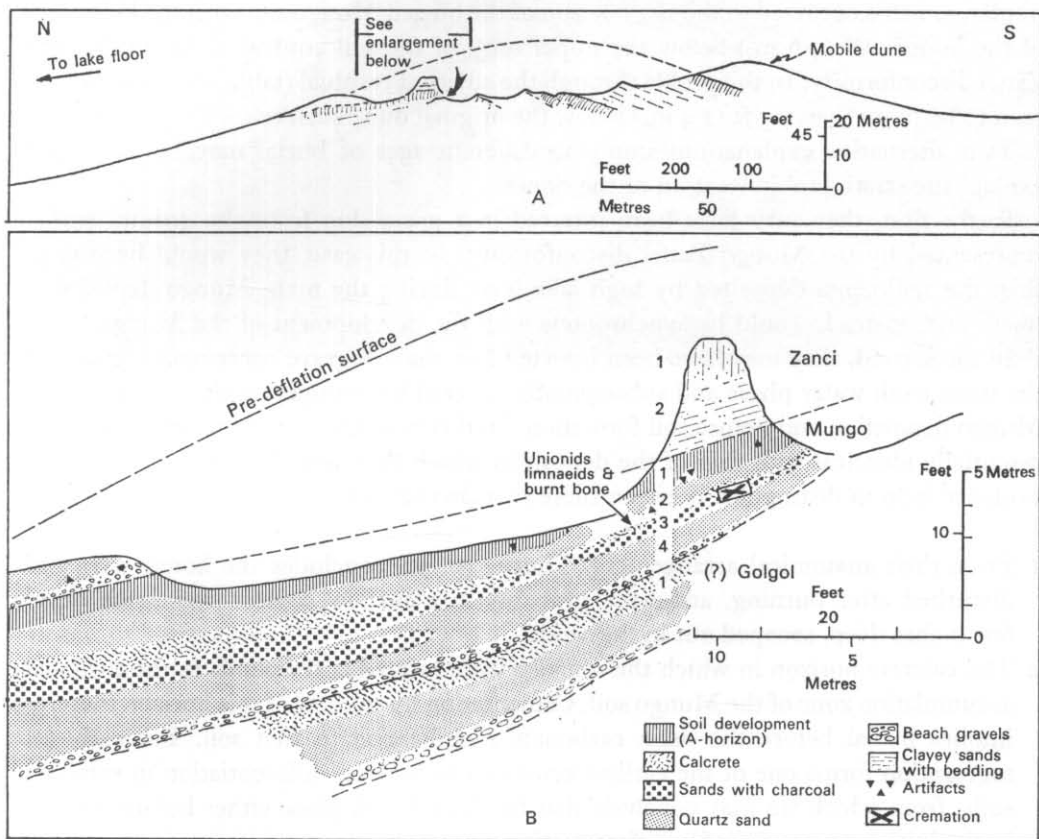


Figure 12. A. Topographic section across the southern end of 'The Walls of China' lunette, L. Mungo, at site of ancient human remains. The bones, cemented in a block of calcrete (arrow), were lying undisturbed on the deflation surface in the eroded core of the dune (see Plate 3).

B. Stratigraphic section at the burial site, constructed from pits and surface exposures. The three stratigraphic units have a layer of high water beach gravels at their base and are disconformably separated from each other by a zone of soil formation, including the development of calcrete. The location of the human bones is shown by the X.

Horizon numbers refer to those described in profile, table 2

confirmed by Mr John Calaby, CSIRO, Canberra, and A. G. Thorne. During a later survey of the area, a carbonate encrusted fragment of a second cranium was found lying on the deflation surface approximately $\frac{1}{2}$ km. west of the burial. Since the adjacent lake and the stratigraphic unit which contained the burial are named after the nearby grazing property, Mungo Station, we have called these the *Mungo skeletons*.

Deflation had already destroyed much of the surrounding stratigraphic evidence leaving the carbonate-cemented bones as a small pedestal on the erosion surface. To date the remains accurately it was therefore necessary to reconstruct the original pre-deflation sequence and to establish their correct stratigraphic position. This was done by precise levelling, linking soil and sedimentary horizons with uneroded sections nearby. The reconstructed sequence (fig. 12) closely resembles the stratigraphic section from which the radiocarbon dates were obtained further north (fig. 11). In the southern section the human remains occurred in the B_{ca} horizon of the buried Mungo soil with the lower level of the bones 2 ft (0.6 m.) below the upper level of the soil equivalent to the Mungo-Zanci disconformity. In the profile through the adjacent residual (table 2) the remains are seen to lie more than 7.5 ft (2.4 m.) below the original dune surface.

Two alternative explanations implying different ages of burial may be invoked to explain the stratigraphic location of the bones.

In the first, they may have been inserted in a grave dug from the ground surface represented by the Mungo-Zanci disconformity. In this case, they would be younger than the sediments deposited by high lake level during the main Mungo depositional phase and, instead, would be synchronous with the development of the Mungo soil.

In the second, they may have been inserted in a shallow grave contemporaneous with the main fresh water phase and subsequently covered by younger sands during the final Mungo deposition and before soil formation. In this case, the age of the bones would be essentially identical with that of the deposit in which they were found. Several lines of evidence help to distinguish between these two alternatives.

- 1 From their anatomical arrangement, Thorne (p. 57) concludes the bones were little disturbed after burning, and were probably in a shallow conical depression only a few inches deep, scooped out in the sand.
- 2 The calcrete horizon in which the remains were located corresponds to the carbonate accumulation zone of the Mungo soil. Cementation by calcrete of this horizon therefore implies burial before the main carbonate mobilization in that soil. But carbonate segregation forms one of the earliest processes in horizon differentiation in semi-arid soils, from which we may conclude that the burial took place either before, or early in the initial stages of profile differentiation.
- 3 On a stratigraphic horizon continuous with that of the burial, concentrations of organic matter including charcoal fragments occurred with burnt bones, occasional unionid shells and stone artefacts providing clear evidence of human occupation. A single unionid shell was cemented in the calcrete block with the bones and a dark horizon with diffuse organic matter occurred immediately below it. This association indicates the bones were of the same occupational phase as that represented by the artefacts, shells and burnt bone, all of which were synchronous with the high water Mungo depositional phase.



Plate 3 Pleistocene human remains from Australia: the Mungo Lunette, with calcrete covered human bones *in situ*

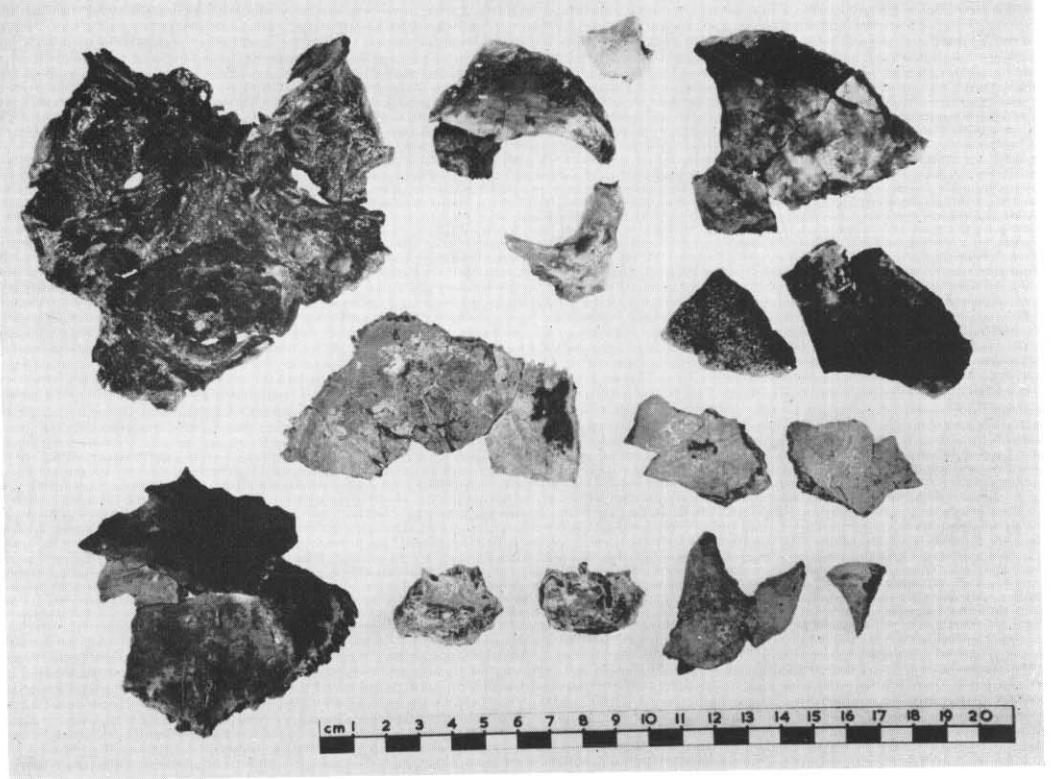


Plate 4 Pleistocene human remains from Australia: cranial fragments of Mungo I

TABLE 2

Soil-sedimentary profile through residual located 20 yd. (18 m.) east of burial site. The gradation between the Mungo 2 and 3 horizons corresponds to the stratigraphic position in which the burial was located. Carbon for radiocarbon analysis has been collected from Mungo 2 horizon

Depth Feet	Metres	Description	Soil sedimentary unit	Fig. 12 Horizon designation
0-3	0-0.9	Grey calcareous clayey sands, weakly developed prismatic cleavage, traces secondary carbonate on planar voids grading to	Zanci	1
3-6	0.9-1.8	grey calcareous clayey sands with bedding preserved sharp contact to	Disconformity	2
6-7	1.8-2.1	reddish yellow (7.5YR 6/6) non-calcareous sand grading to		1
7-7.5	2.1-2.3	light brownish grey (10YR 6/2) sands with dark humic matter, traces of shell and burnt bone grading to	Mungo	2
7.5-8	2.3-2.4	grey (10YR 6/1) sands with calcrete horizon grading to	[Human remains]	3
8-9	2.4-2.7	light brownish grey (10YR 6/2) sands with rounded calcareous gravels sharp contact to	Disconformity	4
9...	2.7...	Dark grey (10YR 4/1) sands cemented by hard calcrete	? Golgol	1

In summary, therefore, the three independent lines of evidence suggest the bones were interred in a shallow grave only a few inches deep, before the period of soil formation and contemporaneous with the other evidence of human occupation on the shores of the freshwater lake.

The reliability of the shell date (ANU-331) for determining the age of human occupation may be questioned both on the basis of contamination and on the inconclusive association with artefact bearing horizons. As far as the former is concerned, contamination is likely to be caused in this case more by younger pedogenetic carbonate than by older radioactively dead carbon (Deevey *et al.* 1954, Rubin *et al.* 1963). Contamination by limestone dilution is not considered a hazard in this environment from which geologically old limestones are absent. Contamination errors are therefore likely to produce a date which is too young rather than too old. The date obtained, however, is consistent with

other available evidence including the entire sequence of radiocarbon results (nineteen from the Willandra lakes) and the degree of pedogenesis in the buried soil from which the shells were derived.

The association of the dated shells with the occupational layer is supported by the following evidence:

- 1 Both shells and artefacts from the Mungo soil bear a distinguishing encrustation of secondary carbonate. Only shells with this crust were used for dating.
- 2 The shells were lying on the deflation surface in the immediate vicinity of the occupational layer in which *in situ* artefacts were located. While some shell could have fallen from higher stratigraphic levels during erosion (although the soil carbonate crust argues against it), there is little possibility of any shell being appreciably older than the occupational horizon on which it lay.
- 3 The presence of the shells in the dune is difficult to explain without attributing them to human transport.

The evidence therefore suggests that the derived age is a realistic one for the shells and that they in turn are closely related to the occupational horizon. This interpretation is currently being tested by determining the radiocarbon age of charcoal from the occupation horizon, using a sample which in the reconstructed section (fig. 12), is equivalent to a level 6 in. (15 cm.) above that of the burial. An attempt will later be made to date the bone directly by C^{14} analysis of collagen or bone apatite. In the meantime, however, two estimates of age can be made with varying degrees of reliability.

First, the remains are certainly older than the high water gravels of the Zanci depositional phase which has been established elsewhere at about 20,000 B.P.

Secondly, in the correlation between the two adjacent sections (figs. 11 and 12) the remains fall close to the horizon dated by carbonate encrusted shells suggesting an age closer to 30,000 B.P. An estimate between 25,000 and 32,000 B.P. seems consistent with the data presently available. The radiocarbon analysis of charcoal on the occupational horizon will provide an additional and independent estimate.

Quaternary environment

On the basis of the lake stratigraphic evidence, I have previously argued that extensive physical changes affected this area, some of which were of a cyclic nature (Bowler 1970). The periods of high lake level indicate a climate with low temperatures, high run-off or a combination of climatic conditions quite different from those of the present regime. During the high water phases, salinity was low and transverse quartz dunes were blown from the lake-shore beaches. The lake-full periods were later followed by drying during which dune building ceased and soils formed on earlier aeolian deposits. In the transitional phase from high to low levels, clays and silts were periodically (perhaps seasonally) blown from the saline muds of the drying lake floor forming the widespread clay or sandy clay lunettes.

The linear dunes likewise record periods of alternate stability and instability. The presence of buried soils within the dunes points to at least three such periods requiring vegetation destruction and sand mobilization over wide areas.

The lake stratigraphic sequence above indicates at least three dune-building soil-forming cycles in late Quaternary time, two of which occurred during the period of human occupation. The Mungo lake-full phase was followed by partial drying and soil formation approximately 25,000 years ago. The final high water Zanci phase (see high beach gravels, fig. 12) commenced about 23,000 and ended at 16,000 B.P. in response to drastic changes in the hydrological regime, when salinities increased and the lake dried for the last time. Both linear and lake-shore dunes were then stabilized and soils began forming on the youngest aeolian deposits.

The exact magnitudes of temperature and precipitation changes which controlled this sequence are difficult to specify, but their reality is beyond doubt. The effects recorded in the widespread changes in landscape, sediments and soils demonstrate the controlling influence of climatic change in this non-glaciated environment.

Although human occupation apparently continued in this area from near 30,000 B.P. until modern time, a period which witnessed extensive changes in the physical environment, Jones and Allen (pp. 47-56) observe little change in the typology and economy between the Mungo occupants and recent inhabitants of the area. But the climate and regional environment known to the Mungo people with its numerous large freshwater lakes was considerably different from that of the last 10,000 years during which the lakes were virtually dry. The relative absence of changes in the archaeological data throughout that period points to the wide adaptability in the living habits of early Australian man and to the diverse use which he made of his stone implements. Continuing studies will help to define the range of human adaptation involved and will establish more precisely the nature and sequence of the environmental history in what is now a semi-arid region.

2 Archaeology (R.J. and H.A.)

As soon as it was realized that the burnt and broken bones cemented into the Mungo unit by calcrete could possibly be human, the archaeologists in the party were in a quandary. We had not come prepared for an excavation, and yet here before us was a feature which could contain the oldest human bones so far discovered in Australia. The field identification was hasty and speculative, being based on two burnt fragments of parietal and mandible, and it was by no means certain that a later careful examination would confirm it. The calcrete block (plate 3) was in a state of fragmentation with only a central core still *in situ*. Other pieces had recently broken off and in the loose sand there were many wind-eroded pieces of bone. The blocks had an area of about 2 sq. ft, with a calcrete thickness of 6 in. With D. J. Mulvaney, we photographed and drew the features, collected the loose bones, then numbered and removed the broken carbonate blocks. The central carbonate block still in place was sectioned to confirm its stratigraphical position, undercut and then removed. The finds were packed into a suitcase and arrived back at the laboratory undamaged.

Having had the human identification of the bones confirmed, Bowler and ourselves returned to the site a week later to carry out a detailed survey, to collect dateable material and to look for other archaeological manifestations.

Structure of the site

Erosion, particularly from a freak rainstorm which greeted us on our second arrival, revealed stone tools: a few *in situ* and many more on the surface. Both groups had a similar limited distribution, being found only at the outcrop zone of calcrete over a distance of 150 yd, parallel to the Pleistocene lake beach, and some 20 yd away from it. No artefacts were found outside this zone. There were twenty-seven artefacts *in situ*. Some had their tops just protruding from the surface, and cross-sections cut into the deposit showed them firmly cemented into the undisturbed carbonate-rich Mungo deposit. Four artefacts were discovered while excavating into dark patches containing charcoal, described below, and these were totally covered by calcreted deposit of the Mungo Unit. All of the *in situ* tools were covered with a thick coating of carbonate.

The surface collection consisted of 200 artefacts, all of which had been encrusted with a thick coating of carbonate up to 1 mm. thick and in one case 3 mm. From their fresh appearance, they had only recently been eroded out of the deposit. From their concordant distribution with the *in situ* tools and their carbonate covering, it is highly probable that they are of the same original assemblage. No typological differences could be detected between the two collections.

Deflation had also exposed some fifteen patches of black deposit. These were usually roughly circular or oval in plan, some 2-3 ft in diameter, and their boundaries with the unstained sands of the Mungo deposit were sharp. Excavation showed that they were shallow about 2-4 in. deep with a flat elliptical cross-section. There were carbonates concentrated in the upper half of this section. The black deposit contained finely divided charcoal, burnt animal and fish bones, shells, and, in four cases, stone artefacts. These were cemented into the deposit by a thin layer of calcrete which covered them. The occurrence of the faunal elements within these patches differed considerably between each other as shown in table 3. We do not think that they represent general lake side debris, but that there has been selectivity in their deposition. Most of the bones are burnt and broken, and they are associated *in situ* with stone tools. For these reasons, we think that the circular patches are hearths, and that their contents are the remains of human diet and other activities.

These hearths were all situated in the same general area as the carbonate encrusted surface and *in situ* tools, parallel to the shingle deposit representing the beach of the high lake level, and some 15-20 yd away from it. The burnt and calcrete covered human bones were at the extreme south-east end of these hearths and about 15 yd away from the nearest one. We think that the artefacts, the hearths and the human bones are all different manifestations of the same archaeological site. This was a transient lake shore settlement, the inhabitants camping, using stone tools and burning their dead on the sandy beach and dune a few yards from the water's edge.

Typology

Of the *in situ* collection, there were nineteen retouched implements and only eight unworked flakes. A high proportion of finished implements was also found in the surface collection of carbonate encrusted artefacts, with ninety-two worked tools and ninety-five-

flakes, suggesting that most of the tools had been brought in ready made from elsewhere to receive only a final trimming or resharpening on the site. Most tools were made of silcrete, a known worked source of which is a lake-side gravel bed some 10 miles to the south-west.

TABLE 3
Contents of hearths

Hearth number	Mammal		Bird	Fish	Shell	Emu egg	Stone tool
	Large	Small					
1	X			X	X	X	
2				X			
3		X	X	X			
4		X	X				
5	X	X		X			
6	X			X			
7		X		X		X	
8		X	X	X	X	X	X
9		X	X	X			
10	X	X	X	X	X	X	X
11	X			X			
12		X		X	X		
13	X	X	X		X	X	
14	X			X			
15							X
16							X

Most of the implements have been manufactured from flakes, some of which would have been large, up to 4.7 cms. thick. Other tools are made on well-shaped cores, and a few from naturally broken stones. Typologically, three general classes of implements can be detected. All of these are within the category 'scrapers', ranging from heavy worked cores to fine scrapers. We are carrying out a detailed statistical analysis to describe the assemblage and also to test the validity of our typological distinctions. The proportions of various types within the assemblages are set out in table 4, and some representative examples are shown in fig. 13.

Core tools (fig. 13, nos. 1, 2) These usually have one flat striking platform from which flakes have been struck forming a circular domed or elongated keeled core. A second pattern of flaking was superimposed on the first, causing the angle of the worked edge to become steep, with extensive step flaking. Typically this angle is 90° or more, forming an obtuse overhanging edge. Most tools have this steep worked edge around much of their perimeter and a few show it all the way round. These tools have traditionally been called

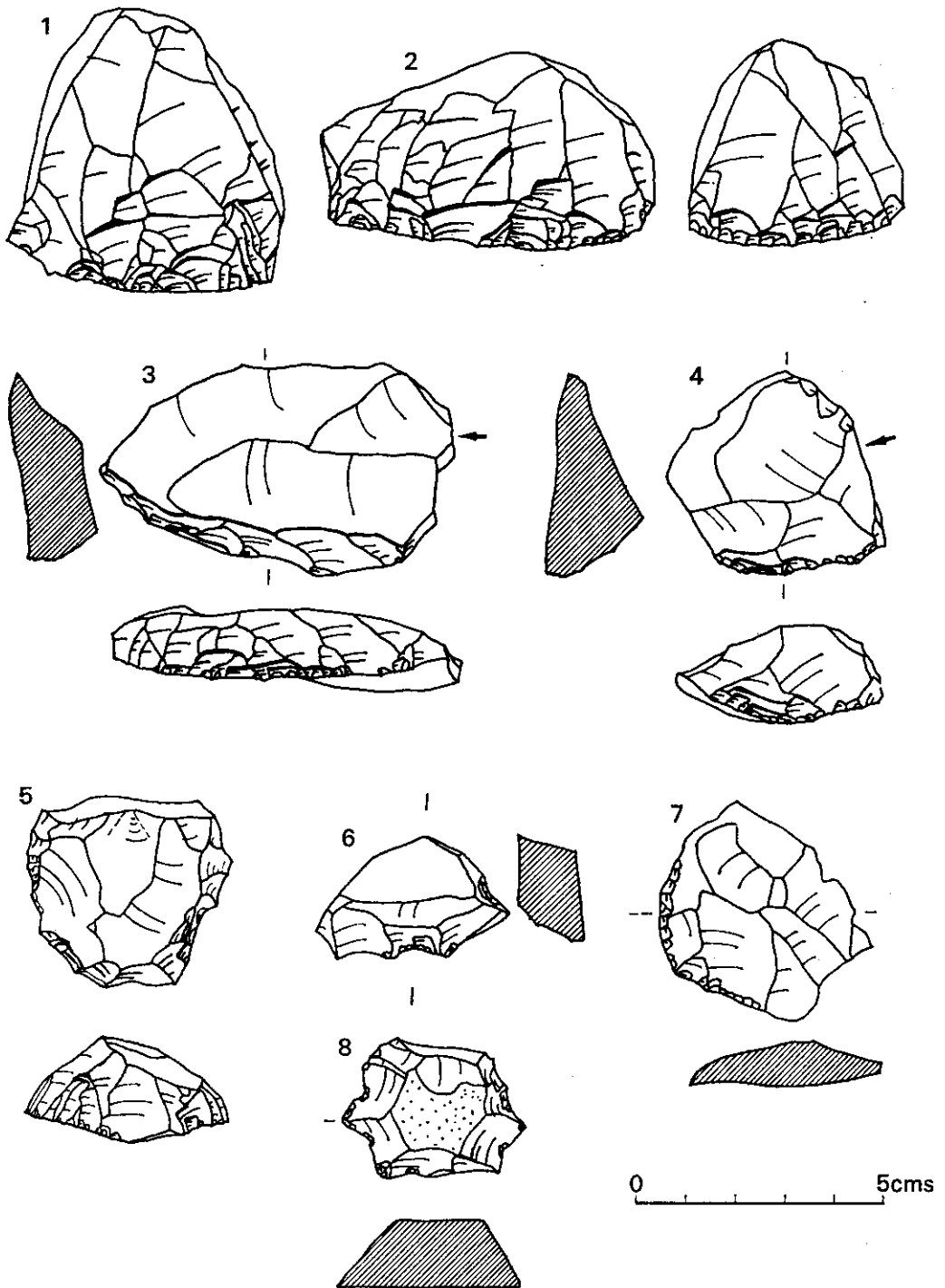


Figure 13. Artefacts from the Pleistocene living site at L. Mungo, western New South Wales; see text for details

'horse hoof cores' in Australia (e.g. Tindale 1937: 49-56; McCarthy *et al.* 1946: 10-12). They are heavy, ranging from 100 to 1,000 g. in weight, and were probably used for pounding or heavy planing and scraping activities.

TABLE 4

Proportions of tool types

Tool type	<i>In situ</i> number	Surface, calcrete encrusted collection number	Total	
			number	%
'Horse hoof' core tools	5	20	25	22.5
Steep edge scrapers	9	45	54	48.7
Flat scrapers	2	16	18	16.2
Multi concave scrapers	0	2	2	1.8
Others	3	9	12	10.8
Total	19	92	111	100.0

Steep edge scrapers (fig. 13, nos. 3-6) These were manufactured on thick flakes, and they have one or more steeply retouched edges whose angles range from 70° to 90°, with an edge height of between 1.0 and 2.5 cm. Often the edges show steep step flaking and they are usually straight or slightly convex in plan. There does not seem to be any formal relationship between the position of the worked edges and the total implement; rather, any suitable part of the flake was chosen and retouched until a robust steep edge was formed. For this class of implements in Australian industries, we propose the term 'steep edge scrapers'. Functionally they would have been suitable for a wide variety of cutting or scraping and planing activities.

Flat scrapers (fig. 13, no. 7) This is a provisional name for a class of flat flakes with fine oblique retouch around parts of their margins, giving them a sharp working edge with an angle of between 45° and 70°. They would be suitable for cutting flesh or vegetable material.

In addition to these tools, which formed the bulk of the collection, there were some scrapers with small deep concave working edges (fig. 13, no. 8) and a few unretouched cores with alternate flake scars. Some large rounded pebbles of calcrete occurred *in situ* singly or in small groups. These could have been obtained from the immediate neighbourhood and their probable function was as hearth stones or as anvils for cutting and pounding. They show no obvious signs of working. Several pieces of ochre were present in the carbonate encrusted surface collection.

This assemblage, both in terms of the characteristics of its flaking and the types of implements present, is typical of other old Australian industries. We propose to call the cultural tradition to which they belong, the 'Australian core tool and scraper tradition'. The Mungo assemblage is the oldest evidence for it so far discovered in Australia. Jones (1968: 186-91) and Mulvaney (1969: 151) have discussed other sites in Australia, whose antiquity goes back to 20-25,000 years B.P. Within this tradition were many variants both in time and space; however, it survived on the mainland from at least 25,000 or 30,000 years ago to about 6,000 B.P. when it was replaced, or added to, by a complex of point, backed microlith and adze flake elements (Mulvaney 1969: 107-32). In Tasmania, it persisted until the time of European contact (Jones 1966). We feel that it is highly unlikely that the Mungo site will eventually prove to be the oldest find of this tradition in Australia.

Fauna

The age of the Mungo site and the chemical composition of the deposit has affected the survival of the evidence. All the bones we recovered came from charcoal-enriched areas and most were burnt and covered with carbonate. It is possible that other bone and shell material incorporated within the A horizon has been leached out. Bone, shell and charcoal may have acted as foci for the deposition of secondary carbonate during the period of soil development within the Mungo sediments. Faunal identification has been carried out where possible, but the fragmentary nature of most of the material makes sophisticated analysis difficult.

Shell fish The species represented is the freshwater bivalve, *Velesunio ambiguus*. At present this species is distributed throughout the Murray-Darling river system from high upstream to the brackish lower waters. It thrives in shallow water on stable sandy or muddy bottoms, though it also has the ability to survive severe drought conditions (Williams 1968: 69). In the ethnographic literature for the Murray-Darling region, there are many references to Aboriginal exploitation of this resource during the summer months (Lawrence 1968: 85-122; Allen 1968). They were not seen eating them in winter. Little is known of the ecology of this species nor of factors affecting its availability during the yearly cycle.

Fish Most hearths contained fish remains. Vertebrae, spines, headbones and otoliths were represented. In one hearth, portions of the backbones of two fish of different sizes were found cemented together by carbonate. Specific identifications were made using bone and otolith material and by comparing our collections with reference collections

held at the Inland Fisheries Research Station at Narrandera with the aid of Dr L. C. Llywellyn. All of the fish remains so far identified are Golden Perch, *Plectroplites ambiguus*, of which there are a minimum number of seventeen individuals. From the fossil material, fish ranged in size and age from immature individuals weighing less than half a pound to mature fish weighing more than about 35 lb., most being in the medium to large part of this range. From the growth rings on one vertebra, Llywellyn observed that the individual concerned would have been about fifteen years old at time of death.

The species has high salinity tolerance, but requires the introduction of large volumes of water into its habitat to begin breeding, which nowadays takes place in the spring when the floodwaters flow down the Murray-Darling rivers. Similar spring floods could be expected during glacial conditions with the annual melt of the periglacial snows in the catchment highlands. However, as the species nowadays can only breed with a water temperature of more than 23° C (74° F) (Lake n.d.: 28-30), this water must have been warmed during its passage through the network of channels and lakes of the drainage system of western New South Wales. The presence of immature fish at the Mungo site may mean that it was occupied soon after this spring period.

Birds Bird bones are present, but species cannot be identified. However they are all from small birds.

Many fragments of emu egg were found, both *in situ* and covered with carbonate on the surface. In this region, emus are widely distributed and common nowadays throughout the scrubby and open plains. They lay their eggs in late winter, the young being born in late winter to early spring.

Mammals In some cases, teeth and jaw fragments allow specific identification, which was carried out by Mr J. H. Calaby, CSIRO Division of Wild Life Research, Canberra. The data are tabulated in table 5, the ecological information being taken from Krefft (1866), Marlow (1962) and Calaby (pers. comm.). The bettong is a burrowing animal (Tedford 1967: 145), but the Mungo material is burnt, broken, and found in hearths, so we think that it represents food remains. With the exception of the thylacine and wombat these are all small animals, weighing a few pounds only. There were in addition many broken bone fragments which belonged to animals much bigger than the ones listed above. Judging from the diameters of the long bones, some of these came from animals weighing more than 20 lb. in weight, and the most likely candidates would be the macropods - wallaby and kangaroo.

Comments Although the faunal collection is a small one, it does raise several interesting points.

(a) *Faunal history* The fauna, both terrestrial and lacustrine, is similar to that found in the region at the time of European contact as described by Krefft (1866), and its continuity there over a period of some 25,000 years is most interesting.

Apart from the thylacine mandible, no bones of extinct animals were found at the site, nor eroding elsewhere from the Mungo Unit or more recent deposits. One heavily mineralized and rolled mandible of an extinct giant marsupial, probably a *Macropus*

TABLE 5

Mammal remains and data(a) *In situ* or carbonate encrusted on surface of hearths

Species	Min no.	Common name	Preferred habitat	Present in region in 1850
<i>Bettongia lesueur</i>	5	rat kangaroo	sandhill, woodland and plain	yes
<i>Lagorchestes leporides</i>	1	brown hare wallaby	open grassland, light timber, or saltbush	yes
<i>Dasyurus geoffroii</i>	1	western native cat	open savannah woodland, desert woodland	yes
<i>Lasiorhinus gillespiei</i>	1	hairy nosed wombat	open plains or mallee	yes
small Macropodinae (no sp. ident. possible)	3			

(b) Surface find on Mungo deposit at site

<i>Thylacinus cynocephalus</i>	1	Tasmanian tiger	open forest and scrub	extinct on mainland
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(J. Calaby: pers. comm.) was found on an eroded surface, about half a mile from the site, showing that this giant fauna once existed in the area. The mineralization was quite different to that of the Mungo bones, and it is probably much older. The Mungo evidence contrasts strongly with that from Lake Menindee a hundred miles away to the north-west, where a rich fauna of extinct forms including giant marsupials together with representatives of modern types as in Mungo, were collected from a lunette dated by the samples L.J. 204 26,300 ± 1,500 B.P. and GaK 335 18,800 ± 800 B.P. (Tindale 1964; Tedford 1967: 18). Charred bones of an extinct kangaroo in what was believed to be a hearth, and the presence of a few stone flakes *in situ* argues for the presence of man with this fauna at that time (Tindale 1955: 284-5; Tedford 1967: 18), though the evidence is not conclusive (Jones 1968: 187).

The discrepancy with Mungo may be due to one of three factors:

- 1 The Mungo collection may be too small to be representative. However, no bones of extinct fauna have been seen eroding out of the entire Mungo lunette, nor any other lunette within the Willandra system.
- 2 At 25,000 to 30,000 years ago, there may have been large regional variations in the occurrence of the giant fauna and/or in human dietary habits. However, the two sites are both lake-side dune sites in a connected drainage system only a hundred miles apart. Such a regional diversity of the entire giant fauna would be remarkable, even if it were on the verge of becoming extinct.
- 3 Mungo and Menindee may not be of the same age. We feel that Bowler's stratigraphic work and series of C¹⁴ dates provide a good control on the age of the Mungo Unit. From the published accounts (Tindale 1955; Tedford 1967) and from our own observations, the stratigraphy at Menindee is complex, and possibly further stratigraphic and radiometric work is warranted there in view of the problem raised by the Mungo site.

At present, there is no obvious answer to this question, but its solution has implications for the more general problem of the chronology and causes of the extinction of Australia's giant fauna, and the possible role of man as an important or decisive agent in it. (Tindale 1959; Gill 1963; Tedford 1967: 151; Martin 1967: 105-6; Merrilees 1968; Jones 1968: 202-5).

(b) *Human diet* The diet of the prehistoric inhabitants of Mungo Lake was varied and based on a wide exploitation of land and lake resources. From the sand dunes and plain they obtained bettongs, from the scrub or open bush a range of small marsupials including native cats and small macropods, and they caught larger animals as well. They foraged for emu eggs and caught small birds. They dug into the mud near the lake shore for shell fish and caught golden perch in the deeper water.

Some of this food could only be caught seasonally. Emu eggs are available in the region in late winter. The shell fish are easiest to catch in summer and judging from the ethnographic evidence, may not be available or palatable in winter. The young perch would probably have been caught in late spring or early summer. To sum up the seasonal evidence, the site was occupied at least during late winter and also late spring/summer. From the stratigraphy and structure of the site together with the quantity of artefacts and food remains, it is likely that it represents the débris of only a few visits by a small group of say one or two dozen people. It was probably a seasonal camp on the lakeside, occupied a few times over a period of a small number of years before being covered up or abandoned.

This economy is remarkably similar to that practised by the ethnographically observed Aborigines of the Murray-Darling river system in the last century (Lawrence 1968: 85-122; Allen 1968). These caught small and large marsupials, emus and their eggs, shell fish and scale fish. Their usual seasonal movements were to the lakes and rivers in late spring and summer, fanning out into the bush country in winter in search of bush foods, camping near ponds and billabongs after the winter rains. The only major detectable difference between the two diets is that the modern Aborigines also ground a variety of vegetable foods, particularly grass seeds. They did this with sandstone grinding dishes. No such tools were found in the Mungo assemblage. They are, however,

common in other sites in the area, some of which are probably of Pleistocene age, and only further field work will indicate whether or not the apparent absence of grinding equipment in Mungo times is real, or due to a chance absence at the Mungo site itself.

This continuity of a broadly based and varied economy over a period of about 25-30,000 years in this region, is of considerable interest in view of the climatic and cultural changes which have taken place here, and in view of the evidence and theories put forward for drastic and revolutionary differences between Pleistocene and post Pleistocene adaptations in some other regions of the world, notably Europe, West Asia and the Americas.

3 The human remains (A.G.T.)

This material, the oldest yet recorded for Australia, consists of the cremated remains of two individuals, both the result of single, separate disposals. Although fragmentary, at least 25% of the total skeleton of Mungo I is present, and all regions are represented. Mungo II consists of approximately thirty small fragments, mostly of the cranium and vertebrae. The preliminary comments below refer to Mungo I only.

A few scattered fragments were found eroded from the dune. A layer of carbonate 1-2 mm. thick encrusted them. The bulk of the material, however, was embedded in thirteen blocks of carbonated sand which had broken away from the exposed carbonate layer. Dental and percussion drills were used to clear individual pieces from the matrix and all fragments were then immersed in weak acid for final cleaning (plate 4).

Cranium Approximately 175 fragments permit considerable reconstruction, particularly because a large area of the base is preserved intact. Most of the occipital bone has been reconstructed from matching fragments. The face is poorly represented: the right zygomatic and virtually all of the maxillae are missing or so thoroughly smashed that fragments cannot be reconstructively identified. The frontal, parietal and temporal bones are badly fragmented but several edge-matchings have facilitated examination of 5-7 cm. of the lambdoid, sagittal and coronal sutures on one or both sides.

Mandible Of two large portions of the body, one includes the symphyseal region between the canine alveoli, and the other the left alveolus at M2 and M3. Ramus fragments include the right condyle and an area which, after reconstruction, includes the complete left coronoid process and much of the condylar process.

Dentition Three isolated teeth were recovered but none retains enamel.

Post-cranial All areas are represented. The long bones are extensively broken; the largest single fragment is an 11 cm. portion of the left femur shaft. Several relatively complete vertebral bodies and neural arches are preserved, three neural arches being held in anatomical relationship by the encrusting carbonate. A few carpals and tarsals are undamaged.

Morphology Mungo I is a young adult female of gracile build and small stature. The sphenoccipital synchondrosis is barely ossified and the cranial sutures remain open.

Compared to recent Australian Aboriginal females the cranial vault and long bones are thin and poorly muscle-marked. Several features are typical of recent Aboriginals generally, including a rounded orbital border of the zygomatic bone and the general form of the basicranium and the zygomatic trigone. Metrics indicate a very broad basicranium. The brow ridges are divided, with no suggestion of a torus. There is no evidence of parietal bossing or of sagittal keeling. The mandible displays a distinct mental trigone and sigmoid notch. There is no trace of a genial pit and the minimum antero-posterior width of the ramus is more than 35 mm.

There are several palaeo-Australian characteristics present; their significance is increased in view of the individual's sex and age. There is considerable recession of the frontal squame behind the orbital margin, marked post-orbital constriction and moderate temporal crest development in the area immediately posterior to the zygomatic trigone. In view of the relationship which has been suggested for the Australian Aboriginal and the Solo population, it is important to note that in Mungo I the foramen ovale is single and does not lie in a pit, and that the petro-tympanic fissure does not lie on the floor of the glenoid fossa.

The extraction of the bone from its matrix and its colour, size and form, permit some conclusions regarding the method of disposal. It is clear that the individual was cremated as a complete and fully-fleshed cadaver. The pyre was insufficient to achieve full incineration and most bones of the back and neck seem to have been little more than singed. (The neural arches of three mid-thoracic vertebrae, the axis, atlas and occipital condyles and the right mandibular condyle and glenoid fossa, were all in correct anatomical relationship.) The size and distribution of recovered fragments indicates total and thorough smashing of the burnt skeleton, particularly the face and cranial vault. In some instances the direction of the blow can be deduced. The state of the edges of the burnt fragments indicates that smashing of the bones took place after the pyre had been allowed to cool and that re-firing did not occur. Finally, from examination of the calcrete blocks, it is clear that the ash and smashed bones were gathered together and deposited in a conical hole or depression 16–20 cm. deep and approximately 75 cm. in diameter. This deposition took place either beneath the pyre or immediately adjacent to it.

The method of disposal in this case has been recorded ethnographically in South-East Australia. It is also consistent with Tasmanian practice, both recent and, at least in the west of that island, more than 1,000 years ago.

Conclusion

The Mungo site is dated to between 25,000 and 32,000 years old. It is thus the oldest archaeological site so far discovered in Australia. Several cave sites from northern, southern and eastern Australia have basal deposits dated to a little over 20,000 years B.P. (Jones 1968), the Menindee site may date from 18,000 to 26,000 years B.P., and in the Keilor terrace system, Gallus (1968) claims human artefacts of the same order of antiquity as Mungo, though details of their typology have not yet been published. The human remains at Mungo, being by far the oldest dated skeletal material from Australia, are of considerable interest. The cranium displays some of the palaeo-Australian features

seen in the Talgai, Cohuna, Mossgiel and Kow Swamp crania (Macintosh 1965; Thorne 1969).

The diet of the Pleistocene inhabitants of Mungo was similar to that found in the area in the ethnographic record. The stone industry persisted on the mainland until some 6,000 years ago and in Tasmania until last century. Cremation was practiced in south-eastern Australia and Tasmania in ethnographic times, and the Mungo remains confirm Hiatt's prediction (1969) that cremation has a Pleistocene antiquity in Australia. In these features, it seems possible that a distinctively Australian culture was already established in the region when the Mungo Site was occupied some 25-32,000 years ago.

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Abstract

Bowler, J. M., Jones, R., Allen, H. M., and Thorne, A. G.

Pleistocene human remains from Australia; a living site and human cremation from Lake Mungo, western New South Wales

A recently discovered Pleistocene archaeological site at Lake Mungo, western N.S.W., is announced and described. This was found within the core of a lunette sand dune at a level dated to between 25,000 and 32,000 years B.P., and is thus the oldest archaeological site so far discovered in Australia. The stratigraphy and chronology are described, and a palaeo-environmental reconstruction is made. Within the site were stone tools, hearths, faunal remains and a human cremation. The Mungo typology changes little in south-eastern Australia until about 6,000 years ago, and the diet is similar to that recorded in the ethnographic record. The cremation was of a young adult female; the bones had been smashed after burning. Morphologically, the remains show some resemblances to Australian Aborigines, but there are also some palaeo-Australian features.

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19 The Demography of Hunters and Farmers in Tasmania

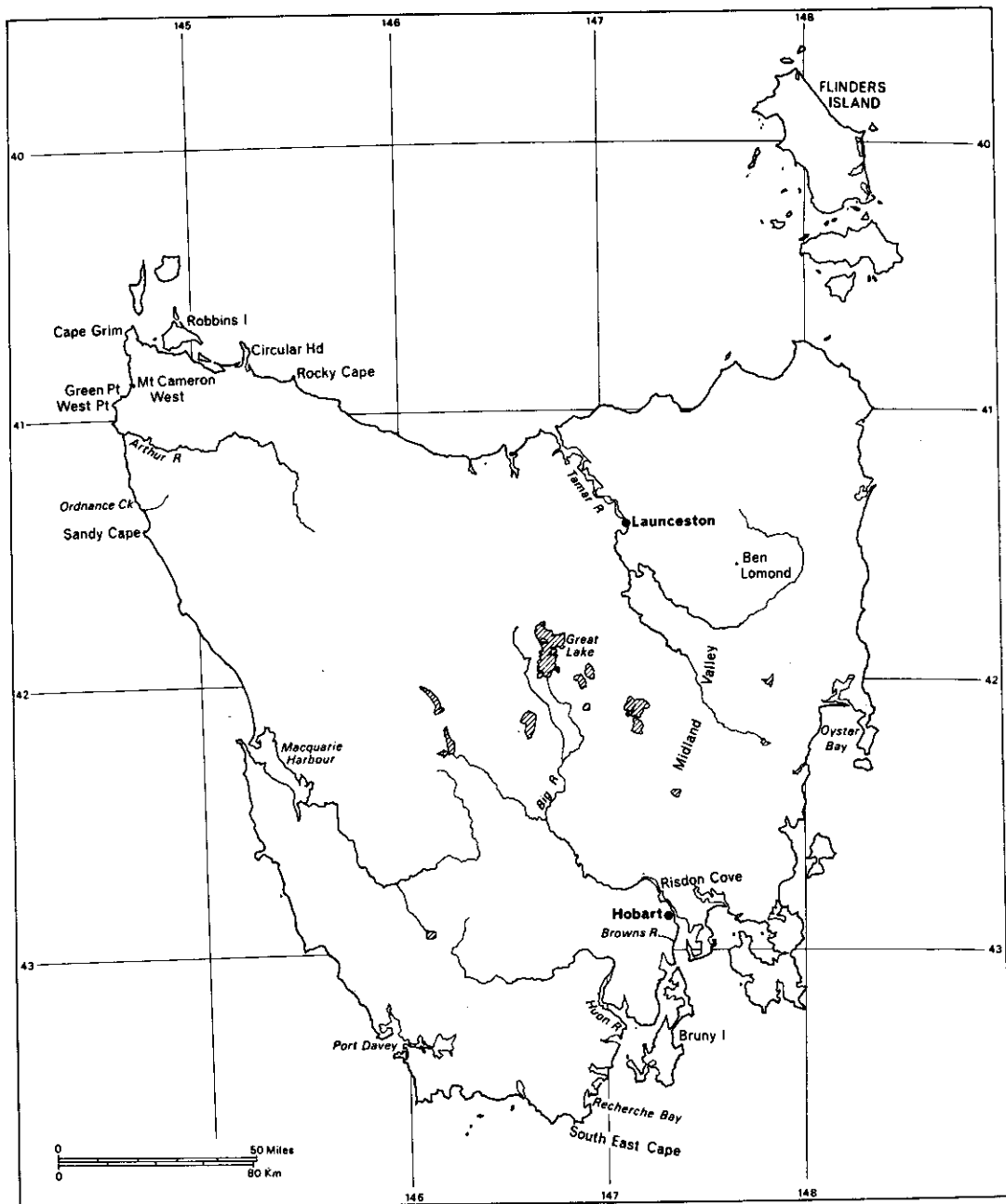
Rhys Jones

The cultural change which is focal in our view of the history of man is the Neolithic Revolution. This is what separates the hunter from the farmer, the savage from the barbarian. If we look back at the history of the last 10,000 years, the main thread of the story is the invention, development, and spread of agriculture throughout the entire inhabited world.

The interface between Palaeolithic and Neolithic fascinates us, and, when we think of it, we automatically cast our minds back thousands of years ago to the end of the last Ice Age and to the beginnings of the post-glacial period. Yet in Australia, the Neolithic Revolution is happening all around us, and it will be one of the fascinating problems of Australian archaeology and history to combine our disciplines to study it. We are fortunate, for we have a detailed historical documentation of the entire process; the exploration, economy, and race relations. It happened such a short time ago in most places that the countryside is essentially the same now as it was during the first impact, and we can look at the land and see our own effect on it and compare it with that of the hunters, unhampered by 10,000 years of previous farming (Tindale 1959:42-6; Jones 1968:201-11, 1969; Merrilees 1968:4-5, 16-20). There are still trees standing which were already old when the first squatter walked by and ring-barked them; and there are people living, both farmers and hunters, who have experienced the change. Indeed, in some parts of Australia, the process is going on at the present day.

In this brief essay, I hope to begin an attack on the problem by considering the relative sizes of the human populations of Tasmania under both hunting and farming economic régimes. I have chosen population, as it is one of the most important parameters used by biologists when seeking to establish

Fig. 19:1 Tasmanian localities referred to in text



the success or failure of a species. Tasmania is convenient because, being an island, it is circumscribed (Fig. 19:1). The ethnographic accounts are surprisingly good, considering that they were all written before the science of anthropology had begun (Hiatt 1967-8), and recently they have been vastly augmented by the publication of the field journals of G. A. Robinson from 1829 to 1834 (ed. Plomley 1966). The wealth of archaeological sites on the island (Jones 1965, 1966; Lourandos 1968) gives us some hope that one day it will be possible to extend this picture into the past in some detail. In addition the geography and history of the European colony there have been well documented.

A comparison between the populations of hunters and farmers in Tasmania brings out the revolutionary nature of the changes in human ecology which have occurred there in the past two hundred years.

The Hunters

The Aboriginal population level is difficult to assess, and because all the Aborigines are now dead it is impossible to test our conclusions in the field. However, some attempt must be made, and a careful analysis of the historical sources allows us to reach figures of a similar order of magnitude by several methods.

Contemporary estimates quoted by Roth (1899:163-5) range from Melville's 20,000 to G. W. Walker's 500. We can begin with a base line, for Robinson mentions the names of 281 Aborigines in his journals (1829-34), most of whom he actually met in his travels (Plomley 1966:977-88). A few Aborigines met or alluded to are not named, and seven more were captured in 1842 (West 1852: 2, 65). It would be possible to make a diligent search of Robinson's and other journals, official reports, police records, and

newspaper accounts—particularly in the period 1820 to 1830—of all the Aborigines captured, killed, died through disease, found as corpses, or abducted. We might thus obtain a minimum number for the population at that time. I have not done this systematically, but my guess is that the figure of approximately 300 from Robinson could easily be doubled. These records pertain to the period 1825 to 1835, fully twenty to thirty years after the original British settlement, and must be regarded very much as minimum estimates for the original Tasmanian population. The groups seen by Robinson were only remnants of former numbers, some 'tribes' being represented by as little as one individual (Robinson 3 November 1831, in Plomley 1966:500-1) and others had totally disappeared. Large areas of Tasmania had been entirely depopulated. I think that we can safely say that the original population was considerably in excess of 600.

TASMANIAN TRIBAL ORGANISATION

The most convincing estimates of the pre-contact Aboriginal population have been based on studies of Tasmanian social organisation, into tribes and language groups, coupled with contemporary estimates as to the size of these groups (Milligan 1890:6; Walker 1898; Roth 1899:163-71; Radcliffe-Brown 1930a:695). These, combined with Schmidt's linguistic work (1952), produced a coherent picture of the pattern of Tasmanian tribal organisation at a general level. These workers, however, did not have the benefit of Robinson's field notes, nor the results of archaeological work, and the new data can be used to test hypotheses already in the literature. I differ slightly from the above authors in my final estimate of the size of the Tasmanian population, but it is heartening to find that such a re-analysis brings out a

broad consensus of opinion as to the distribution, order of magnitude, and basic social structure of the Tasmanian Aboriginal population.

First, there is a question of nomenclature. All writers on Tasmanian social organisation have referred to the basic units as 'tribes', but the word has had different meanings for different people. Berndt (1966:26-33, 56) has shown that for Australianists, the term 'tribe' has a wide range of meanings from the broadest linguistic units to small-scale aggregations of local groups. The names 'horde', 'clan', and 'community' have been defined in terms of sociological attributes so specific that they are outside the scope of the Tasmanian historical evidence. The colonial term 'mob' is not synonymous with 'tribe', since it referred to Aboriginal groups ranging from foraging units of a few families to large seasonal congregations of several hundred people. Given the flexible nature of the term 'tribe', the precedence established by its use in the early historical literature, and the lack of an obvious alternative, it is useful at least for the time being to retain the word in discussions on Tasmanian social organisation. To avoid any confusion, I propose the term *Robinson tribe* to describe those units called 'tribes' or 'nations' by Robinson, and *Walker tribes* for the units called 'tribes' by Walker (1898:178-87), following a common practice in the natural sciences, e.g. Beckmann thermometer, Gaussian curve.

Robinson tribes. Throughout his journals, Robinson talked about the Aborigines being organised into 'tribes' or 'nations'. He was particularly interested in their composition and location, because the information was vital to him in finding them in the first place, and in making sure that all surviving members of such groups had been contacted. His journals contain a wealth of information

on the subject, gathered from his own observations, and from interviews with Aborigines, both as to the contemporary situation and what it used to be in the past.

A Robinson tribe consisted of a group of people who called themselves by a particular name, and were known by that name to other Aborigines. Many had two names (Plomley 1966:969-70), the reasons behind this not being known, but a linguistic analysis of the meaning of the Aboriginal names for these tribes would be most illuminating, if it could be done (e.g. see Plomley 1966:970). Each tribe was related to a particular locality, the core areas of which were well known; thus people talked of the 'Sandy Cape Tribe', 'Port Davey Tribe' and so on. From Robinson's journals, Plomley (1966:970-6) has counted and mapped forty-six of these tribes (see Fig. 19:2). This distribution is similar to that of archaeological remains and direct ethnographic observations (Fig. 19:3), indicating that a reasonable coverage of the island's tribes has been achieved. There are, however, some important gaps where we have no evidence of tribal names in areas known to have once supported large Aboriginal populations. The most important of these areas are in the Midland Valley and the country about Hobart and Launceston, all occupied early by the British colonists. Some named locations on the map refer to what were once several tribes, though there is no extra information to allow us to map them separately, and Plomley (1966:969) thinks that as little as half of the original tribes have been recorded. I think that, taking into account these gaps in our knowledge, the figure of forty-six should be increased by 50 per cent, so let us take a figure of seventy as being a reasonable, conservative estimate for the number of Robinson tribes in Tasmania before European contact.

Along the coasts, where we have the most

Fig. 19:2 Tribal and linguistic map of Tasmania

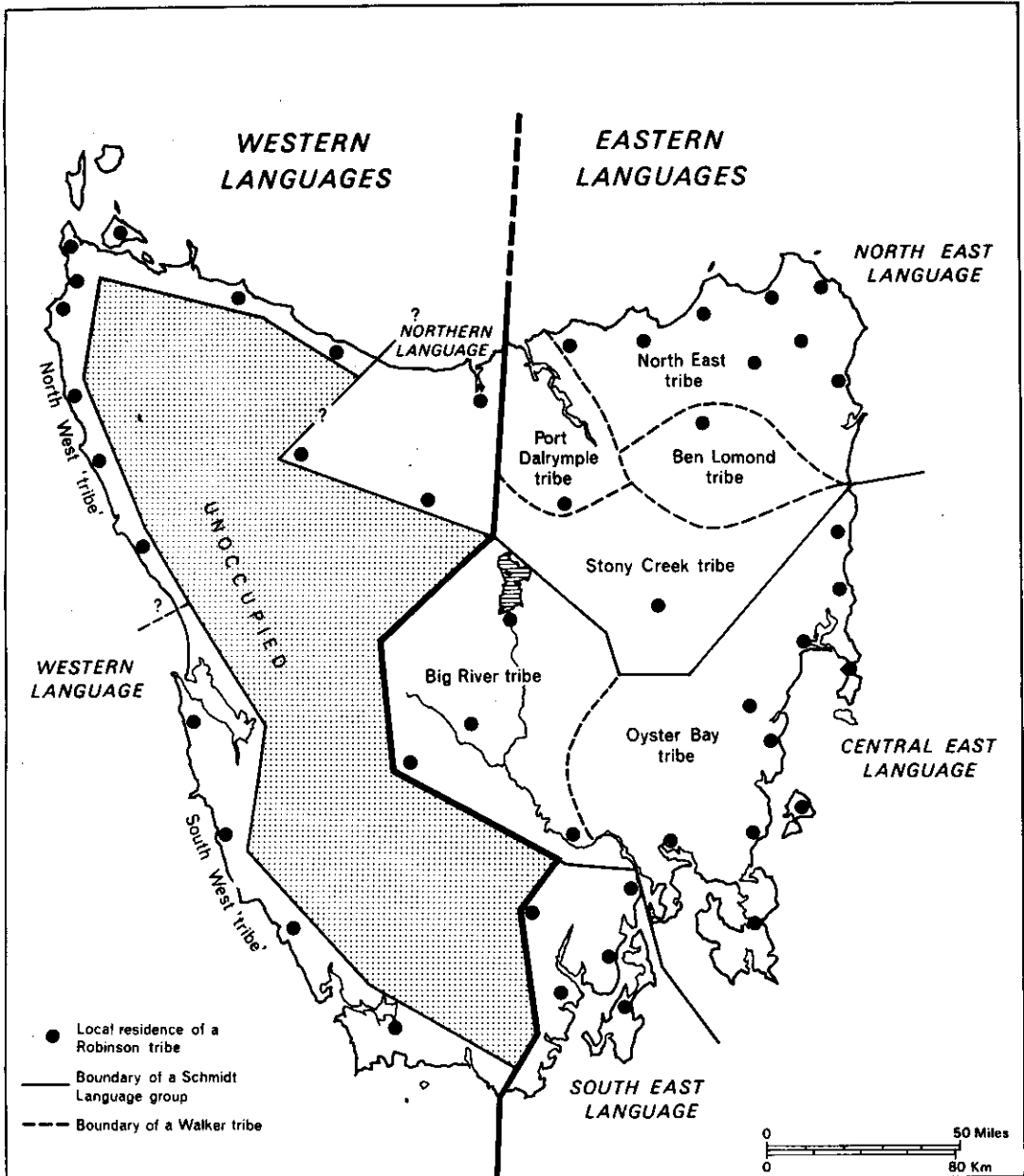
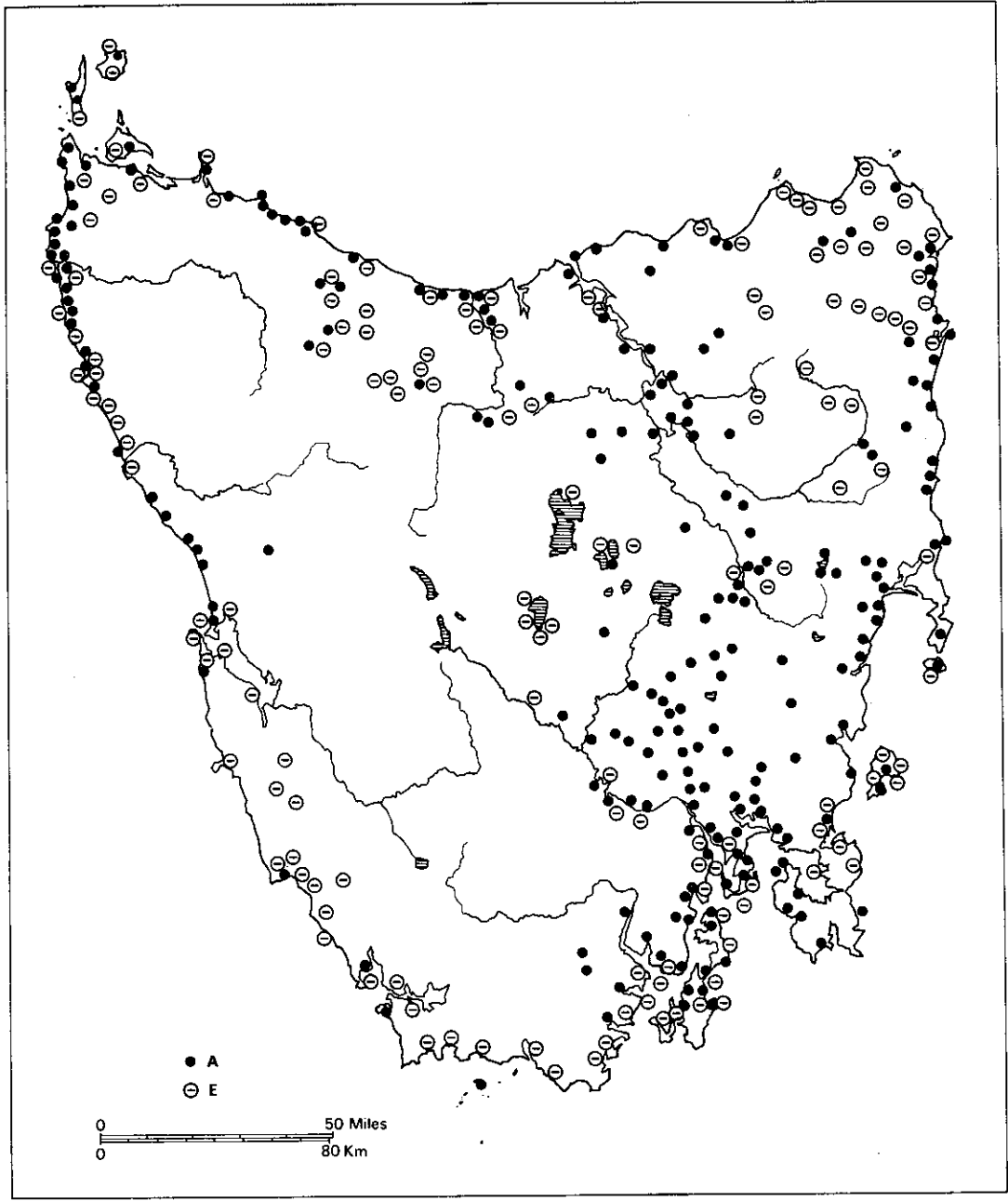


Fig. 19:3 Distribution of Aboriginal man in Tasmania. A, archaeological remains (after Jones 1968:209); E, direct ethnographic observations (after Hiatt 1967-8:192).



complete evidence, we see that the Robinson tribes were regularly spaced, each one occupying about 24 to 32 km (15 to 20 miles), and in the southwest, with its lower food resources, this distance was approximately doubled (Plomley 1966:969). Aborigines knew when they were in the country belonging to a certain tribe, and some evidence on the native geography of part of the southeast coast suggests that natural features such as rivers or hills sometimes formed boundaries (Robinson 11 January 1831, in Plomley 1966:312). Although a tribe was often to be found in or near its recognised territory, the annual seasonal movements of most groups took them 150 km or more away from their core areas and across the territories of neighbouring groups (Walker 1898; Kemp 1963:243; Hiatt 1967-8:190-205; Plomley 1966:969). Ideally, the tribes were exogamous (Robinson 21 June 1834, in Plomley 1966:888), the wife usually moving to her husband's tribe, and analysis of the data from northwest Tasmania shows that marriages took place with neighbouring tribes.

There are difficulties in trying to calculate the size of these tribes. Robinson, our best source as to their composition and size, was working when the Aboriginal population had collapsed in most places and consisted of the ageing remnants of former numbers, whereas the late eighteenth-century maritime explorers, who were seeing an intact population, only stayed a short while in Tasmania and did not venture far from their ships. In southeastern Tasmania, on 12 February 1793, Labillardière (1800:308-9) saw a group of forty-eight people, consisting of ten men, fourteen women, and twenty-four children, eating their food around seven fires; elsewhere he saw forty-two people, consisting of seven men, eight women, and twenty-seven adolescents and children. On 31 January 1802 Péron (1809:195-6) saw a party of

twenty women returning to their husbands after shell fishing, implying a total population of sixty to eighty people including men and children. Later, at Oyster Bay, he saw twenty-five to thirty people from his ship. In 1804, Knopwood reported that an exploring party led by Collins found a native village at the Huon River consisting of twenty families (Plomley 1966:18), and Kelly in 1816 saw what he thought were at least fifty people on Robbins Island on the north-west coast (Bowden 1964:30). In 1824 a tribe, probably from Oyster Bay, consisting of sixty-four people, visited Hobart, and the following year a tribe of fifty people visited the town also. A despatch to Governor Arthur in 1828 relates how a party of about fifty Aborigines used regularly to visit Bruny Island and Recherche Bay (West 1852: 2, 15; Plomley 1966:49, 100 n.3).

In 1830 Robinson met his first tribe in the bush, namely the Port Davey tribe (Robinson 18 March 1830, in Plomley 1966: 132). This consisted of twenty-six people, but of these twenty were adults, two were adolescents, and only four were children or babies. To be a viable breeding unit under hunter-gatherer conditions, there would have had to have been as many children as adults, giving us a population of forty. Although this was Robinson's first encounter with them, the tribe itself was by no means intact. One year previously, at least nine people from this tribe had died in a pulmonary epidemic at Bruny Island (Plomley 1966:76-7), and we have no means of knowing how many more had died in the bush from similar causes. The remnants of the West Point tribe met in 1832 consisted of twenty-three people, of whom ten were men, five women, four adolescents, and only four children (Robinson 17 July 1832, in Plomley 1966:633). Given sex and age ratios similar to those observed by the first French explorers, such

a group would have consisted of ten families giving about forty people.

Each tribe apparently consisted of a number of *hearth groups*, a hearth group approximating to a single family of man, wife, children, and sometimes dependants and friends. In the tense evening before the attack on Robinson at the Arthur River, he describes the Aborigines taking up their positions for eating and sleeping according to their tribal affiliation, the remnants of each tribe in family hearth groups close to one another, and away from those of other tribes (Robinson 3 September 1832, in Plomley 1966:649). Labillardière, in the observation referred to above, saw forty-eight people in seven hearth groups, and elsewhere, in February 1793, he saw nineteen people in three groups (1800:303) (Plate VII). In the bush, in May 1792, he saw fourteen fireplaces in one spot, the people being absent (1800:127), but a population of between fifty and eighty people is implied.

Robinson and other observers saw many groups of huts clustered together in what they called villages. On the west coast these huts were dome-shaped, about eight to ten feet (2.5 to 3 m) in diameter and height, and they contained anything from about six to twelve people. I suggest that on the west coast each hut may have corresponded to a hearth group, and the village to the local residence of part or all of a Robinson tribe. Observers of these villages usually refer to 'several' huts or 'some' huts, suggesting figures from between two and ten. Near the Great Lake Robinson saw a village consisting of five good bark huts (Robinson 10 November 1831, in Plomley 1966:512), and on the west coast he saw a village of four huts, from which he deduced that it belonged to a tribe of forty people (Robinson 6 June 1830, in Plomley 1966:168-70). These villages, and through them the tribes, are probably represented

in the archaeological record. Near Ordance Creek, on the west coast, Robinson (9 March 1834, in Plomley 1966:858) described a large shell midden with concave holes ten to twenty feet (3 to 6 m) wide and from three to five feet (1 to 1.5 m) deep in the surface of the ground. These were for Aboriginal habitations and they had large piles of shells beside them. Near the same place six months earlier, he saw native habitations in hollows dug out of the side of a sandhill, and his field sketch shows five huts (Robinson 4 September 1833, in Plomley 1966:790).

Identical circular depressions have been found on shell middens on the west coast (e.g. Jones, J. F., 1947). Practically every large stable and well-grassed midden that I have seen on the coast between Mount Cameron West and the Arthur River has these well-defined and standard shaped depressions on their surfaces, and I have seen no such features elsewhere on the coast. I think that they were hollows made for huts, or at least for shelter from the wind. A midden (W.P.2) 1 km south of the West Point lighthouse has five of these circular depressions on its surface; the midden (W.P.1; Jones 1966:6-8) 1 km north of the lighthouse has seven depressions (Plate VIII), and another midden at Green Point (G.P.1) some 4 km north of the lighthouse has five. If my arguments are valid, this gives us a picture of these large shell middens as local residences of one or more Robinson tribes, a tribe itself numbering from about thirty to fifty people. The huge size of the middens (e.g. Jones 1966) and their proximity to elephant seal breeding grounds makes this ecologically feasible. The period referred to is from 1,000 to 2,000 years ago.

To sum up this section, I think that in traditional times the extreme population range of a Robinson tribe was between 30 and 80 people and that the majority lay

between 40 and 70 people; that is between 10 to 20 families. In Tasmania there were of the order of seventy such social units.

Walker tribes and Schmidt language groups. Tasmanian society was also organised into larger units than the Robinson tribes. From an analysis of the accounts of colonial settlers, official reports and the writings of learned visitors to the Flinders Isle settlement, J. Backhouse Walker (1898) divided the Aboriginal population of Tasmania into four regional groupings: 1. Southern tribes; 2. Western and northwestern tribes; 3. Central tribes; 4. Northern and northeastern tribes.

Schmidt (1952) carried out an exhaustive analysis of all the Aboriginal vocabularies available to him and published his work without having had the opportunity of seeing Robinson's journals. He defined the existence of five distinct languages or dialects (1952: 54-6), a conclusion which finds general support from Capell (1953:315, 1968:7). These could be divided into two major groups; the eastern and the western languages (Fig. 19:2). In the eastern half of Tasmania, there were three languages or dialects, those of the northeast, central east, and southeast. Along the west and north-west coast one language, the western language, was spoken and another related one called the northern language was situated in northern Tasmania, somewhere between the Circular Head District and the mouth of the Tamar. These linguistic units were identified with Walker's general tribal divisions, and I have mapped their position on Fig. 19:2.

At one time or another, Robinson had with him Aborigines from most parts of Tasmania. By cross checking who could or could not talk to whom and by tabulating all the observations Robinson himself made on linguistic differences across the island,

it is possible to build up a parallel picture which conforms well with the Walker-Schmidt pattern. The distribution of some elements of material culture such as huts and watercraft types together with non-ecologically based cultural traits such as myths, hair styles, body cicatrice patterns, uses of body ochre, and food tabus, etc., parallels the linguistic pattern. So also do details of traditional enmities and friendships, who was afraid and who was pleased to go to certain parts of the island and meet certain other Aborigines. This broad configuration of linguistic and cultural groups makes excellent sense ecologically and receives support from archaeological work. Let us call these major units *Schmidt language groups*.

There were also social units in order of magnitude somewhere between these language groups and the Robinson tribes, and I will call these *Walker tribes* (after Walker 1898). Within the central eastern language group there were two Walker tribes, the Big River and the Oyster Bay. Each of these acted together as a self-contained political unit on some occasions. The members of each tribe met periodically, probably on occasions dictated by the seasonal fluctuations in the abundance of resources. Although the Big River and Oyster Bay peoples spoke the same language and sometimes co-operated, especially in their last desperate counter-attack against their European oppressors, yet the diet, seasonal movements, and exploitation of mineral resources of each tribe had a decidedly different pattern. Both the European settlers and the Aborigines themselves recognised the separate identity of the two groups.

Within the northeastern language group, there were four Walker tribes, some of which were almost entirely independent from some of the others. There may indeed have

been some slight dialectical and cultural differences between them. Walker (1898:184, 186) cites evidence that the people of the remote Ben Lomond tribe spoke a different dialect from some of the others in the same language group. Such minor dialectical differences between Walker tribes within a single language group may be what Clark, the catechist at Flinders Island, was referring to when he said that on his arrival at the settlement there were about eight to ten different dialects being spoken by the 200 Aborigines there (Walker 1898:179). In some cases the language group and the Walker tribe coincided. Such was the case with the northern and possibly the southern languages. On the west coast, I think that from a reading of Robinson's journals we are justified in defining at least two cultural units of the same status and order of size as Walker tribes of the east, namely one in the northwest and one in the southwest. I have entered these on Fig. 19:2 as 'tribes'.

Large congregations of Aborigines consisting of several hundred people were sometimes seen by the early settlers. Thus Knopwood (1948:99) met between 250 and 300 people near Browns River, south Tasmania, in 1807 and 200 Aborigines were seen near Launceston in 1824 (West 1852:2, 16). Many other examples have been given by West (1852:2, 6), Walker (1898:177-8), and Roth (1899:164). Whereas in some cases the actual counts may be suspect, we have no reason to disbelieve all of these reports outright, and I think that they represented the seasonal aggregations of the bands of people who made up part or all of a Walker tribe. These reports range from 200 to 500 people and I think that this was the order of size of a Walker tribe.

To sum up, we may define a Walker tribe as the largest social unit which periodically and systematically met together for reasons

Table 19:1 Calculations of Tasmanian Aboriginal population

Social unit	No. of people in each unit	No. of units in Tasmania	Total Aboriginal population
Robinson tribe	40-70	70	3,000-5,000
Walker tribe	300 (200-500)	10	3,000 (2,000-5,000)
Schmidt language group	?600 (100-1,500)	5	?3,000

of food collecting, leisure, politics, marriage, or ritual. All members would have met all other members at one time and place on several occasions, probably at least annually, and the Walker tribe was probably the biggest unit to which any single person felt himself totally part of, though he was aware of neighbouring groups who shared some of his culture. In some language groups there were several such tribes, in others the linguistic and tribal groups coincided. Walker tribes probably consisted of between 200 and 500 people, and we have evidence of about ten such tribes in Tasmania.

DISCUSSION AND CALCULATION OF ABORIGINAL POPULATION

The Aboriginal population of Tasmania can be divided into a hierarchy of social/cultural units. There was one culture (Kemp 1963:243) divided into five language groups, into ten Walker or 'true' tribes and into seventy Robinson or 'local' tribes. In the areas where we have the best information such as the northeast coast and the west coast, we see from Fig. 19:2 that there could be from four or five up to more than eight or nine Robinson tribes within a Walker tribe, and between one and four Walker tribes within a full language group. With some idea of the size of each of these social units, we are in a position to try to calculate the original total Aboriginal population of Tasmania, and I have done this in Table 19:1.

We have no direct evidence of the size of the Tasmanian language units, but for the mainland of Australia Elkin (1964:11) says that membership of a linguistic tribe ranged from about 100 to 1,500, averaging around 500 to 600, and Birdsell (1968:230) thinks that such units averaged 500 people.

We see that there is a fair degree of correlation between the results, and I feel that a figure of between 3,000 and 5,000 for the Aboriginal population of Tasmania is a reasonable approximation to the truth. This figure is higher than the 2,000 of Milligan (1890:6) and Walker (1898:178) or the 2,000 to 3,000 of Radcliffe-Brown (1930a:695), but they did not have the data available to us today, particularly from the west coast. Plomley (1966:18), who may have done a similar calculation to mine, arrives at a figure of 4,000, though he gives no details.

Tasmania has an area of 67,000 km² (26,000 square miles), giving a population density of between one person per 13 km² (5 square miles) and one per 23 km² (9 square miles). The densities on the ground would have been slightly higher because a quarter of the area of Tasmania was not occupied by the Aborigines. All of the Aboriginal groups had access to the coast or coastal estuaries at some time during the year. Tasmania has about 1,600 km (1,000 miles) of coastline, giving a population density of 2 to 3 people per km of coast (3 to 5 per mile). If we include offshore islands recorded in the literature of early contact as being economically exploited by Tasmanian Aborigines, these figures are somewhat reduced (Jones n.d.). They are still high, however, compared with those of most hunter-gatherers, but they fit well into the range of the highest populations living in the rich coastal and riverine regions of Australia (Meggitt 1966:59-62), and North America (Kroeber 1963:131-81). The archaeological

record supports this picture of high coastal populations in Tasmania, for the west coast between Cape Grim and Sandy Cape probably has a higher density of archaeological remains on it than any other coastline so far recorded in Australia.

I have deliberately tried not to draw analogies from the Australian mainland, for fear of confusing the issue in Tasmania. It is interesting to note, however, that the tribal/linguistic pattern set up here for Tasmania shows a strong structural similarity to that on the mainland. The Robinson tribe shares many of the attributes of Radcliffe-Brown's 'horde' (1930b) or L. R. Hiatt's 'community' (1965:24-7), and it was probably similar to them. The hierarchy of social units from hearth groups through to linguistic and cultural units is also paralleled in detail on the mainland (e.g. Radcliffe-Brown 1930a:688; Berndt 1966:53; Meggitt 1966:68-9). Whether these similarities are due to an ancient shared cultural tradition, or whether they are similar because of the action of powerful ecological mechanisms, is a question worth pursuing further.

Death of the Hunters

Man has lived continuously in Tasmania for at least 8,000 years (Reber 1965; Jones 1968:197-201). During that period, archaeological evidence points to the survival of a single cultural tradition with only small changes in some traits. Put in other words, it is likely that the direct ancestors of the ethnographically observed Aborigines had been living on their island in an unbroken line back to the beginning of the post-glacial period. They had probably been there much longer. Carbon dates on the southeast mainland of Australia show that man was occupying the lands adjacent to the ice-locked peninsula of Tasmania at least twenty-five thousand years ago (Jones 1968:186-91). Having

Table 19:2 Decline of Tasmanian Aboriginal population

1770-1800	1830	1833	1834	1836	1838	1847	1854	1859	1863	1869	1877
3,000-5,000	280	151	134	116	82	45	16	14	6	1	0

allowed for all the adjustments which had to be made in the occupation of the new lands made free by the melting of the ice, and in the reorganisation of society forced by the inundation of Bass Strait, there were still 8,000 years of relatively stable conditions in Tasmania for its human population to adjust itself to the environment.

We have two models to consider. Either the population fluctuated widely about some mean, so that in good years it increased rapidly only to be drastically reduced when population exceeded food supply; or having reached equilibrium, the population maintained itself at about that level over a long period of time. If the latter, then this equilibrium position would be somewhat below the maximum number of people the environment could support at any one time, so that the population could be buffered against fluctuations in the abundance of natural resources. There are many ways in which a hunting and gathering society is able to exercise some control over its numbers, for example through infanticide (N. Peterson pers. comm.).

The structure of Tasmanian society was in harmony with the environment, and it closely matched other hunting and gathering societies in Australia and elsewhere both in form and in population density. My own feeling is that the numbers and distribution of Aboriginal man in Tasmania at the time of European contact were the result of a long established equilibrium between population and environment which had probably been set up over thousands of years.

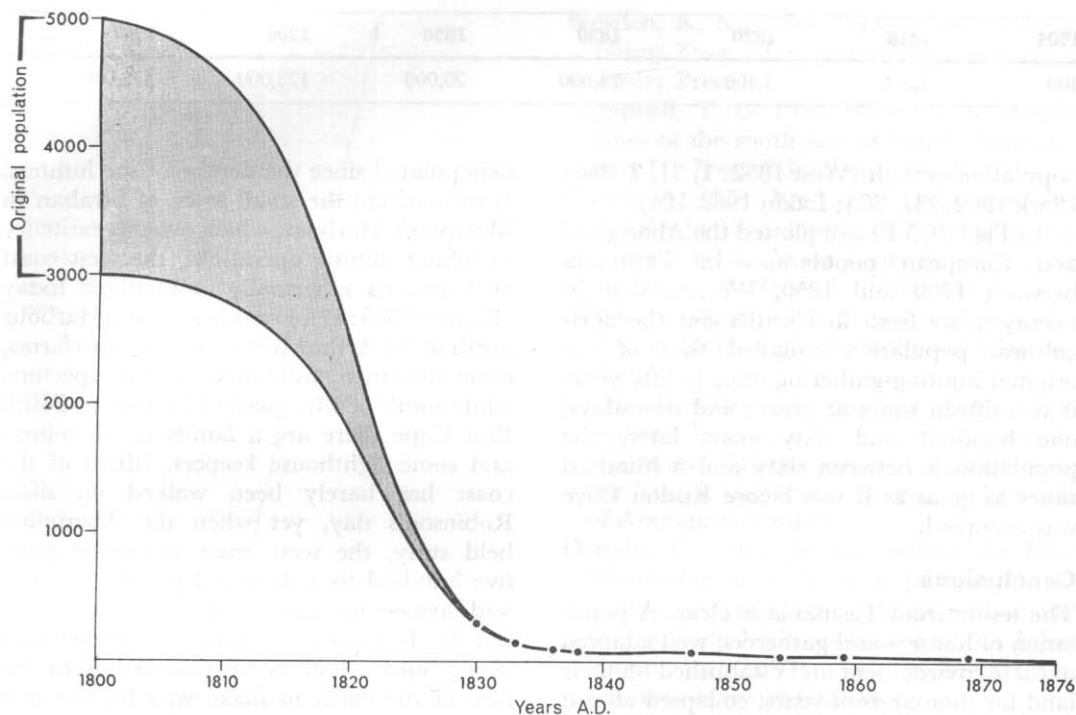
This ancient balance was completely shattered on the arrival of the Europeans.

The fate of the Tasmanians constitutes one of the few examples in written history where an entire people has become totally extinct. Whether it occurred through design or negligence of the Europeans, or whether it was ecologically inevitable, it is the example *par excellence* of genocide. It was an old story in 1803, and it was to be re-enacted many times afterwards on the savannah plains of Australia and in the jungles of Brazil. Savage and barbarian met face to face, and the savage died.

From records kept at various Aboriginal settlements we have fairly detailed figures documenting the final decline of the Aboriginal population from 1830 onwards. There are some minor discrepancies in the published collations of the actual counts (West 1852: 2, 71-2; Roth 1899:164-5; Hormann 1949: 188; Turnbull 1965:163-4; Plomley 1966: 977-88), due to fluctuations resulting from new arrivals and a high death rate, but the figures tabulated below are probably close to being accurate.

I have tried to plot this population collapse in Fig. 19:4, using an approximation to a model logistic curve proposed by Allee *et al.* (1949) to describe the extinction of animal populations. I have taken 1800 to represent the date at which the process began, though Plomley (1966:964) has reminded us that exotic diseases could have been introduced by maritime explorers in the thirty years after 1770. Two model curves are shown, using the top and bottom of the range estimated above for the original Aboriginal population. If the population did in fact decline as shown, then the greatest rate of decrease would have been in the period

Fig. 19:4 Presumed decline and collapse of Tasmanian Aboriginal population. Dots refer to actual counts.



1815 to 1830, when the population would have dropped at the devastating rate of between 10 and 15 per cent per annum. We can compare this with Pool's (1964: cf. 232) maximum estimate for the decline of Maori population after European contact of 1.9 per cent per annum. The curve shows a characteristic long tail on the right hand side, indicating the survival of the remnants of an ageing adult population. The last fullblood Tasmanian died in 1876, seventy years after the establishment of European settlement on the island. Tindale (1937, 1953) and Birdsell (1958:50-2) have documented the establishment and growth of a hybrid Tasmanian-European population on some of the Bass Strait islands and on Kangaroo Island. These populations exist today.

The Farmers

The European population is easy to document, for census records have been kept since the beginning of settlement (see Lakin 1968: 123-64). In the first landing party in 1803 at Risdon Cove there were forty-nine people, and in the following year this was augmented to more than 400 people. Table 19:3 shows the subsequent growth of the European population.

In the early decades most of this increase resulted from massive immigration of convicts, military units, and free settlers. Throughout this period, until about the 1850s, men outnumbered women by two to one, and it is only then that natural increase began to provide the major increment to

Table 19:3 *European population of Tasmania*

1804	1816	1820	1830	1850	1900	1967
400	1,500	5,400	24,000	70,000	173,000	375,000

population growth (West 1852: 1, 31, 2, 356; Clark 1962:237, 383; Lakin 1968:124).

In Fig. 19:5 I have plotted the Aboriginal and European populations in Tasmania between 1780 and 1850. We see that in twenty years from first settlement the agricultural population equalled that of the original hunting-gathering one; in fifty years it was fifteen times as great; and nowadays, one hundred and sixty years later, the population is between sixty and a hundred times as great as it was before Risdon Cove was occupied.

Conclusions

The lesson from Tasmania is clear. A population of hunters and gatherers, well adapted to their environment and established on their land for thousands of years, collapsed almost instantaneously at their first contact with farmers. The story was the same on mainland Australia (e.g. Campbell 1939:33-5; Corris 1968). Some of the reasons for the extinction in Tasmania have been analysed by Hormann (1949) and Plomley (1966:964-7). The Aboriginal population was high by hunter-gatherer standards, being of the same order of size as some of the highest coastal populations on mainland Australia and North America, yet only a hundred and fifty years after the arrival of the Europeans the agriculturally based population is some fifty to a hundred times as great as that of the hunters. The entire Aboriginal population of A.D. 1800 would fit into a small country town of modern Tasmania.

Yet there are some curiosities. In spite of the population explosion large parts of Tasmania have become almost entirely

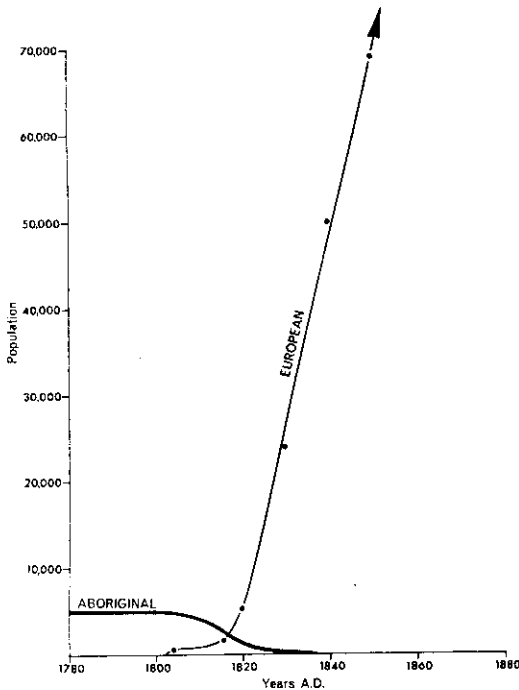
depopulated since the demise of the hunters. If we exclude the small town of Strahan in Macquarie Harbour, which owes its existence to inland mining operations, the west coast of Tasmania is virtually uninhabited today (Farmer 1965:47). From Macquarie Harbour north to the Arthur River there are two farms, some stockmen, fishermen, and prospectors, while south of Macquarie Harbour to South East Cape there are a family of tin miners and some lighthouse keepers. Much of the coast has barely been walked on since Robinson's day, yet when the Aborigines held sway, the west coast supported some five hundred to a thousand people. Hunters and farmers use their land in different ways, but in Tasmania the farmers decided that every hunter had to be removed from the face of the earth to make way for the new order.

Charles Darwin, observing a similar situation in New South Wales in 1836, wrote (1965:230):

Wherever the European has trod, death seems to pursue the aboriginal. We may look to the wide extent of the Americas, Polynesia, the Cape of Good Hope, and Australia, and we shall find the same result. . . . The varieties of man may seem to act on each other; in the same way as different species of animals—the stronger always exterminating the weaker.

We are beginning to look at the historical events in Tasmania in terms of theories of cultural evolution. It is interesting to speculate what effect the events themselves had on the minds of men like Darwin, Tylor, and Lubbock in the original formulation of these theories. Have we come full circle?

Fig. 19: 5 European population growth in Tasmania compared with Aboriginal population decline. Dots refer to actual counts.



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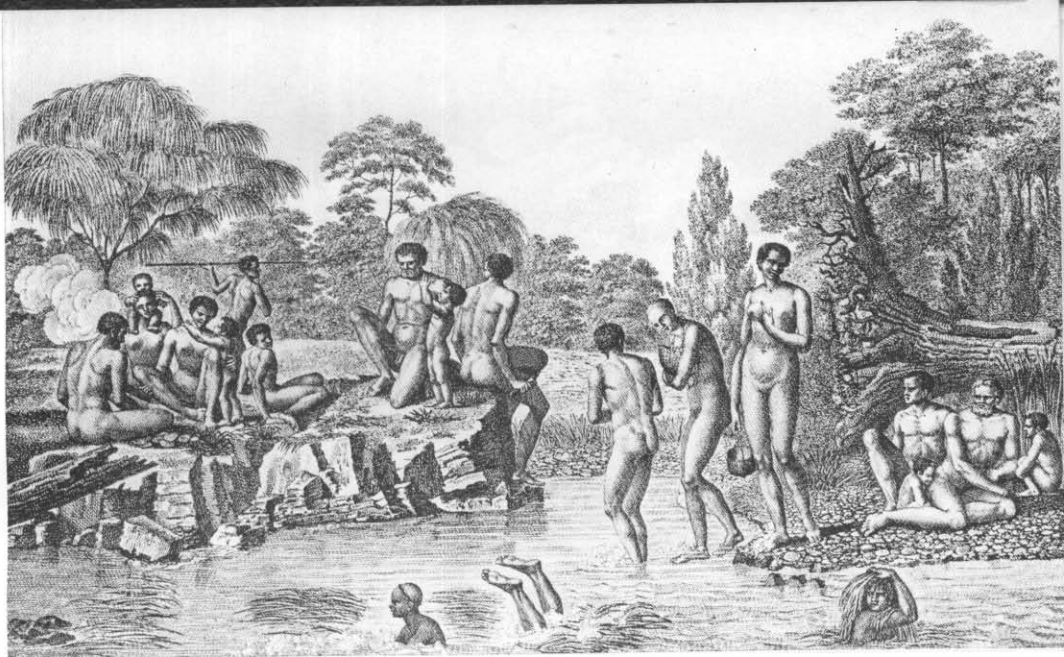


Plate VII Group of Tasmanian Aborigines around their camp fires on a shell midden. Original field drawing by Piron, made in 1792 or 1793, on the southern shores of the D'Entrecasteaux Channel between Bruny Island and Recherche Bay. From Labillardière (1799-1800, Atlas, no. 4). (The Nan Kivell Collection, National Library of Australia.)

Plate VIII Circular depression on the surface of a shell midden at West Point (W.P. 1), northwest Tasmania, 1967 (photograph by Rhys Jones).



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