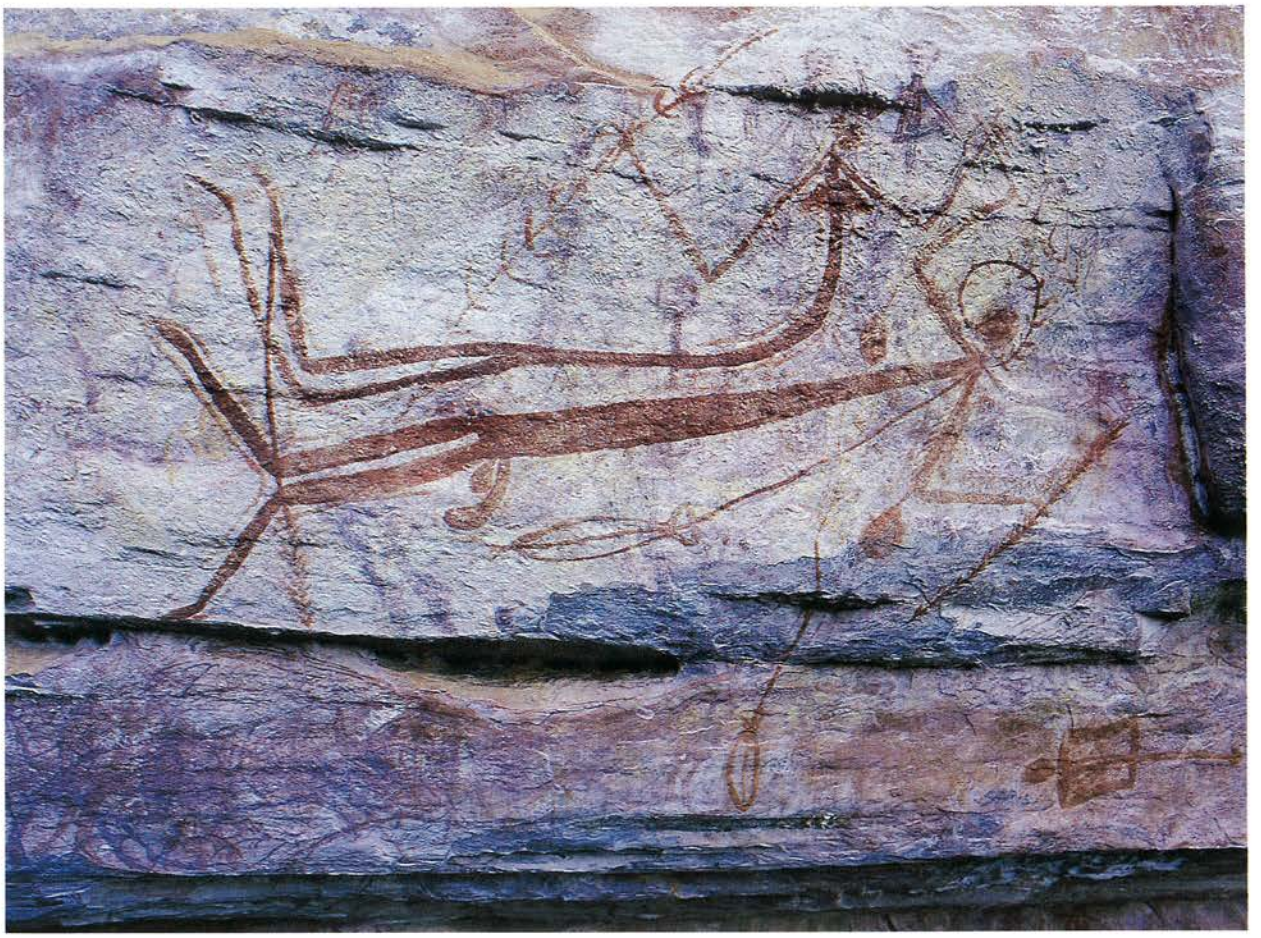


This rock art from Kakadu National Park displays great economy and fluidity of line. Reproduced by permission of the traditional custodians.

I.P. HASKOVEC

CHAPTER 3

CHANGING LANDSCAPES AND SOCIETIES:

15 000 to 6000 YEARS AGO

SYLVIA J. HALLAM

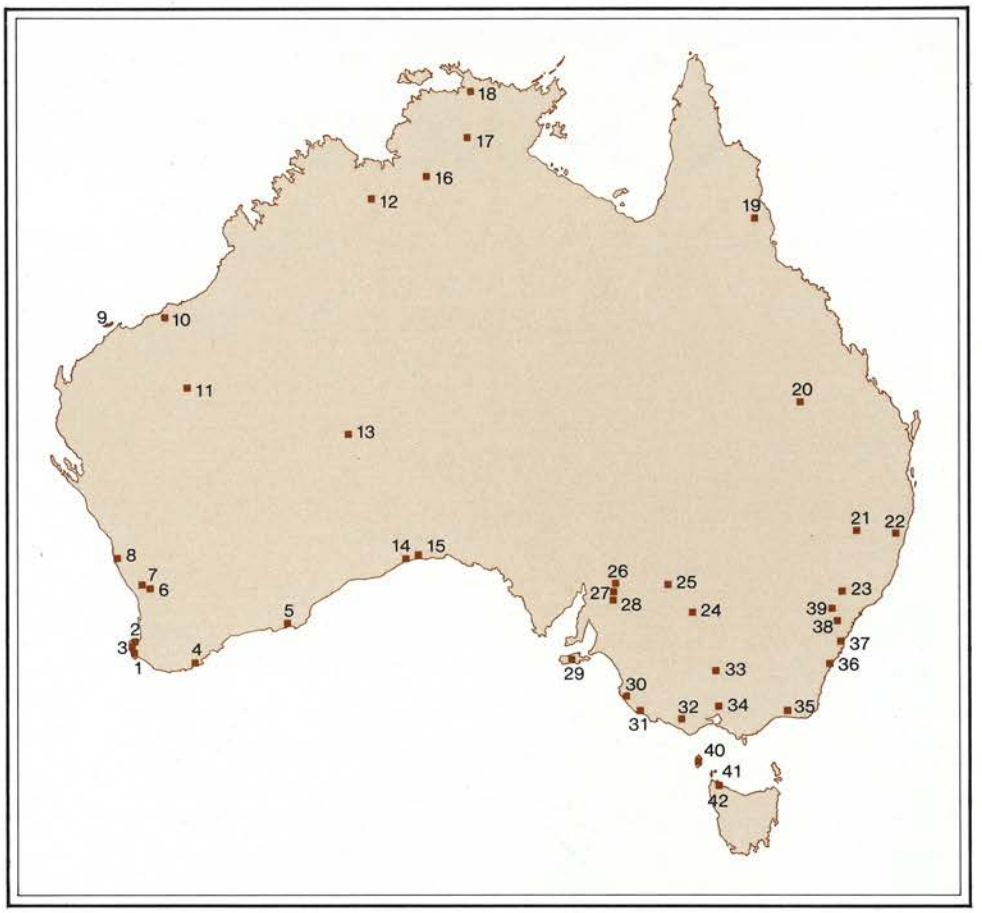
IF WE COULD MOVE through time and space to explore the face of the globe, 15 000 years ago we would find a great diversity of peoples foraging and hunting, living in ways suitable to habitats as different as the tropics and the tundras. Ten thousand years later we would see more people and a more intensive use of resources in many parts of the world. In some tropical regions (such as southeast Asia and parts of central America) and some Mediterranean and semiarid areas (such as southwest Asia, the southern margin of the Sahara and Mexico) people were using and caring for particular plants and animals so carefully that these came to dominate the flora and fauna. People had become less mobile as well as more numerous. They clustered around fixed resources, husbanding them, and they had devised complex social arrangements to control possible conflict within these larger groups. But there was now far more conflict between groups.

All over the world, the population growth that became evident around 15 000 years ago affected human lifestyles. In some areas the increases produced changes that induced even more growth. In southwest and southeast Asia, for example, cycles of population increase necessitated more and more intensive cultivation and stock raising. What is now New Guinea had already embarked on this upward spiral of increased population and intensified resource use before rising seas severed it from the Australian landmass. But in other areas including Australia, population increases and the related more intensive use of resources were constrained by social and economic behaviour instead of transforming it. As a result, population densities in most parts of Australia remained within the limits of available resources.

This helps explain why the Aboriginal Australians did not become agriculturalists. The first European visitors marvelled at how easily foragers on the rich Australian coastal plains harvested in an hour or two enough shellfish, fish, fowl or game for a day, and enough yams, root stalks, cycad nuts or acacia gum to support large groups through days and weeks of ceremonies and festivity. It appears there was little to induce people in such circumstances to rely on particular plants or animals and to tend them laboriously.

ARCHAEOLOGICAL SITES

1 *Devil's Lair, Scott River*
2 *Dunsborough*
3 *Quininup Brook*
4 *Williams Bay*
5 *Cheetup*
6 *Walyunga*
7 *Orchestra Shell Cave*
8 *Jurien Bay*
9 *Dampier Island*
10 *Talga River*
11 *Mount Newman*
12 *Miriwun*
13 *Puntutjarpa*
14 *Madura*
15 *Koonalda*
16 *Sleisbeck*
17 *Ingaladdi*
18 *Malangangerr, Nawamoyn, Nourlangie, Narradj*
19 *Atherton Tableland*
20 *Native Well, Kenniff Cave*
21 *Graman*
22 *Seelands*
23 *Bobadeen*
24 *Willandra Lakes*
25 *Lake Tandou*
26 *Red Cliff*
27 *Roonka*
28 *Tartanga, Devon Downs*
29 *Kangaroo Island, Seton*
30 *Wyrie Swamp*
31 *Bridgewater Caves*
32 *Lake Keilambete*
33 *Kow Swamp*
34 *Keilor, Green Gully*
35 *Clogg's Cave*
36 *Burrill Lake*
37 *Bass Point*
38 *Shaw's Creek, King's Table, Walls Cave, Lyre Bird Dell*
39 *Noola*
40 *King Island*
41 *Hunter Island, Cave Bay*
42 *Rocky Cape*



Aboriginal societies lived through a period of environmental change, when temperatures and sea levels both rose substantially, until at last the climate became much as it now is. They adapted in response to these challenges, but the Aborigines were not passive actors in the drama. Their social arrangements and cultural preferences helped shape the way they came to terms with the transformation.

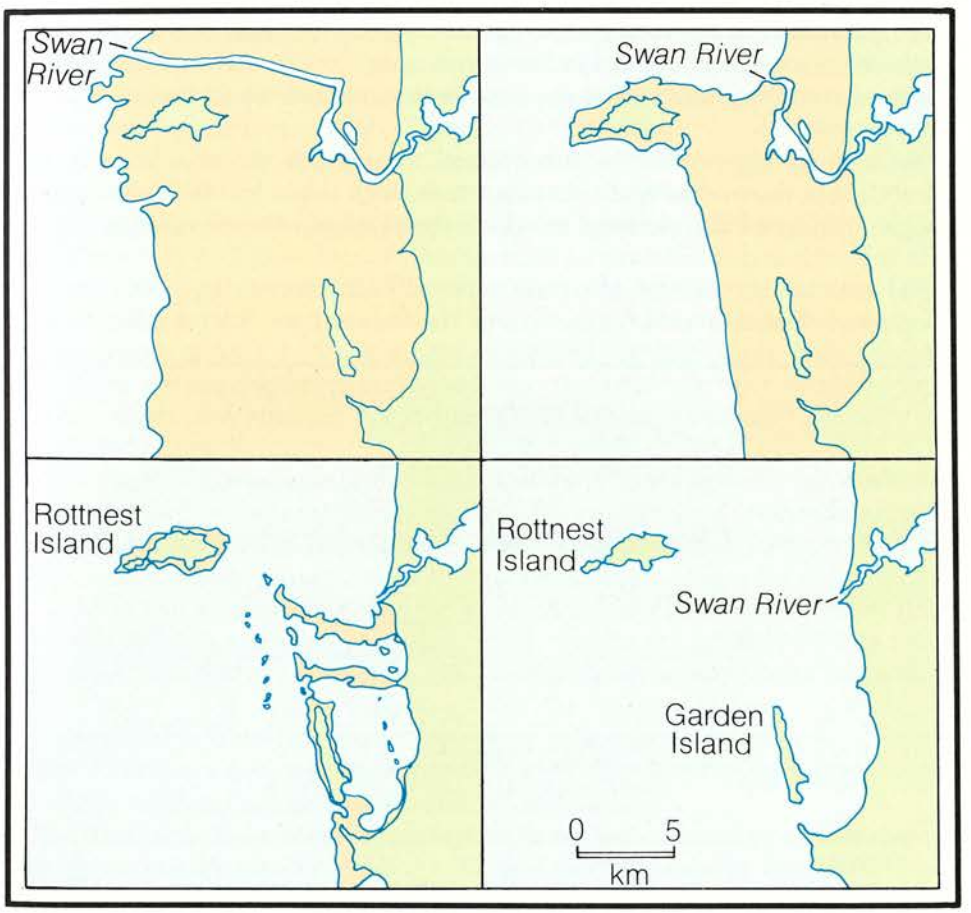
Thus Australian history shows us that humans do not simply react to major environmental changes in predictable ways. Elsewhere in the world people responded to climatic changes of this period by changing the way they organised their food supplies. In tropical Africa and Asia, gardens based on root and fruit crops were developed. In temperate environments, around the Mediterranean and in the Americas, herds of animals and the cultivation of cereal grasses became common. Similar environments existed along the north coasts and in the southeast inland of Australia. Although Aboriginal people living in this areas exploited root vegetables, fruits and seeds, they did not organise them into gardens and farms. Australian societies channelled effort into providing sufficient leisure for a full religious, ceremonial and artistic life.

ENVIRONMENTAL ALTERATIONS

Bidjigurdu—an island. The natives have a tradition that Rottnest, Carnac, and Garden Island, once formed part of the mainland, and that the intervening ground was covered with trees; which took fire in some unaccountable way, and burned with such intensity that the ground split asunder with a great noise, and the sea rushed in between, cutting off these islands from the mainland.

Twenty thousand years ago, when much of the water of the world's oceans was locked in great ice sheets, greater Australia stretched uninterrupted from the equator to 45°S, encompassing the now separate landmasses of New Guinea and Tasmania. As the ice sheets shrank, the oceans rose. Sea levels rose more than 100 metres in about ten thousand years. Between 15 000 and 10 000 years ago sea levels rose rapidly, at times three or four centimetres a year. On coastal plains with a very gentle slope (such as parts of the Gulf of Carpentaria) the sea advanced many metres in a decade. A family group might have returned to the mudflats where they had gathered molluscs during the previous season to find their collecting grounds gone. Areas of rock platform were covered by deeper waters in a few decades; bays and inlets lost the mangrove communities that had provided anchorage for molluscs and crabs. Some biological communities were unable to keep pace with the movement of the shoreline and vanished; others, more adaptable, moved with it.

The alluvial river valleys and coastal plains where many people lived were greatly affected by the rising sea levels. Along the western coast a strip 50 to 100 kilometres wide was lost in the south, up to 400 kilometres off the Kimberley coast. By 8000 years ago rising seas flowed between desert dunes near the Fitzroy River, and mangrove clays formed. A belt of land 50 to 200 kilometres wide was also lost along the south coast of the continent. In the Bight, the sea reached to the foot of an old cliff line last approached by waves 120 000 years ago. A peninsula by the mouth of the Murray River was cut off, forming Kangaroo Island. Much of the Bassian plain between the highlands of Victoria and Tasmania was flooded by about 13 000 years ago. The east coast, where mountains dip more steeply into the



Changes in the landscape around the Swan River, on which Perth is now situated, caused by the sea rising between 10 000 and 4000 years ago.
J. JEFFREY

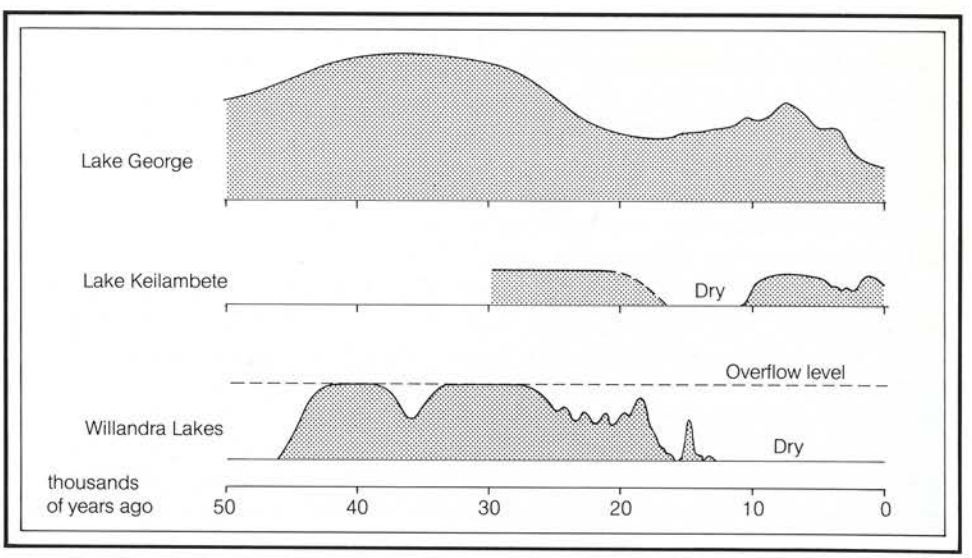
sea, was affected less catastrophically. In the north, Torres Strait was not totally covered by water until about 7000 years ago, at the end of the sea's long advance over thousands of square kilometres of the Carpentarian lowlands.

During this period, many Aboriginal groups might have found their whole pattern of life disrupted. Some lost all their territory. In the west, people who until 20 000 years ago had lived entirely on the coastal plain, had to exploit the forested hills as well as the narrowed plain. Adjustments were made, but we can only imagine what pressures and conflicts people must have suffered as their traditional living space contracted.

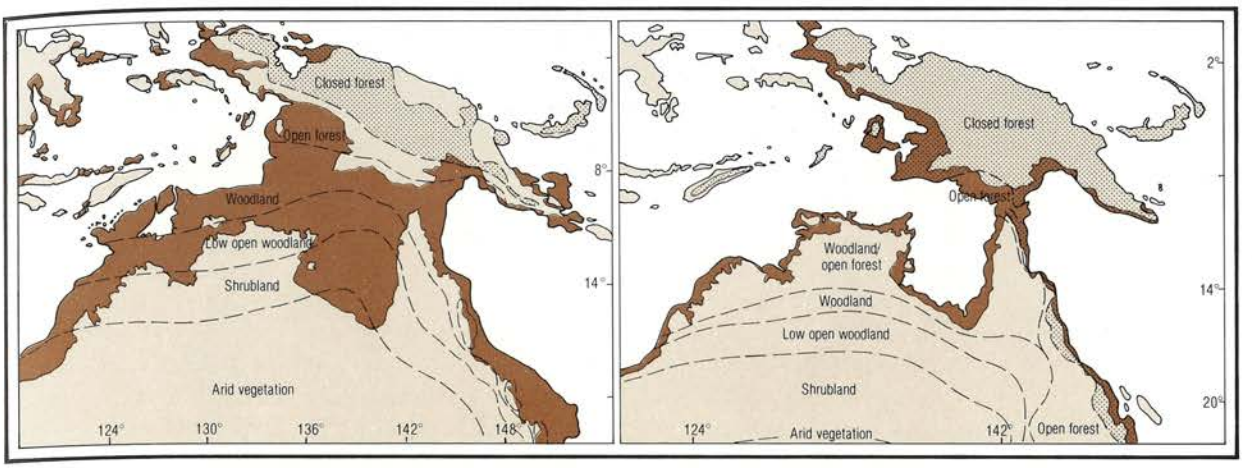
Until 15 000 years ago, the inland had been intensely arid, with strong dry winds whipping up great swirls of dunes. By 10 000 years ago, rising seas had brought maritime influences and rain-bearing winds to areas once far inland. As the seas ate into the coastal plains, rainfall increased inland. But the balance between rainfall and evaporation was delicate. Rising temperatures about 15 000 years ago caused evaporation to increase and the interior climate remained relatively arid. Not until about 10 000 years ago did the seas rise enough to create more inland rainfall. Maximum humidity was reached about 8000 years ago, but while the continental margins became wet and forested, the arid heart became warmer and drier.

Lake George near Canberra and Lake Keilambete in Victoria provide evidence of cool conditions about 18 000 years ago. For the next 3000 years, lake levels fell as temperatures rose. By 10 000 to 7000 years ago, rainfall had increased by one-fifth, and with temperatures similar to the present, the lake levels ceased to fall. But renewed aridity about 6000 years ago caused the fall to resume. Further inland the Willandra Lakes in the Lachlan drainage area shrank and became saline as temperatures rose, and were dry by about 14 000 years ago. Clay dunes formed on their eastern margins, as did similar dunes around the short-lived saline lakes of the great Avon drainage area in the west, indicating great aridity as late as 12 000 years ago.

Around the edges of the continent forests advanced. In the tropical north, now New Guinea, the treeline had risen towards the high ridges by 9000 years ago, and people abandoned the clearings in which they had maintained upland resources such as pandanus nuts and swamps with starch-rich reed roots. Lower down, people rather than climate became the main agent affecting forests. By 9000 years ago people had cleared ground for gardens on the floors of the Wahgi valley and dug



Lake levels fell as climates became more arid about 18 000 years ago. In inland New South Wales, rising temperatures kept the Willandra Lakes dry. Lake levels in the cooler uplands (Lake George) and nearer the sea (Lake Keilambete) were raised again by increasing rainfall from about 8000 years ago.
J. JEFFREY



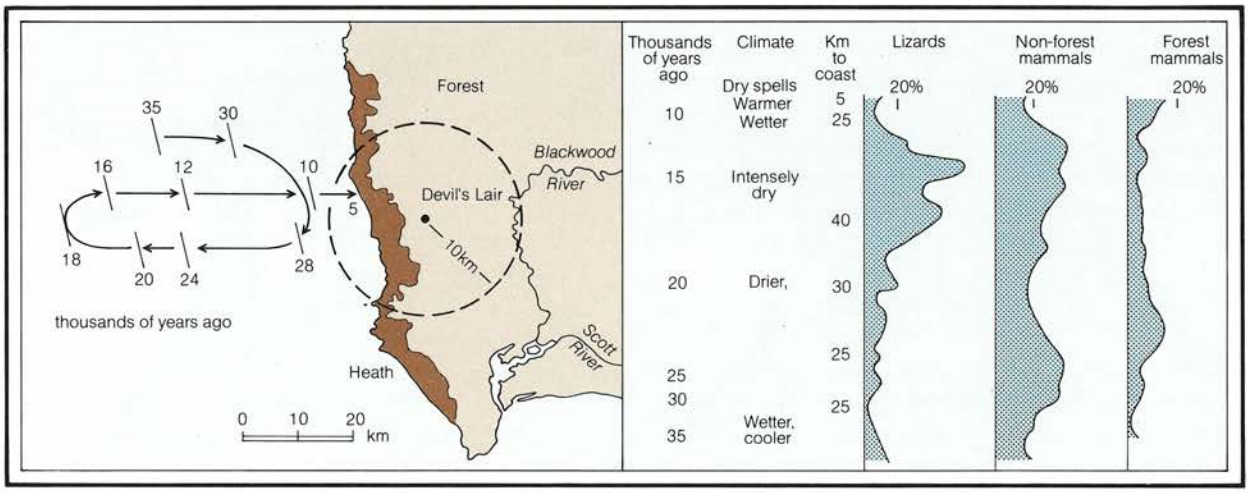
Land area and vegetation in northern Australia and New Guinea. Rising sea levels changed the climate and vegetation, especially of the Australian continent.
J. JEFFREY

extensive drainage ditches; by 5000 years ago they had cleared some forest from the surrounding slopes, leaving them exposed to increased erosion. By 9000 years ago also, despite burning by Aborigines, the Queensland rainforest had expanded, encroaching on open eucalypt forest in parts of the Atherton Tableland. The cool southern forests also experienced dryness followed by increased humidity. In the southwest, around 14 000 to 12 000 years ago, animal bones brought to the site of Devil's Lair, near Bunbury in Western Australia, indicate intense aridity. Levels of this age at the site contain few forest animals, and more creatures (such as the native mouse and honey possum) which prefer heathlands, as well as many lizards. From 10 000 years ago the small wallabies known as quokkas, and potoroos, or kangaroo rats, both of which needed thick scrub and swampy thickets for shelter, increased in numbers. Proportions of damp-loving karri trees also increased as humidity rose and dropped again as the climate became drier. In the southeast, tree pollen increased dramatically about 8000 years ago at Kow Swamp on the Murray, and the Darling also offered improved resources for human population.

In Tasmania 20 000 years ago, the open alpine herb fields had provided ideal conditions for wallabies and their hunters, but from 15 000 years ago the forests closed in, despite the hunters and their fires. People had to abandon intensive use of the uplands around the Florentine, Gordon and Franklin rivers. They appear to have gone on moving sporadically between the coast and the remaining open uplands above the treeline, but eventually much of southwest Tasmania was abandoned to the forests.

Landscape changes about 10 000 years ago were caused not only by worldwide climatic factors, but also by human activities, above all the use of fire to burn off. Fire allowed Aboriginal societies to maintain open corridors through the forest which reached their maximum extent about 8000 years ago. In the southwest, charcoal in swamp deposits within the karri forest (for example, from Scott River Swamp 9300 years ago) suggests that people had begun igniting an area where there had been few previous fires. Later, while firing became more frequent, its effects proved less drastic, suggesting that the countryside was regularly and systematically kept open by firing. Parts of the south coast karri forest were burned about 7500 years ago, and were engulfed soon afterwards by advancing coastal dunes, themselves perhaps also devegetated by fire.

In some parts of the southeast, persistent firing and consequent modification of vegetation caused massive erosion of hill slopes. Deposits in the valley floors contain much charcoal. This happened in Tasmania from 8000 years ago, later in



The climate of the southwest has generally been cool and wet, but a dry period has been dated by radiocarbon to about 18 000–12 000 years ago. This was most intense about 14 000 years ago as is demonstrated by the food remains left at Devil's Lair, which come from open heathlands rather than forest. Animals eaten at the site at this time include many dry country lizards as well as honey possums and some species of mice. Some of the changes in animal remains may be the result of vegetation changes caused by changes in the distance between the coast and the site

J. JEFFREY

the southern tablelands of New South Wales, and later again in the heavily vegetated Sydney basin. In the Helena valley on the southwest coast of Australia, alluvial fills rich in charcoal and artefacts occur from about 15 000 years ago, and imply Aboriginal exploitation. More than 6000 years ago Aboriginal burning began to create the sedgelands along the northern part of the west Tasmanian coast and the open grasslands of eastern Tasmania.

Some burning may have destabilised fragile environments, as on the dunes of Williams Bay near Albany. On the west coast near Jurien Bay, charcoal-rich earths washed down into caves from 12 000 to 4000 years ago are evidence of burning, devegetation and soil instability. At the same time, changing climatic factors probably contributed to this outcome, for animal populations in the region changed from those of a high rainfall area to those of the present sandy scrub.

The main purpose of Aboriginal burning was pasture management. Firing cleared old dead growth (whether of cane grass in the north, spinifex in the arid centre or ground cover in open forest) and provided nutrients in the ash, ensuring that burned areas would respond to the first rain with a luxuriant crop of grass. Those areas most frequented were most burned, especially the edges of swamps, soaks, lakes and watercourses, where firing ensured for the hunters a still more plentiful supply of the game such places attracted.

Within the forest and coastal scrub areas corridors were burned, as in the Maribyrnong valley of Victoria, the Helena valley in the west, and northern Tasmania, to give people clearer and safer travel and access to resources. However, the karri country of Western Australia, the southwest Tasmanian rainforest and the heart of the Queensland rainforest were scarcely penetrated.

If practices in the past were similar to recent ones, only a small part of the area over which people moved was burned each year, creating a mosaic of patches at different stages of regrowth and offering different resources, with the most frequently burned places around water sources standing out as patches of green. Mosaic areas supported a greater variety of plant foods and higher populations of edible marsupials. Under the warmer, wetter conditions of 10 000 to 7000 years ago forests had expanded, but by about 6000 years ago renewed aridity and increased Aboriginal burning were reversing the trend and creating more resources to support more people.

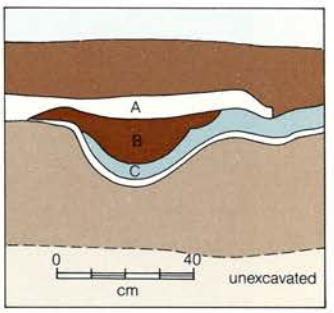
Aboriginal burning practices affected the availability of specific plant foods. Burning promotes reproduction in zamias and cycads, the nuts of which were being prepared for eating 13 000 years ago. The burning of reed swamps at the

A Tasmanian 'wolf' or thylacine, engraved at Talga River Crossing in the Pilbara district of northwestern Australia.

P. RANDOLPH/WESTERN AUSTRALIAN MUSEUM

end of summer enhances the growth of starch-filled roots, and charcoal layers in southwest swamps may be evidence that Aborigines were using fire for this purpose over 9000 years ago. On the other hand, as some important food plants such as yams do not regenerate readily after fire, it was not advisable to burn all areas. Controlled burning maintained a diversity of plant and animal resources.

People affected animal populations as well as landscape and vegetation, helping to cause the extinction of many species within the period we are examining. The largest marsupial, the diprotodon, probably survived until about 6000 years ago on the Liverpool Plains of New South Wales. Smaller as well as larger animals were affected. Thus in the extreme southwest the Tasmanian tiger (thylacine), the Tasmanian devil, some bandicoots, rock wallabies and native mice all became extinct less than 10 000 years ago. Faded rock paintings suggest that Tasmanian tigers persisted in Arnhem Land until much later.



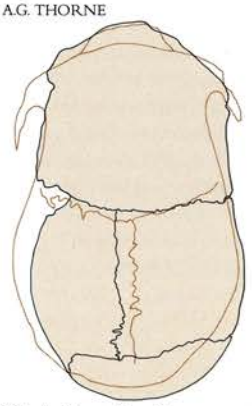
This pit in a site at Cheetup in the south of Western Australia, was lined with Xanthorrhoea *(blackboy) leaf bases and contained large macrozamia kernels. It was sealed in by charcoal dated to more than 13 000 years ago. Pits of this kind were still used to store and detoxify macrozamia in the nineteenth century.*
J. JEFFREY

HUMAN POPULATIONS

Ten thousand years ago there were distinct physical differences between the people living in different regions of Australia. Skeletons dug up at Kow Swamp in Victoria are sturdy and rugged in the face; those at Roonka on the lower Murray have finer features. Recent excavations suggest that the distinctively rugged type may have persisted longer in semiarid zones. But the archaeological evidence which indicates this persistence does not explain it, and by about 6000 years ago these types were merging into regional blends.

A human skull found at Cossack on the northwest Australian coast. It is probably less than 6000 years old. Notable features include the back-sloping forehead, protruding brow ridges and large jaw, and in these respects it is similar to the skeletons from Kow Swamp in northern Victoria.
S. McCONNELL

Flexed burials from Kow Swamp, Vic, dated to between 10 000 and 13 000 years ago. Bodies were buried in several different positions, showing complex rituals in the disposal of the dead.
A.G. THORNE



Skulls from Kow Swamp and Cossack, WA, viewed from above. They are of similar shape.
J. JEFFREY

The Kow Swamp area was treeless when the lakeside lunette formed 14 000 to 12 000 years ago, but by 10 000 years ago the lake was high, the area well wooded and resources abundant. This was a densely populated region, where one group managed to retain its own genetic identity even after finer-featured populations had spread through the areas around them. As the region forms part of the Riverina Plains, no topographic feature separated this group from its neighbours. It may have persisted through control over marriage patterns.

Although the Roonka Flat burial ground, 400 kilometres up the Murray, was very nearly as old, and although it, too, was an area of dense, relatively static populations, it nevertheless yields very different skeletal material. From 18 000 years ago people visited the area at intervals to collect, cook and eat freshwater shellfish. From 7000 years ago they began to bury their dead in the red sand. Twelve excavated burial sites give tantalising glimpses of their social life at this time, but the skeletal remains show none of the sturdiness of those at Kow Swamp. Either there was rapid change between 9000 and 7000 years ago, which is unlikely, or great regional variety was maintained, with relatively sedentary societies keeping their local social and genetic distinctiveness. The likelihood that regional differences, rather than change over time, explain the different anatomical types, is strengthened by the discovery of skeletal remains from areas outside the middle Murray; for example, two kilometres apart in the terrace at Keilor and Green Gully by the Maribyrnong River. Both skeletons are anatomically modern, quite different from Kow Swamp, yet one has been dated to 13 000 years ago and the other to 6500.

PATTERNS OF ADAPTATION

By about 18 000 years ago, people had explored and learned to live in the full range of Australian environments, from the tropical north to the cool south, the humid margin to the arid interior. They had learned to adapt to and to manipulate different and changing environments in different ways.

The wet summers and dry winters of the Kimberley region and Arnhem Land support mainly open grassland and savannah with gallery forest along some rivers and vine thickets by sheltered pools. People camped in the Miriwun rock shelter, on a steep rocky ridge overlooking the cane grass of the Ord River floodplain, at intervals from 18 000 years ago until recently. Plant foods, including water lilies

and reed roots, were abundant in the lagoons and swamps of the floodplain, and pied geese bred there and in the nearby marshes. Goose eggs were eaten in summer and so were freshwater shellfish and catfish, as well as lizards, rodents, bandicoots, possums and wallabies. Occupation 10 000 to 15 000 years ago was relatively sparse: only one rock shelter was used, compared to five more recently.

In Arnhem Land 15 000 years ago, shelters such as Malangangerr and Nawamoyn in the East Alligator River region lay approximately five hundred kilometres from the sea. By 6000 years ago the sea was only forty kilometres away. A range of resources remained available throughout this time, but the quantity must have increased as the sea reached its present level. Freshwater marshes yielded abundant carbohydrate-rich staples from underground storage organs—tubers of *Triglochin* (water ribbons), starch-storing roots of swamp sedge (*Eleocharis*) and flag (*Phragmites*), and roots and seeds of the lotus lily. In eucalypt woodland and monsoonal rainforest, people dug yams (*Ipomoea*) which appear in art on the cave walls probably before 10 000 years ago. They harvested shoots, fruits and nuts: *Livistonia* palm leaf bases, cabbage-palm shoots, emu apples and cycad nuts, a dry-season staple that required prolonged storage or processing to remove poison. *Callitris* wood was used for spears, plant fibres for string and baskets, paperbark for shelter and bedding. The marshes and billabongs also provided freshwater mussels, turtles, frogs and fish, and pelicans, brolgas, magpie geese and their eggs. They attracted wallabies, kangaroos and wallaroos. As estuarine conditions moved further up the East Alligator River ahead of the rising sea, people collected new foods such as shellfish and mangrove crabs and dumped their remains in sites about 7000 years ago. In Arnhem Land, as in Kimberley, new sites came into use as sea levels rose and populations were pushed inland: Ngarradj by 8700 years ago, Nourlangie by 8600; Ingaladdi and Sleisbeck by 6800 and 6600. Excavations by archaeologists reveal the increasingly dense occupation of inland places: in one sample, only four sites were used 20 000 years ago, eight just before 6000 years ago, and fourteen later. Artefacts, too, became more plentiful between 10 000 and 6000 years ago, and still more so after that time: this indicates a rising population.

Stone hatchet heads made up as much as one-quarter of the tools on some sites, indicating the importance of chopping, possibly as an aspect of plant management. Grinding and pounding equipment was also plentiful and appears to have been used for pounding tubers, although seeds, including wild rice, were also available and may have been more important under the drier conditions before the sea reached its present levels. Ochres were also pounded to paint shelter walls.

In the Cape York Peninsula a similar picture has emerged. The Early Man shelter in upland grasslands was little used between 18 000 and 7000 years ago, despite increased rainfall after about 11 000 years ago. More intensive use of the shelter, indicated by twice the number of stone artefacts per thousand years, occurred after 7000 years ago.

Subsistence patterns 12 000 years ago were not unlike those in Cape York a century ago, when people relied on a broad variety of resources, while concentrating on a few storable staples, including cycad nuts and yams, which could be accumulated to support the large gatherings for ceremonial occasions implied by the art on the shelter walls. Some plants, such as kurrajong, lady apple and yam-like vines, were encouraged to grow on the platform outside the Early Man shelter, providing an orchard and vegetable garden on the doorstep. Women were responsible for gathering plant foods and also for hunting small game—possums, the tiny kangaroos known as bettongs, bandicoots and snakes from the undulating plains and sandstone plateaux. Men were responsible for hunting larger game, of which rock wallaby was the most common.

Overleaf.
East Alligator River, Northern Territory.
WELDON TRANNIES

Like their Arnhem Land neighbours, the Cape York people used edge-ground stone hatchets for woodworking and possibly for lopping some plants to encourage the growth of others. Right across the monsoon savannah from Kimberley to Cape York, tropical people relied heavily on plant resources and husbanded them in various ways. They shared the hatchet technology of monsoon Asia and what was then Australia's northern tropical peninsula, New Guinea, but not their expanding population and horticultural technology.

In the northwest of the continent, occupation of the Pilbara area was probably based on a seed-using economy. Many of the highly weathered Pilbara engravings are close to grinding patches on horizontal rock surfaces. These are grouped around hollows that contain water after rain, suggesting wet grinding of grass seeds. Even extremely arid areas, such as Mount Newman on the inland edge of the Pilbara, were used from 20 000 years ago.

Grinding equipment also indicates the increasing use of seed resources about 10 000 years ago in the tablelands and uplands of the east, for example at Kenniff Cave in the sandstone savannah of the Queensland watershed. Fifty kilometres away, the two Native Well shelters were first used intermittently about 13 000 years ago for ritual purposes, indicated by engravings of vulvas and ochre- stained grinders for pigments to decorate ceremonial actors and their equipment. The earliest grindstones appear just over 6000 years ago, when one of these shelters began to be used constantly. This was part of a general increase in human activity in the whole area, leading to more firing and devegetation, and sand blew into the shelters. Similarly, on the western slopes of the New England tableland, systematic exploitation of the shelters at Graman was just beginning 6000 years ago. Many grinding slabs show that wild millet and probably root tubers were being harvested. In addition, emu eggs were collected and kangaroos caught.

In the semiarid zone, areas fed by the Darling and Lachlan drainage from the waters of the Great Dividing Range form a special category. Near the Darling some lakes such as Tandou remained fresh, and people continued to camp and bury their dead in the lakeside dunes. The presence of grindstones shows, however, the importance in the economy of wild millet (*Panicum*) as well as shellfish, and the millet remained an important resource on the Darling until the Europeans came.

All in all, there is much evidence that during the increasingly arid period from about 18 000 to 12 000 years ago, people relied less than previously on game and made more use of plant foods, particularly seeds, in the great swathe of semiarid grassland from the Murchison through the Pilbara, across to the Queensland tableland and the Darling and Lachlan drainage areas in western New South Wales. The seeds, gathered, winnowed, ground while wet and baked into cakes, were mainly grasses, including millet (*Panicum*). Pigweed (purslane), quandong, kurrajong and acacia seeds formed supplements or staples in drier times and places.

Along the Murray, arid conditions had less effect. At Roonka Flat from 16 000 to 7000 years ago, occasional visitors gathered freshwater mussels and left their shells on hearths built of pebbles in the dunes by the river, and at the top of the cliff in the opposite bank. Upstream at Red Cliff, shell middens accumulated more than 11 000 years ago. Downstream at Tartanga and in the lowest levels of the Devon Downs rock shelter opposite, freshwater mussels, fish, birds, tortoises, wallaby and possums were eaten more than 6000 years ago.

Just north of the Murray mouth, a wide promontory projected westward. From at least 20 000 years ago, people camped in a variety of spots, leaving behind small quartz flakes and tools made of pebbles from beaches some distance away. Between 16 000 and 11 000 years ago, they sometimes sheltered in Seton Cave, where large mammals were a major part of the diet, at first the large kangaroo-like *Sthenurus*

and, when those died out, plains kangaroos. Hare wallabies and barred bandicoots were hunted in open country (maintained by firing); possums, bettongs and brush wallabies were pursued in sclerophyll woodlands; waterfowl came from the nearby lagoon and native hens from its grassy margins; a variety of other birds, emu eggs, snakes and lizards, freshwater molluscs and cockles and mussels from the seashore (nine kilometres away) contributed to a varied diet. About 9000 years ago rising seas cut across the base of the peninsula, leaving Kangaroo Island isolated from the mainland. But people continued to live there for thousands of years.

Along much of the eastern seaboard the mountains descend sharply to the sea without a wide intervening coastal plain. There is some evidence that people moved between coast and foothills, in contrast to the year-round usage of the western slopes. Thus at Seelands, the wooded valley of the Clarence River, people left flake tools from 6500 years ago, hunting mainly macropods and gathering emu eggs during their winter visits, but also leaving marine shells that showed that they visited the coast, probably in summer.

In the uplands, from the Blue Mountains near Sydney to Tasmania, the warmer period 10 000 to 7000 years ago brought a fall in resources and population, reversed only towards 6000 years ago. People visited several large rock shelters in the Blue Mountains while the area was relatively open during the cool conditions of 10 000 to 20 000 years ago: King's Table before 20 000 years ago, Shaw's Creek around 13 000, Noola (in the Capertee valley), Lyre Bird Dell and Wall's Cave about 12 000 years ago. These places may have remained secret, penetrated only for ritual purposes. As the valleys became heavily vegetated, after about 10 000 years ago, they were hardly used, until population pressures forced greater use of their abundant resources (mussels, crayfish, eels, ducks, yams, macrozamias, possums, rock wallabies, kangaroos and emus). Of ten shelters around Canberra, only one was in use more than 10 000 years ago; the others were not used until much later. People also made sporadic early visits to the ranges, but there is little evidence of systematic exploitation during this period.

On the edge of the Dividing Range in southern Gippsland, Clogg's Cave was often used from about 17 000 years ago, but less often in the warmer, damper period after 10 000 years ago. Similarly, the Tasmanian uplands were intensively used between 20 000 and 14 000 years ago, when hunters could move easily across the open tundra around the ice caps on Cradle Mountain or Frenchmans Cap; but as the forests closed, in that usage ceased.

It is hard to assess how much use was made of coastal areas from 15 000 to 6000 years ago, because these now lie beneath the sea. Estuarine sites give some clues. At Bobadeen in the Hunter River valley, people were eating freshwater shellfish 8000 years ago, as well as emu eggs, bandicoots, possums, wallabies and kangaroo. On the southern coast of New South Wales, a few sites around Bateman's Bay came into use more than 6000 years ago. Split pebbles and choppers were used there to break open shellfish. A rock shelter on the shores of Burrill Lake, then ten kilometres from the sea, was visited from 20 000 years ago, but organic materials have not survived. A site on Bass Point was also used intermittently during the same period, when it lay well inland; only when the coastline reached its present position did people frequent it and dump shells there, forming a dense midden.

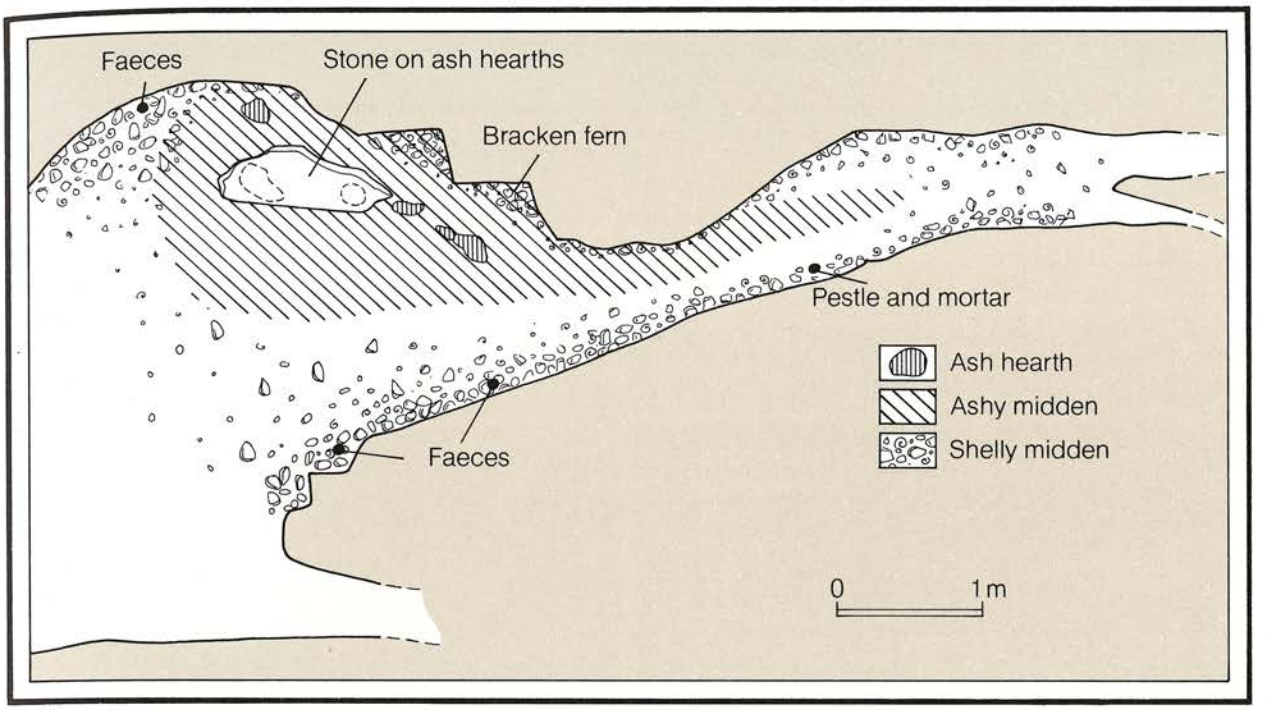
Scholarly arguments about population growth have been based on the number of sites of different dates archaeologically visible on the New South Wales coast and the density of artefacts in successive levels. Excavations at Bass Point and Burrill Lake have found very few artefacts per thousand years in layers from earlier periods, but many in levels formed after 5000 years ago. Sites also became more numerous during this time. The evidence may suggest a tenfold rise in population

over a few thousand years, although it is possible that some of the apparent increase was due to a shift of activities from areas now under the sea, as well as the use of shellfish, the shells of which left especially visible evidence in middens. But studies some distance from the coast support the view that population did increase rapidly. In an area fifty kilometres inland, just north of Sydney, the few sites used before 6000 years ago—Loggers shelter from 11 000 years ago, Mussel shelter before 8500 and Deep Creek shelter before 6000—were only one-tenth of the number used later.

On the western Victorian coast the Bridgewater Caves were used from more than 11 000 years ago by occasional visitors making tools of local flint, hunting large mammals—the grey kangaroo, pademelon and wombat, and the ring-tailed and brush-tailed possums—and making little use of seals, fish, shellfish or other marine resources, although the sea was never more than twenty-five kilometres away. Of nineteen dated sites in southwest Victoria, only two, Bridgewater and a 7000-year-old midden near Warrnambool, are older than 6000 years ago. On the south coast, as in the east, populations that were small before 10 000 years ago appear to have multiplied later.

Tasmania has few sites near the present coast more than 6000 years old, but many more recent sites. For example, on Hunter Hill (now Hunter Island), lying just off Tasmania's northwest tip, people camping in Cave Bay Cave huddled round great fires during the coldest period, and hunted kangaroos and wallabies on the plain: this coastal cave was visited perhaps only once in a thousand years. But about 7000 years ago, as the sea rose, people began to use the cave more frequently, eating fish, rocky coast limpets, muttonbirds and wallabies. Nearby, the South Cave at Rocky Cape began to be used about 8000 years ago as the sea rose nearer to it. Two-thirds of the vertebrates eaten were fish, mainly the brightly coloured wrasse; most of the rest were seals, with a few birds and marsupials. Bony animals made up only about half of the meat diet, the other half being shellfish—turbo, abalone, winkles and limpets. A mass of shell debris filled the cave, but plant food, including

Part of the abandoned floor shows abalone shells, seal bones and, at rear, a large stone placed over the last hearths.
W. AMBROSE



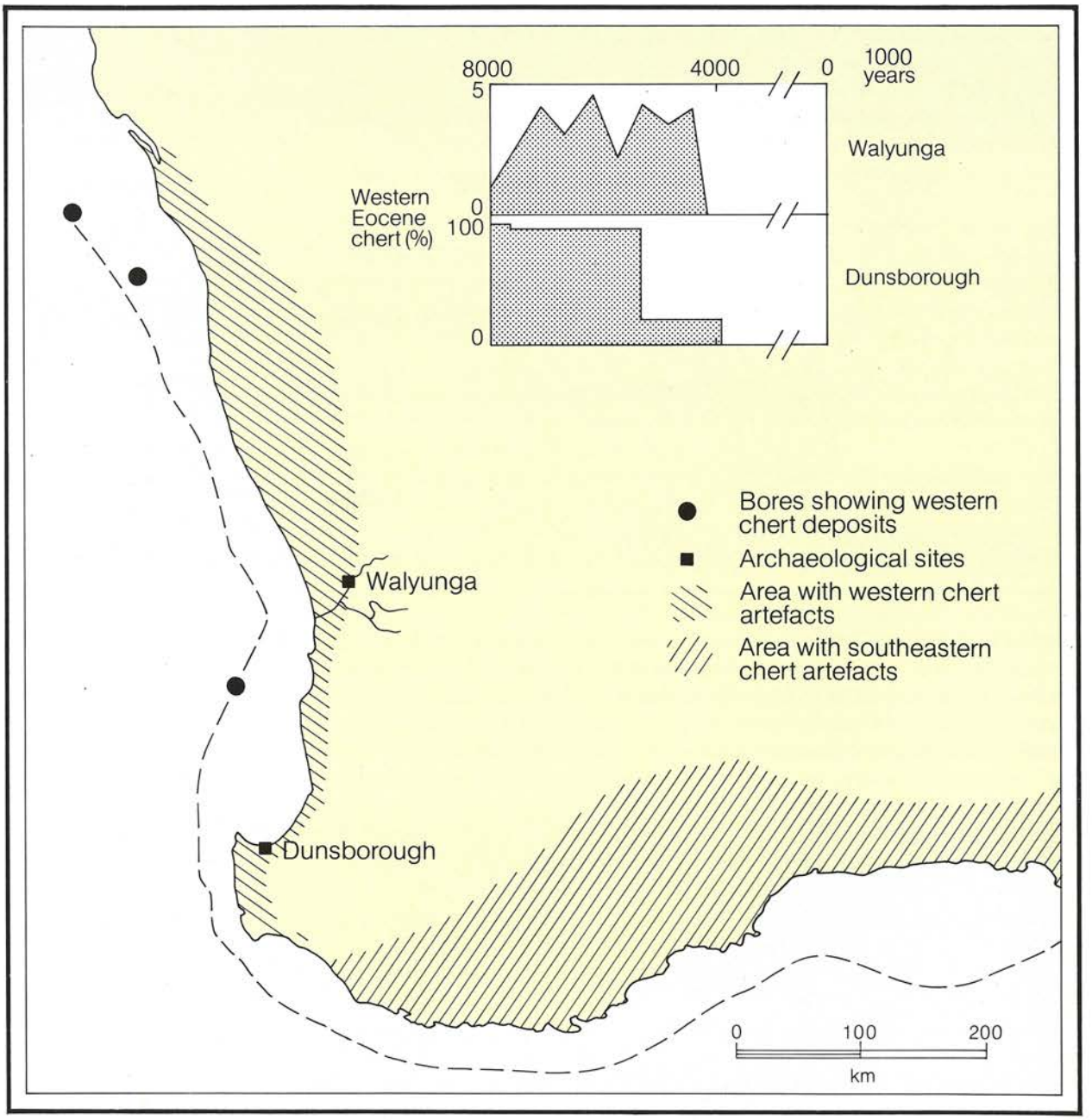
At the cave in Rocky Cape South, northwest Tasmania, a small low chamber was completely blocked off by accumulating debris about 7000 years ago and the floor people last used was left intact. Hearths in the middle were surrounded by a fairly clear area where people sat around the fire. Towards the sides of the cave under the dip of the roof, they had stored bracken fern stems, blackboy kernels, and shells (particularly abalone). A mortar and pestle were stored in an inner recess. A time capsule of camp organisation has been preserved as its makers left it.

PLAN BY H. LOURANDOS AND RHYS JONES, DRAWN BY J. JEFFREY

blackboy shoots and bracken fern, was also important. People flaked their stone tools in the cave also, and then used sharp stone scrapers and knives to work skins and steep-edged scrapers to make spear shafts and bone needles and pins, which in turn could be used to make nets or to make and fasten skin cloaks.

Elsewhere on the Tasmanian coast, people also collected shellfish and dumped the shells as the sea advanced; and on the other side of the Bassian plain (now Bass Strait) people left flake tools like those of Tasmania in the first dunes to form as the sea approached Cape Martin about 9000 years ago and Cape Liptrap and Wilson's Promontory about 7000 years ago. Rising seas also cut off portions of the landlink to Tasmania to form islands. What is now King Island was almost 100 kilometres inland from the coast when people first left the choppers, steep scrapers and large retouched flakes that became cemented into the sand dunes. Their descendants still lived there when it became an island from about 8000 years ago. Similarly, on what is now Flinders Island, grindstones, anvils and hammers, choppers, cores and chipped quartz lie alongside the shell and charcoal, showing that people were living there between 10 000 and 6500 years ago, while the island was being cut off from both Tasmania and the mainland. The process must have been so gradual that they did not realise what was happening until it was too late. Lacking water craft capable of reaching Tasmania, these communities appear to have succumbed after less than 2000 years of isolation, reduced by scarcity, disease or too few marriageable children. A similar fate awaited the people who lived on Kangaroo Island around 9000 years ago.

On the western coastal plain of mainland Australia, from 20 000 to about 6000 years ago, people made their tools out of quartz and a unique type of Eocene chert (silicified limestone). The source of this chert remained a mystery until recently. The known outcrops on the south coast seemed too far away, since most chert was found on the western coastal plain. The mystery was solved only when a geologist deduced that the sources must lie west of the present coast, and this was confirmed when oil exploration bores found the unique chert in appropriate offshore



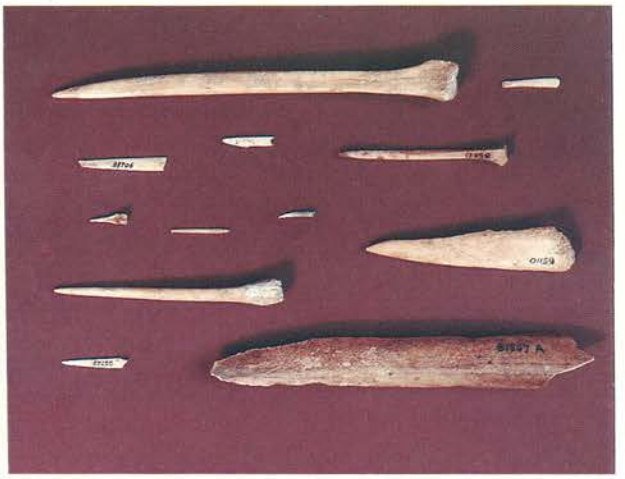
Western Eocene chert is only found in sites dated to older than 4500 years, as at Walyunga and Dunsborough. This chert was created between 54 and 38 million years ago in the Eocene period. Its sources now lie off the west coast, drowned by rising seas. By contrast, eastern Eocene chert is still available.

J. JEFFREY

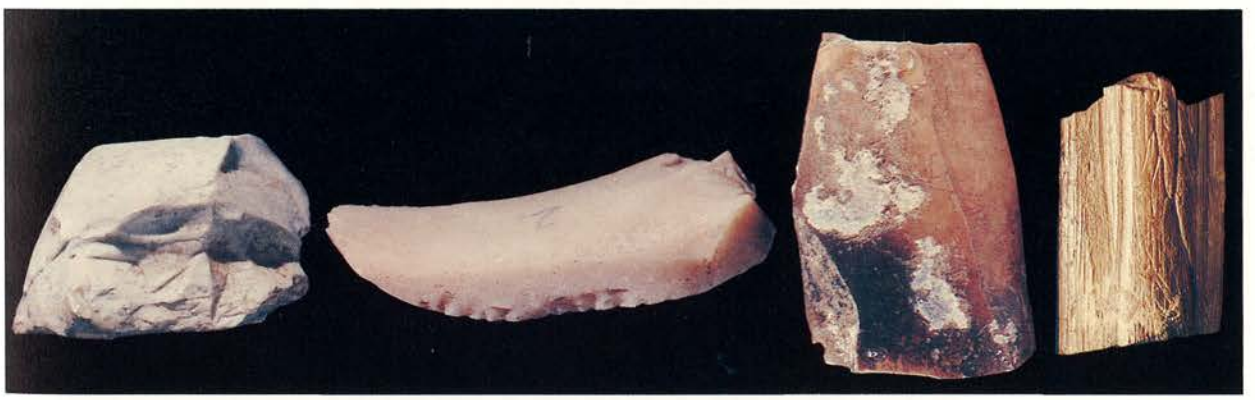
localities. This chert forms a useful marker of sites occupied before the sea reached its present levels about 6000 years ago. Unavailable after the sea rose (although re-used for a while), its presence and absence enables us to compare the pattern, numbers and intensity of usage of sites before and after about 6000 years ago. Sites in certain obvious places—near river crossings, at valley junctions, in the saddles between hills or close to fixed resources such as swamps or yam grounds—were often used in both periods. But the numbers of new sites (without chert), and the quantities of artefacts within them suggest a more-than-tenfold increase of population between 10 000 and 1000 years ago. Even allowing for land lost to the sea, early populations must have been sparser.

People visited Devil's Lair, a cave in the extreme southwest, at intervals from nearly 40 000 to almost 7000 years ago. The bones in the upper half of the deposit represent 400 000 meals over about 20 000 years—perhaps a three-day visit by five people every second year or less frequent visits by larger groups. Between visits, owls, Tasmanian devils and 'Tasmanian tigers' frequented the cave, leaving the fragmented bones of smaller animals such as mice and honey possums. The human visitors cooked mainly large game—kangaroos and wallabies—whose charred bones are found in their hearths. They also ranged through forest around the cave and heaths westward, gathering possums, bandicoots, bettongs, snakes, lizards, emu eggs and a few freshwater molluscs. Occasionally they brought fish or marine molluscs from the coast some 20 to 30 kilometres west.

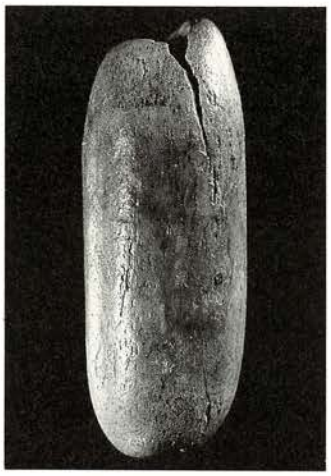
Main excavation at Devil's Lair, WA. The fine stratigraphy is being recorded.
A BAYNES/WESTERN AUSTRALIAN MUSEUM



Twelve-thousand-year-old bone points from Devil's Lair, some made on whole kangaroo or wallaby fibulas and others made on splinters of long bone. Several of the smaller pieces are broken tips of points.
D. ELFORD/WESTERN AUSTRALIAN MUSEUM



Left to right.
A 15 000-year-old chert scraper whose working edge shows undercutting, crushing and overlapping flake scars typical of hafted adze flakes (width of working edge 23mm). A 12 000-year-old chert flake (length 38mm) whose denticulated working edge consists of a dozen closely adjacent notches produced by pressure flaking, using a pointed tool. A flat, partly charred piece of limb bone, probably deliberately broken (length 25 mm). This piece was found in a hearth radiocarbon dated to 30 000 years ago. A 22 000-year-old cylindrical fragment of limb bone (probably part of a kangaroo fibula) showing multiple, deep striations. This 13mm long piece is thought to be part of a bone point shaped by a sharp-edged stone flake or scraper.
D. ELFORD/WESTERN AUSTRALIAN MUSEUM



Excavated from Devil's Lair, this 12 000-year-old bead is probably made from a length of kangaroo fibula. Length 21mm.

WESTERN AUSTRALIAN MUSEUM

On the southern west coast, people ate relatively little shellfish. Indeed, archaeologists once believed that they ate none; but although recent intensive searches have revealed no distinct midden mounds, a few minor shell scatters and concentrations do occur in some south coast dunes about two hundred metres from a shore with intertidal rock platforms. People ate occasional shell meals from other rock platforms near the mouths of the Moore, the Bowes and the Murchison rivers. Yet shellfish use was certainly less intensive than elsewhere, and was very occasional indeed on the sandy coast from Geographe Bay to the Moore River, where rock platforms are few. The staples of the southwest economy were fish and fowl from lagoons and estuaries and the game and plant staples from swamps and rivers. Shellfish made an occasional snack.

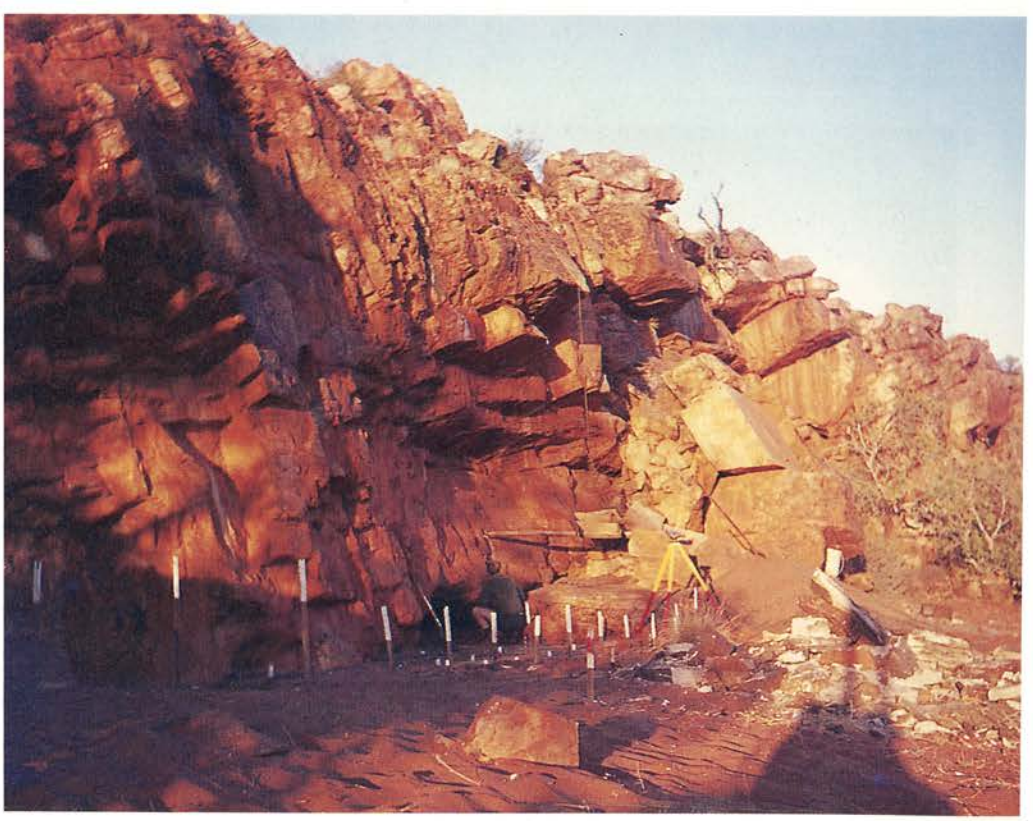
Along the northwest coast, however, shellfish were a major resource. Between the Gascoyne River and Exmouth Gulf more than 7000 years ago, people carried shellfish three kilometres inland and dumped their shells to form a midden. On Dampier Island (now Burrup Peninsula) people began to eat limpets as soon as seas approached present levels and here, too, the middens often lie high up valleys many kilometres from the sea.

Puntutjarpa rock shelter, in a low scarp overlooking spinifex desert, proves that people were visiting the Warburton Range area 10 000 years ago. Aboriginal groups had acquired the knowledge and skills and the supporting network of kin and ritual ties they needed to survive in this most inhospitable of regions. They made wooden artefacts, using large hand-held scrapers for rough work and small hafted adzes for fine work, such as detailed engraving of ritual objects. They also manufactured stone tools inside the shelter, leaving about fifty waste pieces for each finished tool. Raw materials—quartz, opaline chert and porphyry—came from the creek bed a kilometre away; other stone was brought from sites less than

Excavations at Puntutjarpa rock shelter in the Brown Range, a slight scarp in the Western Desert.

S. HALLAM

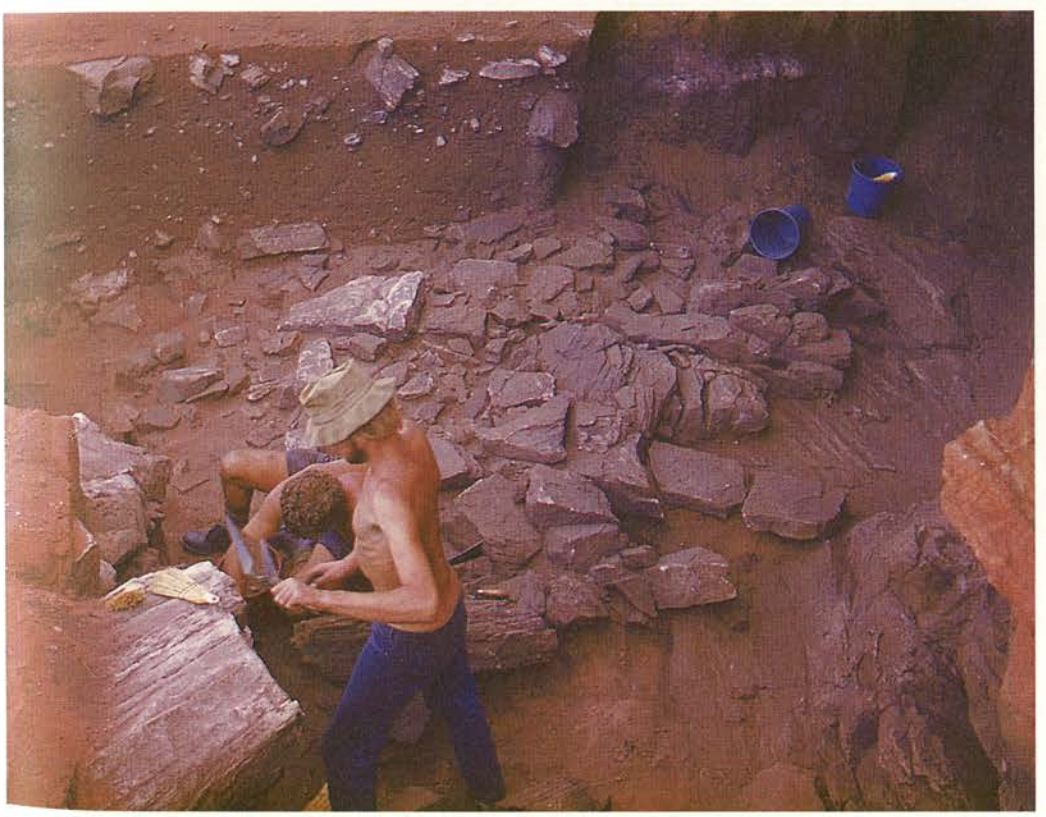
Shelter with a line of posts marking the front of the excavation.



40 kilometres away, well inside the group's range of movement. They used ochre to paint the walls of the cave—a painted piece has been recovered which fell from the roof about 6000 years ago—and they probably painted their own bodies. Grinders indicate seed processing from 10 000 years ago—a typical desert subsistence pattern, relying on the small seeds of the chenopods, because grass seeds did not grow in the arid environment. These the women laboriously winnowed, ground and baked. Raisin-like *Solanum* fruits would be dried, crushed and compacted; figs and quandongs grew outside the rock shelter. Most animal protein food came from ants, termites, grubs, lizards and small mammals that were pounded to use all that was edible, including nutritious bone marrow. Water was found by digging into the creek bed after rains, and in a soak pit near the main habitation that, fed by seepage from the scarp and dug out repeatedly, quenched thirst through the wetter years from 10 000 to 6000 years ago and silted up later.

Elsewhere, the desert story is obscure. Few artefacts have been unearthed, but the arid centre may have been occupied more than present evidence shows. The northern Flinders Ranges have extensive artefact scatters about 12 000 years old. Outcrops of good quality silcrete from Strzelecki Creek, within a desert dune field, were exploited some 15 000 years ago. Hearths occur even in the heart of the dune field, and silcrete tools from dunes near Cooper Creek date from around 12 000 to 10 000 years ago. Since these dry regions were penetrated by then, Aborigines probably also inhabited the centre, around the MacDonnell Ranges, with their permanent water and oasis vegetation in hidden valleys. Firmly dated evidence has not yet been found, but we know that many areas were covered by a metre or more of windblown sand during an arid period around 5000 years ago.

As evidence from caves such as Koonalda shows, even the waterless limestone area of the Nullarbor was explored by Aboriginal people more than 20 000 years



Main trench excavated with a large rockfall in front of it.

People using the shelter cleared away some of the rockfall for added space. The cleared rock is on the right against the wall.

ago. Stone was still being traded from the caves 12 000 years ago, and from the cliffs still later. Madura Cave, looking over the remnant of the southern coastal plain, was used 8000 years ago, but only infrequently before about 4000 years ago.

TOOL TECHNOLOGY

Boomerang arm from Wyrie Swamp, SA, dated to about 10 000 years ago. It is shaped for returning.
D. MARKOVIC

Tip of a boomerang arm, preserved in the peat of Wyrie Swamp, SA, for 10 000 years.
D. MARKOVIC

Most of the tools preserved from around 10 000 years ago are made of stone, but many have steep working edges showing that they were used to work wood. The wooden objects themselves are rarely preserved, except for a group of wooden implements about 9000 years old found with chert tools and chipping debris in Wyrie Swamp in South Australia. They include two types of digging-stick, fragments of a barbed javelin, a short spear, three complete boomerangs and part of another. These unique finds show that aerodynamically complex weapons were developed early in the history of Australia.

Bone was also used for tools, though these were rarely preserved. Yet some bone tools show remarkable continuity of form, and presumably of function, over 15 000 years. Recently Aborigines at Katanning in southwestern Australia were making two different sorts of implements from kangaroo fibulas. Flat or slightly concave spatulas, made by rounding off the slightly hollow bottom end, were used to make holes in kangaroo skins, through which sinew could be threaded when skins were sewn together to make cloaks. Pins to fasten cloaks were made by trimming the solid upper end of the fibula to a tapering point, circular, not flat, in cross-section. Finds of similar flat bone spatulas and pointed fibula pins from about 12 000 years ago in Devil's Lair in the wet southwest, and at other times at Cave Bay Cave, Kutikina Cave, and Rocky Cape South in Tasmania and at Roonka on the Murray, suggest that Aborigines in many regions made and wore stitched cloaks of kangaroo or possum skins. The Tasmanian examples have also been interpreted as net-making implements.

In the flaked stone tool kit, there were two main trends over time: smaller tools were made, often on flakes rather than pebbles or blocks, and composite tools were developed, incorporating a stone or bone component, a gum or resin cement and a wooden haft. Both of these trends continued over the last few thousand years when small specialised tools became common. The makers were increasingly economical in the use of stone as population densities rose and each group, its range narrower, had access to fewer sources of stone. Conversely, as tools were more delicately made, sources of fine raw materials became more important, as did the long-distance transport of stone. There was considerable regional variety in tools, caused partly by differences in raw materials and activities and partly by different traditions of manufacture.

Burrill Lake on the New South Wales coast provides a clear picture of a typical tool kit about 12 000 years ago. About one-tenth of the tools were steep-edged choppers and scrapers made on pebbles and blocks. They weighed two or three hundred grams each, and were suitable for blocking out a bowl or a shield from a tree. The remainder of the implements were smaller. First, there were scrapers, weighing fifty to sixty grams each, made of thick flakes, small pebbles or chunks. Some were nosed or notched, and all had a steep angle (around 80° to 90°) on some part of the edge; these were used for finer woodwork. There was also a group of thinner implements, made mainly on flakes weighing about fifteen grams. Their more acute-edge angles (about 65°), indicate that they were knives, used for cutting rather than chiselling. Some even had finely toothed serrated edges. All such tools recur in varying proportions on sites younger than 15 000 years ago.

The site of Quininup Brook is near the sea in southwest Western Australia. It consists of several areas of debris, two of which encompass several clusters of stones that people must have carried there. Their purpose is unknown; the clusters are not closely associated with hearths, food remains or other artefacts.
W. FERGUSON

Left.
Site 4, looking across the area of the spring, towards the ocean.

Above.
A stone cluster from Site 2.

Mortar and pestle from Quininup Brook. Although they were not found together, such tools were used for crushing seeds, roots, vines and ochre, as well as for flaking stone tools.
W. FERGUSON

People who camped regularly beside a series of falls and pools at Quininup Brook in the extreme southwest between 18 000 and 10 000 years ago left the scattered debris of working stone, mainly chert. Only about 2 per cent of the stone pieces had been used as tools, and of these about one-quarter were cutting tools, sharp (half with a saw edge), and weighing fifteen to twenty grams. Three-quarters had the high-edge angle of planing and gouging tools and weighed about twenty grams. Many appear to have been the stone components of hafted chisels rather than hand-held scrapers. Heavy tools were rare on this site.

In Clogg's Cave in the Victorian uplands about 15 000 to 10 000 years ago, the main tools were thick steep scrapers weighing fifty to sixty grams, some with concavities for scraping spear shafts or noselike projections for gouging. There were thin, straight-edged scrapers or knives, probably used in making skin cloaks, and pebbles for burnishing the skins. Rocky Cape South in Tasmania had a few heavy-duty choppers and planes weighing five hundred to six hundred grams 8000 years ago, but most tools were scrapers, typically weighing fifty to sixty grams and having steep (90°) robust wood-working edges, often notched. The cave also contained knives, usually made on long flat flakes, as well as small round scrapers weighing ten to fifteen grams.

Kangaroo Island tools illustrate variations of size between artefacts from different localities. Heavy tools, in a majority on some surface sites, had an average weight of some hundreds of grams, while the average weight of the flake scrapers used in Seton Cave between 16 000 and 11 000 years ago was only eight grams. Here and at Quininup Brook some of these quite small implements may be adzes, hafted rather than hand-held, with straight or slightly concave trimming and retrimming along one side, reducing the flake to a fraction of its original size. For this to have happened the flake must have been held firmly in gum or resin.

Available raw material affected the sizes of tools. Very small and simple chert and quartz tools were used in Devil's Lair. Quartz was battered at both ends, shattering it into very small pieces before use. Resin on two steep-edged quartz pieces in Devil's Lair shows they were hafted. At Kow Swamp in northern Victoria, where some of the thirteen excavated graves around 9000 to 10 000 years old contained stone artefacts, most tools were made of quartz available within a few kilometres. These artefacts are mostly simple flakes and cores, for quartz is a difficult stone to flake. Some were battered at both ends, showing that the efficient bipolar technique was used to flake them. Other variations reflected differences in the activities for which the tools were required more than the availability of resources for making tools. Perforated beads in Devil's Lair indicate the use of a bow drill, a sophisticated implement.

In some areas, teeth were substituted for stone in toolmaking. In Devil's Lair, lower incisors of grey kangaroos and brush wallabies had their pointed tips broken off and the root scarred for hafting. Until recently, people in the southwest of Australia continued to use kangaroo incisors hafted in wooden handles for delicate engraving.

Stone hatchet heads, shaped by grinding, seem to have been used only in the tropical north at this time. In the Kimberleys, fragments of ground stone show that hatchets were in use at Miriwun; in Arnhem Land ground hatchets, grooved for hafting, persisted from 25 000 years ago. Hatchets made up as much as one-quarter of the tools on some sites. The explanation appears to be an economic emphasis on plants and plant products. A similar explanation, the needs of seed grinding, accounts for the techniques of shaping grindstones and handstones.

SOCIETY, CEREMONY AND CONTROL

Between 15 000 and 6000 years ago, populations became denser and their distribution shifted. People abandoned coastal plains as seas rose, and left the tundra as trees advanced. Groups occupied smaller territories, used plant and animal resources more intensively and maintained them more carefully, burning to improve pasture and to encourage the growth of reeds or cycads. They used stone more frugally and transported it further; they centred their usage, movements and traditions on water, plant and animal resources, stone sources, ritual and trade

centres such as Koonalda and secret sanctuaries such as Devil's Lair. In each area groups maintained distinctive tool styles, art and ritual traditions and, presumably, distinctive mythologies and marriage practices. West coastal plain people used Eocene chert (or flint) but there was a social barrier between them and the inlanders east of the scarp across which the chert was not traded. The rugged people of the upper Murray remained physically distinct from their less rugged neighbours down the river. Eastern peoples did not use adzes; central and western people did.

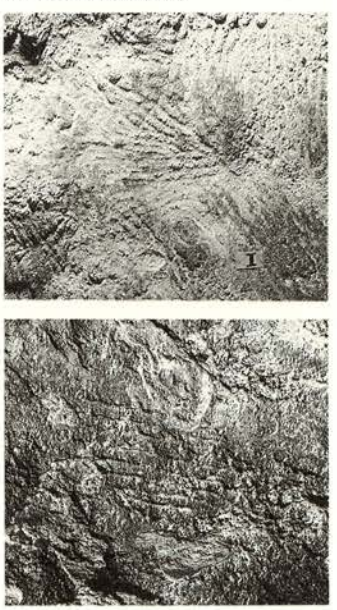
The size of groups and their ranges varied between resource zones. The density and extent of archaeological material on west coast sites and the close spacing of sites indicate larger groups and greater population densities than in the arid interior. The burial grounds along the Murray show large groups concentrating in limited territory and a trend towards more settled life in favoured areas. Group distinctiveness and connections between groups are clear when burials, rituals and art from different regions are compared.

The Nullarbor Plain provides evidence of wide-ranging exploration and the exploitation, mining and distribution of valuable stone in a context of ritual and art, probably implying control by an élite. Exploration, long-distance travel and mining were dangerous, challenging enterprises. Dark shafts penetrated the surface of the plain, producing strange sounds and mysterious updraughts. Perhaps only chosen men descended an 80-metre shaft at Koonalda more than 12 000 years ago, then scrambled 150 metres to quarry nodules of stone outcropping in the walls of the passage. Little light penetrated so far and they lit great bonfires. This practice, repeated again and again, left masses of charcoal and ash in intermittently flooded passages. From the walls they extracted lumps of Eocene chert, a fine-grained rock well suited for flaking into tools, and distributed far to the east, west and north. In the total darkness deeper in the cave, the walls were soft. Perhaps as part of increase ceremonies to ensure supplies of stone, participants drew serpentine sets of parallel lines with their fingertips. Where the surface was hard they scratched lattices, groups of vertical lines and herringbone markings. They dropped charcoal from torches at the 'squeeze', fully 300 metres into the cave, through which a person could barely wriggle to emerge perched high above the waters of a deep underground lake. From about 12 000 years ago, when the sea to expose the same chert at the foot of the ancient cliff-line, it was no longer necessary to go to the cave. But in the nineteenth century the Yircla Meening people still told tales of a great serpent haunting the shafts and caves of the Nullarbor.

People were visiting Orchestra Shell Cave in the west coastal limestone by 6000 years ago. Sets of serpentine lines on roof and walls made with a hand-held animal claw, splayed lines, and a group of straight parallel lines suggest a link with Koonalda traditions. Nearby caves were still sacred when first visited by Europeans. In the southwest, infrequent visitors to Devil's Lair had to descend a deep chimney-like shaft into almost complete darkness. They lit occasional bonfires illuminating the damp and dripping interior. About 15 000 years ago, they dug a pit two metres deep and barely wide enough to hold a man. There may be other pits in the nine-tenths of the cave still not excavated. Finds of several human incisors suggest that young males here went through a tooth removal ceremony as part of the sequence that initiated them into manhood. In recent times initiates were often isolated and subjected to frightening ordeals, intended to evoke respect and awe towards sacred law and the men of high degree who were its custodians. Such a setting would explain the pit, the incisors and various other finds not appropriate to a domestic context: the right half of a male pelvis from another pit, perhaps for ritual use; a limestone plaque criss-crossed by faint incisions, possibly

People were visiting Orchestra Shell cave in the coastal limestone of Western Australia 6000 years ago, and they may have marked the walls at that time. Serpentine lines (top) on the roof and walls were made with animal claws held in the hand; straight lines (bottom) may have been made in the same way. Caves nearby were still sacred in the nineteenth century.

V. MCKEAY/WESTERN AUSTRALIAN MUSEUM



Entrance to Orchestra Shell cave.
S. HALLAM

outlining a four-sided figure; red ochre for body decoration; and pendants in bone and soft stone. These are all about 12 000 years old. Bone beads and bead preforms three thousand years older may be from ceremonial dress.

Caves were commonly used for ceremonial purposes. About 13 000 years ago, large macrozamia nuts were stored in a pit in the floor of Cheetup Cave, a hollow in a great granite dome facing out over the southern coastal heaths east of Esperance, Western Australia. The nuts might have been stored to detoxify them in preparation for a ceremonial gathering. A six-months' old baby girl was cremated and her remains buried in the floor. In the Ord valley, flakes from australites (small meteoric globules that had showered the area) have been excavated in shelters, suggesting that the Kimberley caves were used for ritual purposes from early times. Ritual and trade involving australites continued into the last century, when an australite mounted in gum was part of the contents of a Derby medicine man's bag.

Large ceremonial events took place more often in the open than in the confines of a cave. On the Avon River, inland from Perth, Walyunga was frequented from earlier than 8000 years ago until after European settlement by groups who brought a variety of stone materials from many distant places. Over one million artefacts scatter the site. At Quininup Brook clusters of beach pebbles scattered across the ground more than 10 000 years ago resemble cairns at recent ceremonial sites.

Art frequently serves as a marker of ritual usage, and was important everywhere from 15 000 years ago. Besides the finger markings and scratches of the Koonalda-type tradition, other kinds of engraving were made in many places with suitable rock faces. In the Early Man shelter at Cape York 13 000 years ago, refuse covered some engravings, already very corroded, of various designs: deeply pecked rectilinear and curvilinear mazes, straight and meandering lines, rows of short strokes, clusters of irregular pits, bird tracks and other three-pronged shapes, all deeply patinated, and some grooves filled with a silica gloss. Geometric designs, including concentric circles and spirals and tracks of birds and other creatures form the bulk of the most weathered motifs in the Pilbara. Some have a natural silica gloss covering them; others have not, suggesting that geometric designs and tracks were made for a long time. Simple outline figures are fairly deeply engraved and

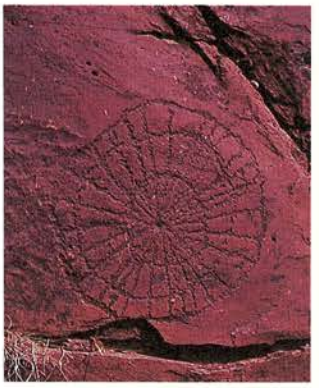
well weathered. They include Tasmanian tigers, now extinct in the region. A complex artistic and religious life spanned the grasslands, from the Pilbara to western New South Wales, and lasted a long time.

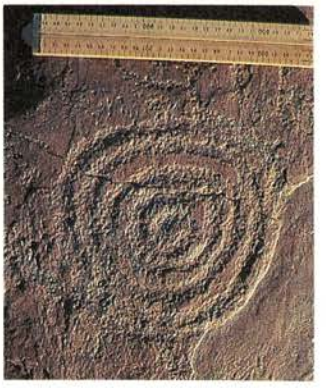
In Arnhem Land and in some Queensland sites, abundant ochre shows that painting on cave walls or human bodies had long been part of ritual traditions. The art preserved in many such galleries, it has been suggested, documents an elaborate sequence of painting styles and motifs, stretching from twentieth-century items to designs at least 10 000 years old. Some of this art may be as old as the cave paintings of prehistoric Europe. Estuarine and floodplain creatures, such as barramundi and crocodiles, signal environmental changes. The basic division appears to have an environmental basis. Before the great floodland plains formed about 7000 years ago, paintings depicted large naturalistic animals, including Tasmanian tigers and devils, and human figures wearing enormous headdresses, 'skirts' and other ornaments and brandishing boomerangs and spears without spearthrowers. Later animals are more stylised and people are shown only with spearthrowers.

All Aboriginal art may be fitted into a context of ritual observance, in which knowledge of sacred matters was a most prized possession, and seniority in matters of law put prestige and social control into the hands of an élite who had achieved high ceremonial and social status, probably as guardians of ritual, social order and ecological lore. The most direct evidence comes from burials.

Alongside Lake Nitchie near the Darling, the body of a man about 1.8 metres tall was crammed in a crouched position into a hole dug 7000 years ago into the hard lime-concreted sand of the lakeside dune. It was then scattered with powdered ochre. During his lifetime his central incisors had been knocked out and he wore a remarkable necklace of canine teeth taken from more than fifty Tasmanian devils. The presence of these animals is striking evidence of damper conditions favouring dense thickets, lush vegetation and permanent water. The elaborate burial implies high status and a society that devoted time and effort to ceremonial matters.

From the rich and heavily populated lower Murray, Roonka Flat provides details of complex burial practices at about the same time. Some bodies had been placed upright in shafts and rearranged later when partly disintegrated; others were tied into compact bundles; yet others were buried lying flat. An upright piece of wood, possibly a sacred board, accompanied some shaft burials. A skin cloak, fastened by a fibula pin, was placed in the shaft over the body of an adult decorated with red ochre and wearing a perforated pendant of fossil oyster shell. Another body, compressed into a vertical grave, wore two marsupial cat jaws as pendants. Both men and women were buried there, with 50 per cent more men than women being accorded this elaborate disposal. Two infants have been found buried with parents—evidence that the very young did not normally merit this ritual. Removal of one or both central incisors had been practised in more than half of the early Roonka burials at Devil's Lair, Lake Nitchie and Cossack between 9000 and 6000 years ago. At Roonka disease appears to have been less common than injury as a cause of death. Some people suffered from arthritis in the backbone or joints, and a few had yaws or tuberculosis. There was no dental decay, but a diet of bulrush roots, water lily tubers, yams and seeds, all pulverised on gritty grinders, had caused heavy wear on the teeth. Some were worn right down to the roots and several people had suffered from jaw abscesses. Over 40 per cent of those buried were under 20 years old and only 6 per cent had lived to be over 50. Violence was very much a part of life and death on the lower Murray. There were several fractured skulls, many fractured limbs, and one amputation. A large fibula point lay within the ribcage of one horizontally buried skeleton, perhaps inserted under the collar bone as in recorded vengeance killings.





Sturt's Meadows, New South Wales. The site consists of an area of low rocks on which many thousands of engravings have been made. These are enigmatic to us for the most part, but include a number of motifs which occur in other engraved sites across Australia. A recent attempt has been made to date these engravings through the 'desert varnish' (a coating possibly produced by fungi or other micro-organisms), which covers many of them. The results suggest that they may be older than 5000 years.

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At Roonka, we glimpse a society in which ritual dominance and conflict were aspects of social and population control. When Europeans entered the continent they observed senior males establishing kin alliances through multiple marriages, generally to much younger wives. They also noted a late marriage age for men, a low ratio of women to men and a wide spacing of surviving children, caused partly by cultural proscriptions that kept women undernourished. These social patterns kept population numbers in check, as did conflict between males over status and chains of retributory killings, sometimes arranged or restrained by senior ceremonial leaders. Thus Aboriginal society practised policies that, by checking population increase, served to balance population and available resources. All these things seem to have been happening by 10 000 years ago.

Over the millennia discussed in this chapter, technological innovation was slight. Increasingly rare raw materials were put to more efficient use by reducing the size of some tools, while composite implements of stone, gum and wood became more common. The ecological changes that took place in the period from 15 000 to 10 000 years ago caused a few dramatic adjustments but, after 10 000 years ago, changes were only relatively slight and local. A variety of ecological zones was more intensively exploited, but most had already been penetrated. The greatest changes may have arisen from society itself. Certainly strong ritual, mythological and artistic activity and a network of contacts indicate the development of a society centred on Aboriginal men of high degree, and this may have controlled more extensive and intensive use of natural resources by rising populations. Within Australia, a rich fabric of life mattered more than numbers or objects: knowledge and control of ritual law and ecological lore, not possessions, were the basis of respect and status in Aboriginal societies. The social structures, mechanisms and values that distinguished Aboriginal from European societies in 1788 were already emerging in Australia between 15 000 and 5000 years ago.