

AUSTRALIAN NATURAL HISTORY

A full-page photograph of a group of people cycling on a dirt path through a dense forest. The path is wide and unpaved, leading into the woods. Several tall, slender trees with thick trunks line the path, their branches and leaves forming a dense canopy overhead. Sunlight filters through the leaves, creating dappled light on the ground. In the foreground, a woman in a red shirt and dark shorts is riding a bicycle towards the camera. Behind her, a man in a light blue shirt is also riding. Further back, a group of people, including a man in a hat and a child in a yellow shirt, are riding along the path. The overall atmosphere is peaceful and natural.

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AUSTRALIAN NATURAL HISTORY

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COVER: Special activities are held in the school holidays to encourage people to enjoy the park in new ways. One activity is bike riding along Lady Carrington Drive. (Photo: G. Steer).

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APOLOGY: The editor wishes to apologise to the author of "Cosmetics from Trees" in the January-March 1979 issue, Dr Paul Sillitoe. He has indicated his preference for the title "Decorating Oil from Papua".

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ONE HUNDRED YEARS — ROYAL NATIONAL PARK

BY CAROLYN PETTIGREW

In the late 1870s, Sydney was a rapidly expanding city but a critical situation existed. Already severely overcrowded, parts of the city lacked adequate sewerage disposal, fresh air and playgrounds. These factors were blamed for the appalling rate of infant mortality which was higher than that of any principal town in Great Britain.

Early in 1879, urban reformers persuaded a majority of the NSW Legislative Assembly that "to ensure a healthy and consequently vigorous and intelligent community... all cities, towns and villages should possess places of public recreation". The motion was popular both within and without Parliament and Sydney city and suburbs gained many new parks as a result of the reformers' agitation.

In addition and quite independently, a group of Syd-

ney gentlemen met to form the NSW Zoological Society. They wished to encourage the introduction and acclimatisation into the colony of certain birds and animals from different parts of the world. They wanted them for their song and as game.

The government quick to meet the demands of both groups announced that 18,000 acres was to be set aside as a "national domain for rest and recreation". Behind this move was Sir John Robertson, a popular liberal politician with somewhat radical inclinations. On 26 April 1879, the National Park was dedicated under Robertson's famous 1861 Crown Lands Alienation Act.¹ Robertson became the first chairman of trustees and set the pattern for almost forty years of the park's development. That he

¹The National Park was renamed the Royal National Park in 1954.

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NAL PARK

was able to choose such a large stretch of relatively unspoilt bushland so close to Sydney, was partly due to the nature of the land itself, partly to good fortune. Little use had been made of the land south of Port Hacking, as it was unsuitable for pastoral pursuits and not much timber had been removed. Moreover, Port Hacking and the Georges River presented natural barriers between the area and Sydney, the rich farmlands and coal seams of the Illawarra being reached via Campbelltown or by sea. However, the recently surveyed Illawarra railway would soon be able to carry visitors into the park itself.

The National Park was the second national park in the world, after Yellowstone National Park in the USA, but it differed greatly in concept from its American counterpart. The National Park was considered primarily as a city park akin to the large common parks being created on the outskirts of London. Although plants and animals were protected, the removal of coal, clay, gravel and soil was

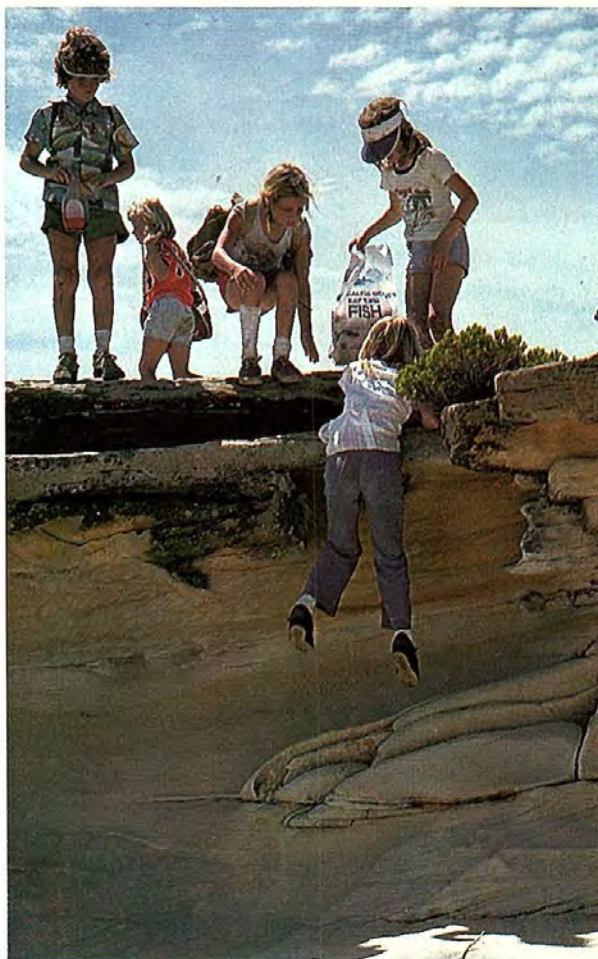
permitted and the notion of 'wilderness', embodied in Yellowstone, was completely absent. Nevertheless, Sydneyites were proud that theirs would be like "no other park in the world."

In the early days, a lot of effort went into creating an appearance similar to English parks so that the "charms of landscape treatment might be added to the beauties of wild nature". Ornamental lawns and gardens were planted and a huge aviary built to house native and introduced song birds. At Audley, construction of the causeway changed the waters of the Hacking River and Kangaroo Creek from salt to fresh, and introduced fish such as perch and trout were acclimatised above the dam. Military encampments were also held, the first in 1886, attracting over 30,000 spectators. The camps were discontinued in 1914 although intermittent army exercises were held in the park until the 1960s. Today, the ornamental trees at Audley, the deer and beautiful stone-

National Parks offer peace and tranquillity. Garie Beach in Royal National Park.

R. Crombie





R. Crombie

Left: Children are encouraged to use Royal as a place to discover the environment. The park is one of the few where a wide variety of habitats can be experienced. Below: Christmas bells (*Blandfordia nobilis*) almost disappeared from the park as a result of insatiable wildflower gathering. Now fully protected the plants are reappearing. Right: Soils derived from rocks of the Narrabeen series, reliable water and shelter bring together the elements to support sub-tropical rainforest. Rainforest on Lady Carrington Drive.



R. Crombie



work along Lady Carrington Drive are the few reminders of the nineteenth century view of what a national park should be.

A consciousness of the need for preservation of native flora and fauna, first developed by naturalists and bush-walkers, was gradually adopted by a significant proportion of society. For the preservationists, the natural landscape of the park was as important as its recreational potential. They therefore opposed some of the methods used by park authorities to generate revenue, especially the sale of timber. Their public criticism led to the gradual cessation of most of these practices.

The National Park was the testing ground for a developing conservation ethic in NSW. Many of the early conservation battles were fought over land management practices in the park. Inextricably, the park's history is woven into the development of the national park movement in particular, and nature conservation in general.

Aboriginal Occupation

In March, 1796, at the height of a violent storm, two young men and a boy battled against heavy seas, to find a safe refuge for their tiny boat. By chance they found a small cove. Flinders recorded the ordeal in his diary and commented "we thought Providential Cove a well-adapted name for this place; but by the natives, as we afterwards learned it is called Watta-Mowlee". Flinders also noted that "no natives were seen, but their traces were recent". Flinders and Bass had met a group of Aborigines two days previously at what is now known as Tom Thumb Lagoon. He observed that "the natives were in nothing, except language, different from those at Port Jackson; but their dogs, which are of the same species, seem to be more numerous and familiar". This is one of the few accounts of the Aborigines who inhabited the area now included in Royal National Park. Much of the information about these people is derived indirectly, from the records of other explorers and local settlers, and from archaeological research. The people themselves did not long survive the introduced diseases such as smallpox and measles.

Aborigines were present at Curracurrang at least 8000 years ago and at Wattamolla at least 2000 years ago. More recent historical and archaeological evidence suggests that by about 1850 Aboriginal occupation, even by remnant family groups, had ended.

Coastal Aborigines were semi-nomadic, their movements determined by the seasons and the availability of food. On land they hunted wallabies, kangaroos, possums, bats, gliders, rats and bandicoots. Fish were also an important part of their diet. In the sheltered cove of Wattamolla silver bream, sand and silver mullet, flathead and 'sea perch' were probably caught with lines, while reef-feeding blue groper, parrot fish, leather jackets and snapper would have been speared or hooked from canoes. Along the rocky ocean shores, drummer and black bream were available throughout the year. A variety of shellfish, including oysters, abalone, mussels, pipis, periwinkles, and scallops as well as crustaceans such as lobsters and freshwater crayfish could also have been collected. Quite a number of food plants are found in the area.

Since the sea was a bountiful source of food, it is not surprising that among the rock engravings of the region fish form the most common motif. Hand stencils and charcoal figures have also been found but most are badly weathered.

Excavations have yielded a variety of implements—spear points or barbs made from bone, stone scrapers, and fish hooks fashioned from shell. One of the more enigmatic finds was a small blue bead. Whether it was one of the beads and other paraphernalia left by Cook at Kurnell, remains open to romantic speculation. More significantly, evidence of trade in raw materials has been found, suggesting that the Aborigines participated in a diverse regional economy. However, the picture of Aboriginal occupation of the area is far from complete and not until a thorough study of the landward sites is undertaken, will we gain a fuller understanding of how Aborigines utilised this rich and beautiful landscape.

Wildlife in the Park

When the park was surveyed in the early 1880's, wild cattle and sheep, escapees from small private land-holdings along the coast, were found on the plateaux. In 1885, another large herbivore was deliberately introduced. The undergrowth of sixty-five hectares on the southern shores of Port Hacking was cleared, sown with grass and enclosed as a deer park. Fallow, red, sambar and Javan rusa deer were added at various times, although Javan rusa became the dominant species. But the Official Guide Book commented "a nine wire fence did not a prison make" and the deer escaped their enclosure to roam the countryside at large.

Deer almost certainly compete with native fauna especially during times of drought, and the mown appearance of grassy patches along the coast and inlets of Port Hacking is testimony to their appetite. Only one serious attempt has been made to remove the deer from the park. In the 1930s, the herd was reputed to be about 600 strong and farmers were offered the animals free, although no-one anticipated how difficult it would be to capture them. Later, a proposed shooting round-up was shelved amidst public protest. The deer remain a problem today although attempts are made to reduce their numbers by live trapping.

Another menace to wildlife is the introduced predator. Dogs and foxes were reported to be a nuisance in 1912, in 1932 a shooting drive by mounted rangers greatly reduced the number of dogs and cats. These animals are still dumped in the park and their effect on birds and small ground-dwelling mammals can only be surmised.

Few records of native fauna were kept in the early days, and those available are confusing because of the Trust's practice during the early 1900s of introducing animals from other parts of NSW. Some, such as emus, failed to survive. The diversity of wildlife has also declined due to clearing of neighbouring land for farming and the growth of Sydney's suburbs. Although on a map the park appears to connect with the extensive water board catchment areas, it is cut off by the four-lane Princes Highway, a very effective barrier to mammal migration.

The park still has a fairly rich mammal fauna. Over thirty species have been recorded, dasyurids and



R. Crombie

phalangiers being the most numerous species. Additional sightings of macropods not native to the area have also been noted.

Royal National Park is perhaps best known for its birds, and might well be called the cradle of Australian ornithology. In 1924 the Scientists Cabin, near Upper Causeway, was established and for many years was the base camp for scientists studying the behaviour of satin bower birds and lyrebirds. From studies carried out in the park, E. Nubling first accurately detailed the male bower bird's peculiar habit of painting and decorating its courting bower with blue objects. Neville Cayley and A.H. Chisholm, both at one time trustees, and Keith Hindwood are among the well-known ornithologists who regularly worked in the park.

Naturalists in the 1930s claimed that the large crowds of visitors were driving native fauna, particularly birds, from the park. Egg collecting, though illegal, was popular and probably did more harm. To answer these criticisms, the Trust invited the Australian Ornithological Union to carry out a detailed survey. Over 200 bird species were recorded; swamp parrots and pacific gulls known from earlier records were, however, absent. Nevertheless, the sheer number of species silenced the critics without proving them wrong. Had estimates been made of the

number of breeding pairs of ground nesting birds a different picture might have emerged, for these were the species most likely to have been affected. Today, 201 native bird species and nine introduced species are officially listed for the park.

The diversity of habitats required to support such a varied fauna is in part a reflection of the topography and underlying rock strata. Essentially, the area is a southward rising plateau of Hawkesbury sandstone. Fluvial in origin, the sandstone was possibly deposited by a huge river originating 250-350km to the southwest, with a flow pattern likened by geologists to the Brahmaputra River in India. Under the massive sandstones of the Hawkesbury series are the Narrabeen shales and sandstones. Smaller in extent, but again fluvial, the Narrabeens were mainly derived from the erosion of folded rock in the New England district. Narrabeen shales outcrop in the southern end of the park and are exposed along the upper reaches of the Hacking River valley. The contrast between the Hawkesbury and Narrabeen headlands at Garie dramatically illustrates the different weathering landform shaping properties of the two rock types.

The sandstone tops are dominated by heaths and woodlands and where there is protection from ocean winds, the woodlands change from mallee formations to those of gnarled gaunt angophoras. Hanging swamps and wet heaths occur wherever drainage is slightly impeded. Two principal streams flow north through the park and in the shelter of their gullies open eucalypt forests display the beauty of the incredibly diverse sandstone flora. By contrast, Narrabeen-derived soils, reliable water and shelter bring together the elements which support the sub-tropical coachwood-sassafras rainforest of Bola Creek and the upper Hacking River—'glens of exquisite loveliness'. Palm Jungle, littoral rainforest dominated by cabbage tree palms, is the coastal equivalent of the same conditions.

Probably about twelve per cent of Royal National Park has been significantly altered by human landscaping, the rest remaining relatively inaccessible to vehicles and their attendant disturbance. Frequent fires whip across north-easterly directed paths, through areas of known small mammal populations; the effect of the fires is so far unrecorded. People steal plants and birds with a sophistication not previously experienced. Children unashamedly hack down trees for their campfires in popular camping spots. Two and a half million visitors annually leave tonnes of garbage. Vandals wreak their mindless havoc. Despite all this, on a week day or away from the main picnic areas, it is hard to believe that Sydney is just across Port Hacking. Royal National Park still embraces all the qualities, save wilderness, for which more distant national parks are renowned. As the Official Guide of 1893 remarks "It is time, and time alone, that will prove the vast value of this magnificent dowry to the people of New South Wales".

FURTHER READING

Pettigrew, C.J. and Lyons, M.J. 'Royal National Park a Brief History' in 'Australia's 100 years of National Parks'. NSW National Parks and Wildlife Service, 1979.

The rugged cliffs typical of Royal National Park's coastline.

IRIAN JAYA ORIGINS

BY WILHELM SOLHEIM II



Sitting korwar with top knot from eastern ledge of larger tower (see photo p. 326) east of Padwa, total height 26.7cm.

The prehistory of New Guinea is very little known. Irian Jaya, the western Indonesian half is, archaeologically, the least-known part of Indonesia. The first organised research there began in September 1975, although Irian Jaya was not completely unexplored before.

In 1907, Van der Sande found bronze artefacts in Lake Sentani. Over the next thirty-five years, similar artefacts were reported, considered to be related to the so-called 'Dongson bronze culture' of northern Vietnam. How and when these bronzes come to Lake Sentani remains a mystery. In 1937-38, Josef Roder led an expedition to the Arguni Island area of MacCluer Gulf, western New Guinea, in search of reported cave paintings, which he found. In the final, long-delayed report on this expedition, he mentioned other archaeological materials also discovered in these caves. Following World War II, K.W. Galis kept track of all accidental archaeological finds reported to the Dutch government offices and visited many of the sites.

Very few archaeological data emerged, however. Recently it was hypothesised that the Austronesian-speaking people,¹ the Nusantara, originated in the southern Philippines and eastern Indonesia. The Nusantara's most likely route into the Pacific would have been

¹ Austronesian languages are those related languages spoken by the native inhabitants of Polynesia, Micronesia, Island Melanesia, Indonesia, Malaysia, Philippines, the pre-Chinese peoples of Taiwan, some groups in Vietnam such as the Cham, and the Malagach of Madagascar.

along the north coast of New Guinea to the Admiralties and the islands of the Bismarck Archipelago. A survey of the Irian Jaya coast was therefore mounted, to collect artefacts these people might have left as evidence of their move into the Pacific.

In an area for which there is so little existing archaeological information, it is very difficult to plan an exploration programme. The problem is mitigated by searching for caves. With little time to cover a wide area, it is impossible to find sites by ground survey. Information must be obtained from local inhabitants who are familiar with nearby caves, many of which were used in prehistoric times for burial, temporary shelter, refuge, or living. Archaeological materials found there may not necessarily give a cross-section of the cultures of peoples living in or using an area over time, but they provide a beginning.

The best rock type cave formation being limestone, it was the coastal limestone areas that were examined. Four areas were surveyed—the northern and western portions of Cenderawasih Bay (formerly Geelvink Bay), scattered areas near the western tip of New Guinea, the Kaimana area on the southwest coast, and part of Lake Sentani.

The most thorough survey was of Biak and the Padaido Islands, in Cenderawasih Bay. On the south shore of Biak Island exists a *kampung* or settlement called Padwa, consisting of about ten small houses built on piles over the water. To the east of the *kampung* are two limestone formations with sheer sides extending upwards about sixty metres. The outer formation has two horizontal grooves all the way around, one above the other. The lower groove is still being cut by high tides while the upper one, now about five metres above high tide, was formed by wave action either from an earlier higher sea level or at the present sea level with tectonic movement raising this cut to its present position.

The people living in Padwa speak Biak, an Austronesian language. They are very interested in the history of their *kampung* and reported that five generations ago, their ancestors arrived on the coast from an interior settlement closeby, which had been founded by people moving from a *kampung* towards the eastern end of Biak. This, and ultimately all Biak *kampungs*, were established by people from *Kampung korem*, a location

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several hundred metres upriver from the present *Kampung korem* on the north coast of Biak. Legends, partly magical in nature, tell of the original Korem founders, the first Biak-speaking people who came by boat from the east, probably from the north coast of Irian Jaya. These people have been very successful, first inhabiting Biak Island and later taking over all of Biak and the Padaido Islands from their earlier inhabitants, except for the island furthest east, Padaido Island itself.

The people living in Padwa were very hospitable. The survey party stayed in the house of the local school-teacher, Mr Suabra, sleeping on the floor of his main room, and were accompanied by two officials from the Institute of Anthropology of Cenderawasih University at Abepura (near Jayapura, the capital of Irian Jaya) who were both natives of Biak, so there were no communication difficulties. Problems developed, however, with the neighbouring *kampung* of Urfu. Disagreements between Urfu and Padwa over the ownership of the two limestone formations east of Padwa reached a climax when archaeological testpits were put down there. News of this reached Urfu and a misunderstanding developed that came close to an open fight. Happily, the elders of both *kampungs* wished to solve the argument peaceably, and after rather heated discussions several Urfu elders were invited to examine the excavation work. This arrangement convinced them that the work being carried out was neither illegal nor unfairly advantageous to the people of Padwa in their rival claims to this land.

The first settlement of Padwa, called Padwa Mnu, was located on top of the two limestone towers. These were easily defensible if attacked, and provided an unobstructed view of any approach by water. During World War II, the people of Padwa were able to watch the air battle over Biak when the Americans and Australians attacked the Japanese. All the caves close to Biak town had been used by the Japanese, producing much disturbance and leaving considerable equipment, including unfired ammunition and unexploded hand grenades.

The inner and larger limestone tower had numerous vertical fissures as well as the upper horizontal groove. Several fissures and the westward facing upper ledge contained many burials. In the first cave were deposited human bones and part of an old *prao* (a small to medium sized (ca 46 metres) single outrigger canoe used by the local people)—the remains of the two men who founded Padwa Mnu, their *prao*, and friends who moved there with them. In a small cave immediately above this one

were the skeletons of a 'big man', a female, and a baby. In both caves broken pottery, beads, and other small artefacts were also found. On the western ledge of the smaller tower, skeletons were found with artefacts and a few unbroken nineteenth century European porcelain bowls and plates, fish spears, other badly rusted iron artefacts and even one polished stone axe. The dead, brought here in a stretcher, were placed on top of earlier funeral remains. For people considered to be special, a secondary² burial ceremony was held, and their bones were placed in a carved wooden coffin on a ledge of the larger tower. The western ledge continued in active use into the 1930s.

West of Padwa, continuing for about 200 metres, was a limestone cliff. In two areas where the upper ledge was particularly evident there were other exposed cemeteries. Associated artefacts were similar to those from the Founders' Cave and included a number of *kar-war*. These are carved wooden figures representing specific ancestors. Though greatly valued by art collectors, they rarely appear in museums (mainly in Holland and Germany) and very little was known of their manu-

² A primary burial is a burial of the body immediately after death. After some years the primary burial is opened, the bones cleaned and then reburied. The opening of the primary burial, cleansing the bones, and the reburial (secondary burial) involves considerable ceremony.

W. Sothman



Secondary burial in a plain coffin next to semi-flexed burial on ledge west of Padwa.

facture and use. *Korwar* were particularly disliked by the first Christian missionaries among the Biak. Christianity was first brought to this area in the years preceding World War I by Biak missionaries who themselves had been brought up in Christian missions in eastern Indonesia. In many areas the first missionaries had their converts bring their *korwar* to a large gathering where they were burned. Failing to understand their own traditions, they mistakenly considered these figures to be idols, when they were mainly thought of as vehicles for the ancestor represented by the figure. A figure was carved soon after the death of a man or woman and kept by the family. In times of stress or anticipated stress the figure was brought out and the spirit of the represented ancestor was ceremonially called for consultation. The spirit then came and resided in the figure during the consultation, leaving the figure after giving advice.

Most of the *korwar* are made of softwood but for famous people they were sometimes carved from hardwood. Very rarely were they made of stone; there used to be three stone *korwar* in Padwa but these were destroyed on the orders of the missionaries. Twenty-nine rather fragmentary *korwar*, including three made of hardwood, were collected by the survey team. Twenty-seven varied in height between 19.4cm and 29cm, one was 32cm and the other 40cm.

Near the area where several *korwar* were found, the survey team also discovered a simple, narrow coffin with a lid, containing the bones of an adult woman and those of a baby or possibly a foetus. Next to the coffin was a skeleton in a semi-flexed position with the heels brought up against the pelvis and the leg bones vertical, perpendicular to the body. Another similarly simple coffin containing no bones was also found and taken to the anthropology museum at Cenderawasih University to be included in an exhibition explaining the survey and showing what had been found. Four months later when the survey team returned to Padwa, the local people were shown pictures of the exhibits. Although they felt very proud that Padwa was the subject of an exhibition, they were surprised to see the simple coffin, and not one of

the more ornate, carved ones. At their invitation, two carved coffins were chosen from a ledge at the base of the larger tower east of Padwa to take back for the exhibition. In one were the bones of a famous warrior, and in the other those of a woman who had been loved and highly admired by the people of the *kampung*. Both were known by name and had descendants still living in the settlement.

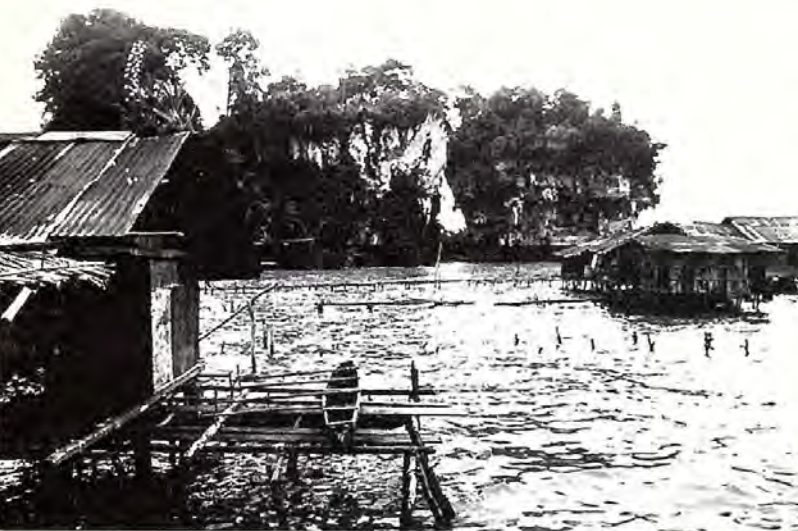
The survey team also visited Gag Island, Waigeo (to the west of Irian Jaya) and Mé Island, west of Kampung Salio, a leper settlement run by the Indonesian government. On Mé Island, at the base of a limestone cliff, there was a small shrine with a carved wooden image and at its base a very large triton shell, a human skull cap, and an old bronze gong. As this shrine was obviously of local importance, none of its contents were disturbed. Continuing the journey to a small island in the northeastern end of Kaboei Bay, the survey team visited a burial cave which would have been impossible to find without local assistance. Here were many skeletons and wooden bed-like platforms, wooden chests, coffins, porcelains, stoneware and other artefacts. This cave had been visited a few months earlier by a boatload of Indonesians from Sarong and they had taken artefacts away with them. A very small test pit was put in to see how deep the deposit was and then the survey team was permitted to take one carved platform, a few nineteenth century, mainly Dutch, porcelains and other artefacts from the surface, to make an exhibit in the museum at Cenderawasih University.

The third area surveyed was around Kaimana. The most interesting find was a tremendous number of paintings in wave cuts in the cliffs north and south of Kampung Mai Mai, southeast of Kaimana. The wave cuts resembled those at Padwa, raised about five to six metres above present high tide. The paintings, in different shades of red, were on the back wall above the ledge and protected by an overhanging ceiling. They were similar to those published by Röder from the Arguni area and included human figures, lizards, dolphins and a variety of geometric patterns. In some parts, much of the original painted surface had weathered away, some paintings were superimposed on others, and in many cases, lime in solution from the ceiling above had washed over portions of paintings, blotting them out. These paintings are probably quite old, the people in Mai Mai having lived in this area for a long time. Asked whether they knew any stories of their ancestors arriving from elsewhere, they could tell none and had no knowledge of who had made the paintings.

On several Sundays, the survey team visited various *kampongs* on the shores or islands in Lake Sentani. Kampung Abar is the source of earthenware pottery for people around the Lake today and has been throughout the remembered past. Information on their pottery manufacture was gained from several of the women potters. The island of Kwadawari was also visited in the western end of the Lake, to find data on carving from the most famous of the Lake's woodcarvers. He had recently died, but his son and other men were continuing the old traditions. Woodcarving had almost died out but a woodcarving revival now seems to be under way.

The local people also told the survey team that nine

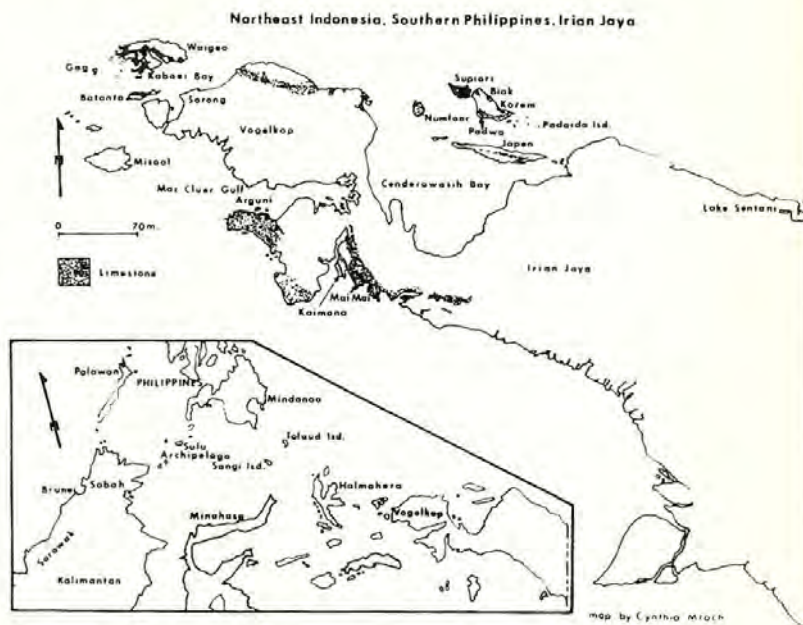
Wave-cut limestone towers to the east of Kampona Padwa with Padwa houses in foreground.



bronze artefacts had been found on Kwadawari. Around 1906, a large tree near the shore had blown over and six bronze artefacts were found in the roots. In 1958, Professor de Bruyn received permission to dig where the tree had been and he found two more artefacts. The ninth was found when a football field was levelled at the northwestern end of the island. De Bruyn took the two that he found away with him. Between 1924 and 1940, a German missionary called G. Schneider was given two artefacts. These, he said, would be turned over to the ethnographic museum in Leiden, Holland, but it is not known whether they ever arrived there. The tool found at the end of the island was given to a Dutch 'information officer' in the 1950s. This was a smaller version of the handled round-edged axe (illustration page 327). The four remaining tools are in the possession of a Kwadawari elder, who keeps them in a leather bag. When they were taken from the bag to show to the survey team, the old people nearby became quiet and respectful. When the tools were returned to the bag, three elderly men clapped their hands in unison three times. The survey team also excavated a burial area in the centre of Kwadawari. Much pottery similar to that at Abar was found, but no further bronzes. Indeed, the bronzes of Lake Sentani remain as much of a mystery as ever.

Due to a two-month delay at the beginning of the Irian Jaya survey, the laboratory processing and analysis of the collected materials were not completed. Until this research has been finished, the full results of the programme will not be known. It is most likely that inferences that the Nusantara moved into the Pacific along the north coast of New Guinea would be gained from pottery remains showing relationships to the Lapita pottery of the South Pacific and the Sa-huynh-Kalanay pottery of Southeast Asia. A possible early site found west of Kaimana had pottery and associated shell and stone artefacts which may be similar to whatever lies still buried at the early Sa-huynh-Kalanay sites in eastern Indonesia and southern Philippines. In Cenderawasih Bay and northeast of Sorong, pottery has been found with many of the decorative elements of the Sa-huynh-Kalanay pottery but most of these were proto-historic sites. No specific elements of the early Lapita pottery were noted in the Irian Jaya pottery. Thus, while there is possible evidence for the relationship with Southeast Asian archaeological cultures there is as yet no close relationship demonstrated with Melanesian archaeological cultures.

The author acknowledges the Ford Foundation Southeast Asia Research and Fellowship Programme and the Indonesian office of the Ford Foundation who gave financial assistance to the three sponsors of the survey: the Indonesian National Research Centre of Archaeology, Cenderawasih University, and the University of Hawaii. Thanks are given to Dr Rubini, Rector of Cenderawasih University and Dr Suharno, the Director of the Institute of Anthropology at Cenderawasih University for the laboratory and staff facilities they made available to the project, to Mr Coates of Freeport Indonesia, Inc., Messrs Moorman and Kansil of Pacific Nickel, Mr Arthur of Sun Oil Company, Mr Tan of Kaimana, and Mr Muharramsyah of the Indonesian Department of Culture for their indispensable assistance in the field. Many others helped greatly to make this project a profitable one.



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Four bronze (?) artefacts from Kwadawari, Lake Sentani, Irian Jaya. Total length of dagger at right 13.8cm. The two axes to the left have not previously been published while the two objects at the right are included in de Bruyn's report on the Lake Sentani bronzes.

W. Solheim



DOMESTICATING JOJOBA

BY R.L. DUNSTONE AND J.E. BEGG

Jojoba or *Simmondsia chinensis* is an evergreen shrub found in its natural state only in the Sonora Desert region of Arizona and California in the USA and in Sonora and Baja California in Mexico. The bushes grow three to five metres in height and have deep and extensive root systems. They are found in coarse textured soils receiving from 100 to 500mm of rain per year, the species being common at altitudes between 600 and 1200m. Smaller plants are found along the coast and on islands in the Gulf of California.

The plants are very resistant to heat and drought and may live for one to two hundred years. They tolerate soils with high levels of salt and boron.

Jojoba normally flowers following autumn-winter rains. Male and female flowers are on separate bushes and pollination is effected by wind. Male flowers appear as small yellow balls but the female flowers are green and inconspicuous. The fruits look, superficially, like a green acorn, containing one to three brown seeds, each a little larger than a coffee bean.

The seeds ripen in summer and can be harvested and crushed to produce about fifty per cent of their weight of a liquid wax which has properties similar to sperm whale oil and spermaceti.

Taxonomy

Simmondsia chinensis has recently been classified as the only member of a unique family, the Simmondsiaceae. It was previously included in the Buxaceae or Box-tree family, which is a large cosmopolitan group.

The first specimen, described by Link in 1822 was erroneously believed to have come from China and named *Buxus chinensis*. In 1844 Nuttall independently described a specimen from San Diego in southern California which he named *Simmondsia californica* in honour of the naturalist F.W. Simmonds. It was later realised that they were the same species. As the International Code of Botanical Nomenclature rules that the first species name must be used, even if, as in this case, it is misleading, the correct botanical name is *Simmondsia chinensis* (Link) Schneider.

It has many common names including deer-nut, coffeeberry, wild hazel, grey box bush, hohowi and jojobe. The preferred common name is jojoba (pronounced ho-ho-bah) which is probably a Spanish transliteration of the Indian 'hohowi'.

Uses by Indians

The Indians have had a long association with jojoba which was commonly used for medicinal purposes, as a wound salve, for hair oil and for making ceremonial candles.

Jojoba occurs naturally on the reservations of the Apache Indians who have hand harvested considerable quantities of seed from wild stands in recent years. The

liquid wax produced in this way is expensive and insufficient to meet a large commercial demand.

Commercial Uses

The liquid wax from jojoba has many uses. It is an excellent base for the manufacture of high grade cosmetics, for ointments and as an anti-foaming agent in the production of penicillin.

When hydrogenated it forms a hard white crystalline wax which has a melting point of 70°C, burns with a bright smokeless flame, and can be used for high quality candles. The hydrogenated wax is also suitable for use in polishes, as it is harder than candelilla wax (obtained from the shrub *Euphorbia cerifera*) and is nearly as hard as carnauba wax, the 'king of waxes', (obtained from the Brazilian palm *Copernicia cerifera*).

When sulphurised it is very stable, remains liquid and maintains its viscosity over a wide temperature range. It can, therefore, be used as a lubricant for machinery operating at high temperatures and pressures.

The liquid wax from jojoba is chemically purer than sperm whale oil, and it is clear, odourless and has a longer carbon chain length which improves its lubrication and wetting agent properties.

Increasing demand by industry for the wax *cannot* be met solely from harvesting wild stands. It will require the domestication of the species so that a reliable, high volume supply of seed can be produced in plantations.

Domestication

In most cases the domestication of our major crop plants has been achieved through a process of selection and breeding over hundreds of years and requires continuing effort to maintain disease resistance, quality and yield.

Only occasionally do we see a wild species, domesticated in a short period as the result of a deliberate decision on the part of an interested group. The Chinese gooseberry or kiwi fruit (*Actinidia chinensis* Planch) is a recent example. It was first introduced into New Zealand from China seventy years ago and has since been domesticated by a group who recognised the potential of the plant in 1940.

Jojoba has recently been taken up by a number of groups interested in developing it as a cultivated industrial crop. It is at a particularly exciting stage for research workers and farmers alike as the plant has obvious potential but nobody can be sure when (or if) its potential as a cultivated crop can be realised.

The hopes for jojoba as an industrial crop are derived from two sources. The product seems to be unique, highly valued and to have potential application in a wide range of industries. Secondly, a study of the natural history of the plant has shown that it should be suitable for growth on sandy soils in semi-arid areas using limited



B. Dunstone



Above: A branch of a male jojoba plant growing in the CSIRO laboratories in Canberra, showing the sequence of development from the small bud at the tip to the fully opened flowers. Above right: A branch of a female jojoba plant growing in the CSIRO laboratories in Canberra, showing an open flower (top left) and developing fruits.

Below: A forty year old female jojoba growing at Broken Hill, New South Wales.



BOB DUNSTONE is an experimental officer in the CSIRO Division of Plant Industry, Canberra, Australia. His research interests include the physiology and evolution of crop plants. He has been interested in jojoba since 1974 when, as the phytotron biologist, he first saw the species growing under controlled conditions. J.E. BEGG is a Senior Principal Research Scientist in the CSIRO Division of Plant Industry, Canberra, ACT. Research interests in crop physiology include the biological mechanisms by which plants adapt to stress, particularly water and high temperature. Research work with jojoba dates back to 1972.

supplementary irrigation and on saline soils. These properties make it particularly interesting to Australians where seventy per cent of the continent is too dry, too sandy or too saline for growing conventional crops.

Jojoba in Australia

The introduction of jojoba into Australia dates back to the mid 1930s when the late Albert Morris brought in seed from Arizona as part of a programme evaluating the suitability of native and introduced species for the revegetation of denuded areas around mining towns. Only three plants survived from these early plantings, two females and a solitary male which are separated by some 600km. No seed was produced until males were planted near the females in 1977.

Interest in jojoba was revived in Australia in the early 1970s following the First International Conference on 'Jojoba and its Uses' held in California. Seed was introduced for evaluation at a number of research stations in the arid and semi-arid regions. These experimental plantings were established in all the mainland states and the Northern Territory by state departments of agriculture or forestry, and CSIRO. Since 1972 members of the CSIRO Division of Plant Industry have been carrying out research into the basic biology of the species. The aim of the work has been to understand the physiological basis for the plant's adaptation to arid areas and to relate its performance to that of other species in terms of tolerance of heat, ability to extract water from deep in the soil profile, and resistance to desiccation during drought periods.

The results of this work encouraged us to commence field trials in 1976, which now total thirteen sites throughout New South Wales and South Australia. State Departments of Agriculture have established plantings in these and the other mainland states.

In 1978 great enthusiasm for jojoba as a crop was generated in Australia at the time of the Governmental Enquiry into Whales and Whaling. A number of nurseries were established and trials were planted. In addition companies and cooperatives were formed to speculate on the establishment of large scale plantations in areas that they felt were comparable in climate and soil type to areas where the plant grows naturally.

The physiology of jojoba

Controlled environment studies in the Canberra Phytotron and glasshouses have shown that the vigorously growing taproot system promises to be very efficient in exploiting deep ground water. Seed sown into moist sand at 27°C germinates within a few days. The thick fleshy taproot then elongates at approximately 2.5cm per day and can reach a depth of 50 to 60cm before the shoot appears above ground.

Roots of mature plants have been reported at depths of 10 metres and work in our laboratories has indicated that roots grow down until the wet zone on top of a water table is reached.

Studies under controlled conditions have shown that jojoba is exceptionally efficient at producing a large weight of plant material for each unit of water lost. Its water use efficiency is higher than many other crop

plants and it is more resistant to desiccation than well known Australian arid zone plants such as mulga (*Acacia aneura*), spinifex (*Triodia basedowii*) or brigalow (*Acacia harpophylla*). Factors contributing to jojoba's greater resistance to desiccation include the presence of a thick waxy cuticle on the leaves and a high resistance to water exchange through the stomatal pores in the leaf surface.

Some problems of Domestication

Domesticating a wild species can be a very complex and lengthy process. In the case of jojoba we have a plant with a number of very positive attributes. The product is of high value and easily separated from the seed by known technology. The plant is well adapted to arid zones by the nature of its root system, the structure of its leaves and by the superior performance of critical physiological systems.

Unfortunately there is a debit side to the plant. Although we are often told of the promise of high yielding individuals, most wild plants yield poorly and often do not produce seed regularly. This is particularly apparent in areas where the plant is stressed during flowering; for example, frost can decimate the flowers.

Ideally, we would like to propagate only the individuals which yield large numbers of seeds all containing a high percentage of the wax. This is very difficult because all seed is produced as a result of cross-pollination. While inbreeding crops such as wheat retain their selected characteristics from generation to generation, naturally cross-pollinated seed does not produce homogeneous seedlings all having the superior characteristics of the selected parent.

Attempts have been made to reproduce superior plants by vegetative means (cuttings, grafting or tissue culture) to avoid the lack of uniformity experienced with seedlings. Difficulties have been experienced here as, in many trials, plants produced from cuttings have been as variable in yield as those from selected seed.

At the moment we are carrying out research in an effort to understand why cuttings can be so variable and are trying to evaluate the most effective way of propagating potentially superior material identified in field trials.

The network of small field trials will soon indicate where jojoba will not grow successfully in Australia. Soils that are too heavy or areas where frost is too severe are quickly eliminated as the seedlings often die in the first year.

Other unsuitable areas are not so quickly eliminated by short term trials. These are areas where the plants will grow into fine-looking plants but will not bear satisfactory yields of seed, or where the yields vary from year to year.

The most common criterion for selecting a site in Australia for a jojoba plantation is to choose the homocline of an area where the species occurs in large numbers in its natural habitat. However, the occurrence of the plant, even in large numbers is not a guarantee that it will produce adequate yields of seed in that area since the criterion for success in its native habitat is simply survival. Plants will survive and perpetuate the species effectively where seed is set only two or three times per

NEW FEATURE

—a note from the editor

From now on every issue will feature a special centre-fold photograph. In all issues except the annual special issue the centrefold will be an animal of some kind together with some background information on it.

We hope you'll find it useful, informative and adding interest to the magazine. Perhaps you may use it as project material or merely keep it as a beautiful photograph.

This month our centrefold is an animal well known to most Australians—the brush-tailed possum. The photograph was taken by Bob Crombie and kindly supplied by the National Parks and Wildlife Service of New South Wales.

BRUSH-TAILED POSSUM (*TRICHOSURUS VULPECULA*)

Brush-tailed possums may already be familiar to you because they are common in most parts of Australia. You may have heard them clambering all over your roof at night or scampering up the nearest tree fleeing from your approach. This possum is one of the few native mammals to have survived the growth of suburbia, the introduction of potential enemies such as dogs and cats, and the changes brought about by the removal of native bushland.

Description

If you're not altogether sure that it's a brush-tailed possum in your backyard here's a general description. They are about the size of a cat and vary in colour from black to grey. The tail, as is implied by the name, is thickly furred and tapers to a small unfurred finger-like tip. In Western Australia a white tail-tip is common. If you've ever watched possums curling their tails around the branch of a tree while climbing you'll have realised how useful their tails are for them. The underside of the tail is unfurred and improves its grip.

Their eyes and ears are suitably large for animals which must rely on their senses of sight and hearing to a great extent.

Habits

Brush-tailed possums spend the daylight hours huddled up in a tree, under house eaves or if possible inside someone's roof. When nothing else is available they will use caves or holes in the ground.

Since they are nocturnal, dusk sees them stirring to search for food. They normally eat young leaves or blossoms and occasionally fruit if available. It seems that nothing is more delightful to them than the flowers and fruits in your own garden and you'll have a permanent guest if you decide to offer a titbit. At first a close encounter with a group of possums (and eventually it will be more than one) may seem delightful but all too often they find access to your roof where life is safe and warm over a guaranteed source of food. Even this may seem bearable until stains start appearing on the ceiling.

Brush-tailed possums are protected by law in every state of Australia except Tasmania so that if they become a problem permission to remove them must be sought from the appropriate government department. In most States it is the National Parks and Wildlife Service. You would then be given permission to trap and release them. (The pest exterminating companies have licences to trap possums.) If you have to remove one yourself it's a good idea to take it to natural bushland as far away from your home as possible. They've been known to find their way back over a couple of kilometres.

Remember too as timid as they seem, that they're not entirely without defence. Their claws are extremely sharp and they will bite if frightened, emitting a hissing noise as if in warning.

As with all wild animals it's best to leave them alone altogether. They can be observed from a distance where you can appreciate them for their own sakes as wild and beautiful animals.

Possums are marsupials

The possum, koalas, wombats, kangaroos, native cats, bandicoots are several small insect eating marsupials (known as dasyurids). These are the pouched mammals, whose young are born in a very immature state after a relatively short period in the uterus. The young then develop to an independent stage in a pouch where there are teats secreting milk. Although marsupials are not unique to Australia the largest variety of them is to be found here.

In possums the pouch opens forwards towards the head (unlike wombats and koalas). Kangaroos have a similar arrangement. Usually one young brush-tailed possum is born per year and carried in the pouch until about 5 months later when it is big enough to move around or travel on the mother's back. In Tasmania, brush-tailed possums are believed to breed twice per year.

Possums belong to the super family within the order MARSUPIALIA, known as Phalangerioidea *Diprotodonta*. These are marsupials having a pair of projecting median lower incisor teeth and having the second and third toes bound together. The group also includes kangaroos, wallabies and koalas, phalangers, gliders and wombats.



Brush-tailed possum,
Trichosurus vulpecula
(Photo: R. Crombie)

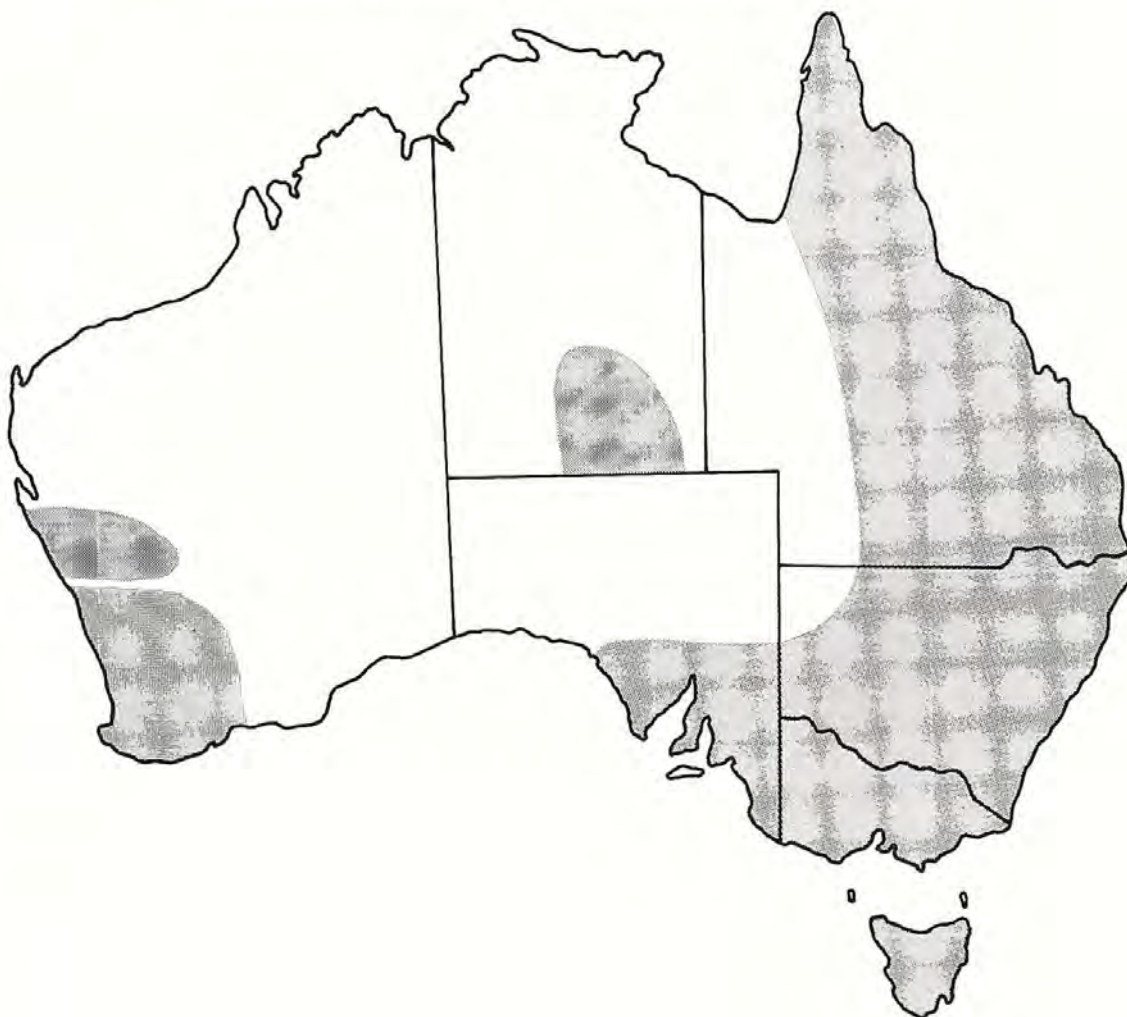


Possums in other countries

The brush-tailed possum was introduced to New Zealand in 1858 where it is now regarded as a pest and is not protected by law. In that country it is mistakenly called an "*opossum*". This term in fact applies to a family of marsupials, found in North and South America which includes the American Opossum and which are unrelated to the brush-tailed possum.

Further Reading: W.D.L. Ride "A Guide to Native Mammals of Australia".

Distribution of brush-tailed possum (*Trichosurus vulpecula*) in Australia.



century. The plant is so long-lived that even under those conditions an individual tree may successfully reproduce itself several times over before it dies.

A plantation owner who was unlucky enough to plant in such a marginal area would not realise that his plantation was a failure until he had missed two or three expected crops and this may take up to ten years.

We already know several of the environmental factors which could cause yield loss problems and are carrying out basic research in an effort to anticipate others. An example of this is current work on the effect of low temperature on pollination and fruit set. We are interested in discovering whether the poor fruit set observed in cold conditions is due to the reaction of the male or the female plant and to seek out genotypes with improved cold resistance.

Our studies so far have shown that pollen will generally not germinate at a temperature lower than 14°C. We are checking other males to see whether there are genetic differences in this quality, and we can also select for later flowering lines to avoid the problems by having pollination take place in warmer weather.

In the more tropical and subtropical areas, a different problem may arise. The plants may grow rapidly during the vegetative stage but at maturity they will not develop the adequate flush of flowers so necessary to a successful crop.

Jojoba has been observed to flower under the influence of autumn rains following a hot dry summer. Our research has shown that under well-watered conditions, flowering is stimulated by a rapid drop in temperature. In northern Australia where the summers are wet and frequently overcast and there are no cold fronts moving through in autumn, the temperature range may be inadequate to initiate a flowering flush. Field trials have been set up to verify the results of this basic research but we will have to wait until maturity for confirmation.

It is quite possible that there are some areas where the spread of natural jojoba populations is limited, not by climate or soil but by the action or competition of other plants or animals. Such areas could prove satisfactory for cultivating the species as farm practice would control pests and competing weeds. The 'homo-clime' principal for choosing potential jojoba sites would overlook such areas.

Cultivation

At the moment no particular set of cultural practices has been agreed upon.

There is a basic disagreement between those who feel that jojoba should be developed for growth under natural rainfall and those who advocate an irrigated system.

When dependent on local rainfall the plants would have to be well spaced and the ground may be graded to concentrate runoff in the plant rows.

The second group would use close spacing with strategically timed irrigation during the critical periods of autumn and early spring. It may be necessary to select different plant types to suit these cultural practices.

Another practice which will influence the choice of selected plant types will be the method of harvest and the way in which the plants are to be trained to suit the

harvester. At the moment, plants are either pruned or bound with nylon netting to force them into a mushroom shape so that the seed can fall clear of the plant. If the plants are to be harvested by a machine which straddles the row then uniformity of height will be important and the often larger male plants may have to be pruned or placed in separate rows.

The choice of propagation method will also be limited to some extent by the cultural system adopted. A propagation system which results in a fibrous root system may work very well for an irrigated farming crop but not for a rainfed crop where drought tolerance is essential.

Overseas research

Much of the research being carried out in other countries has been, and will continue to be of great value to Australia. Many members of the farming or investing community as well as research workers are in contact with workers in the USA, Israel, Mexico and India. Plantations have been proposed for Costa Rica, South Africa and the Sudan, and many other countries are showing interest in this stage.

Development in Australia

The next decade will be crucial for the development of a jojoba industry in Australia. Many areas being tried may prove to be unsuitable. Other areas will be suitable only if particular selected lines are used. Qualities such as frost resistance or late flowering may be essential to successful fruit set in cold areas.

Trials presently being planted out by farmers will be very important to the future of the industry. The successes and failures will provide a clearer picture of where jojoba may be grown in Australia and what cultural practices are suitable. The variable plants obtained from the seed that is currently available will form a 'genetic bank' from which we can select material for future generations of improved jojoba.

Close cooperation of growers and research workers at this stage of development will be an important factor in the rapid domestication of the species.

It is only after the basic research has been carried out and the field trials have been assessed that we can proceed with larger plantations with confidence of success and a realistic expectation of financial returns.

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JADE — the majestic mineral

BY JOAN HINGLEY

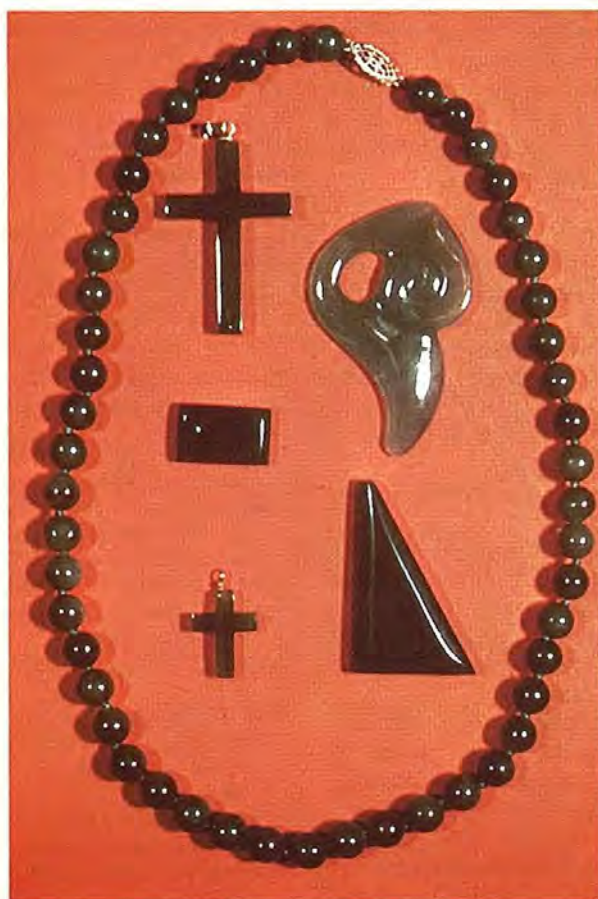
Jade is a stone endowed with a rich heritage of majesty and magic evident in many superb works of art both ancient and modern. Its dual qualities of beauty and practicality have won it a place of honour in history and the modern world has not grown immune to its attractions. The demand for jade is increasing and new deposits are being sought to replace the expiring traditional sources. Australia is fortunate to be able to count it amongst its many resources.

Jade is a cover term for two minerals called nephrite and jadeite, which look alike. They have different atomic

structures and chemical compositions but are so similar in appearance that they are treated as the one material. When jade was first introduced to Europe by the Spanish explorers of Mexico it was called *piedra de yjada*, stone of the loin, because the Aztecs believed it would alleviate pains in the side and kidneys. In French this became *le jade*, in English simply 'jade' and in Latin, *lapis nephriticus*. These names were applied to similar-looking material which arrived later in Europe from China and it was not until 1863 that Alexis Damour, a French mineralogist, recognised the existence of the two min-

Jewellery made from
Cowell jade. Photo-
graphed from *Mineral
Resources Review*.
No. 141, published by
Department of Mines
and Energy, South
Australia.

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erals of jade, with quite different characteristics.

Jadeite is a sodium aluminium silicate belonging to the pyroxene family and nephrite is a magnesium, calcium, iron silicate belonging to the tremolite-actinolite series of the amphibole family. Jadeite has a higher refractive index, is denser and is slightly harder than nephrite. They are compact materials consisting of interlocking grains, though jadeite is granular and nephrite is fibrous. The felted texture of nephrite imparts a toughness to the material, which makes it more manageable during carving and enables tools such as ancient axe heads to be honed down to a fine edge. Jadeite is more brittle and consequently more fragile. The difference often shows in the final polish as nephrite has an oily lustre and jadeite is brilliant or vitreous. Both are metamorphic minerals formed by the alteration of rocks associated with the intrusion of serpentinite bodies.

There has been a marked tendency in recent years to apply the term 'jade' to any hard green rock. These jade simulants usually have descriptive prefixes, such as



John Field/Australian Museum

'Transvaal jade', a massive form of grossular garnet from the Transvaal in South Africa and 'Queensland jade', which is chrysoprase. Recently, 'Pilbara jade', a massive chlorite rock, has been introduced from Western Australia. Though these are attractive ornamental minerals in their own right, only the minerals jadeite and nephrite can be called jade. Confusion also arises from the term 'greenstone', which indiscriminately groups different

Above: Modern carving of a nurse from the Peoples Republic of China. From the collection of Jim Wilson. Size: 17 x 16cm. Below: Chinese 'magic knot' pendant carved from Tamworth jade.





Chinese nephrite jade vase. From the collection of Jim Wilson. Height: 18cm. Photo: John Fields/Australian Museum.

mineral and rock types, such as the New Zealand greenstones and the greenstone rock suite of Western Australia. Greenstone may be a convenient ethnological or descriptive field term but is not synonymous with jade.

In China, staining is used for artistic effect or to give carvings an aged appearance. Some materials can be stained to look like jade or to improve the colour of inferior jade. There seems to be an abundance of the rare 'Imperial' jade which would suggest that much of this material has been stained. A carving treated in this manner can usually be detected by the accumulation of colour in veins and fractures and eventual fading.

Nephrite and jadeite occur in a wide range of colours though some colours are characteristic for either jade. The finest and rarest quality nephrite is the translucent, emerald green 'Kingfisher' jade. The 'Spinach' jade is the green nephrite familiar to us as Maori greenstone; 'Mutton Fat' is a grey or yellowish-green nephrite; 'Melting Snow' is used by the Chinese to describe a flowing white jadeite and the lilac and blue shades are the prized 'Mauve' jadeites. The precious and rare jadeite, a very translucent bright emerald green colour, is called 'Imperial' jade because it was commissioned for the Imperial workshops and was the sole prerogative of the Emperor.

Both jades occur in mottled green and whites and in reddish browns. Boulders of jade are often found with a brown skin. This is caused by weathering and is also apparent along cracks which have penetrated the interior of the boulder. Chinese carvers use this skin to their advantage by incorporating the weathered zones into their colour schemes in order to use as much of the jade as possible. They often carve through the skin to expose the green material in cameo fashion to obtain a two-colour effect.

Chinese jade artefacts go back to 1766 BC, the Shang dynasty. Many of these are 'tomb jades' or artefacts that were buried with the dead to prevent decomposition of the body. They often exhibit white chalky areas which are the result of leaching due to the ammoniacal solutions produced by the decay of the corpses. It is ironic that the jades which were intended to prevent decomposition were themselves decomposed by the bodies.

The first jade available to the Chinese was nephrite, which comes principally from the Yarkand and Khotan regions in Turkestan, Central Asia, an area adjacent to the main trade routes. Marco Polo visited the Imperial workings there and gave an account of the mining methods. The nephrite occurred as pebbles and boulders which had been eroded from the surrounding mountains and washed into the streams. Workers waded into the water to feel out the smooth jade pieces with their feet and work them to shore, under the surveillance of one of the Emperor's observers who recorded each piece as it was found. Jadeite did not enter China before the eighteenth century so that the ancient jades were carved from nephrite or 'chen yu', true jade. Jadeite was introduced from Tawmaw, Burma, at a time when supplies of unflawed nephrite began to run low. The fine-quality jadeite began a classic period in which beautiful objects were carved from the magnificent 'Imperial' jade. It was during this time that the art of jade carving was subsidised by Chinese royalty and a peak of artistic achievement was attained during the K'ong-hsi (1622-1722) and the

Ch'ien lung (1736-1795) of the Ching dynasty. This policy has been continued by the government of the People's Republic of China, which encourages the traditional arts. Themes depicting modern life in China are used in jade art alongside the traditional. One may find a carving of a nurse with her box of medicines amongst incense burners and lotus flowers. A particular tribute to the skill of the Chinese carver are the compound carvings which consist of patterns which extend through the stone by carving from the reverse side as well as from the front. This technique was developed in the Sung dynasty (AD 660-1179) and required great patience and dexterity in order not to break any of the delicate interwoven floral stems. Jade is never actually carved; it is ground away and it can take months of slow, careful work to complete such a design.

The Chinese held jade in high esteem and this regard for it persists today. The proverb "A bag of gold will not buy a piece of black jade" is an indication that the Chinese value good jade more than they would a mere precious stone. In Chinese, jade is called 'Yu', a term which embodies concepts of beauty, spiritual purity and nobility. There is a particular hue of jade that the Chinese find unacceptable and will not carve. It is considered unlucky and the knowledgeable Chinese will not even touch it though most Europeans cannot tell the difference. Jade carvings were often used as special anniversary gifts and artists employed a number of symbols to express blessings of health, wealth, happiness and longevity. The flying bat and melons were used extensively for this purpose and were regarded as potent charms when combined with certain colours.

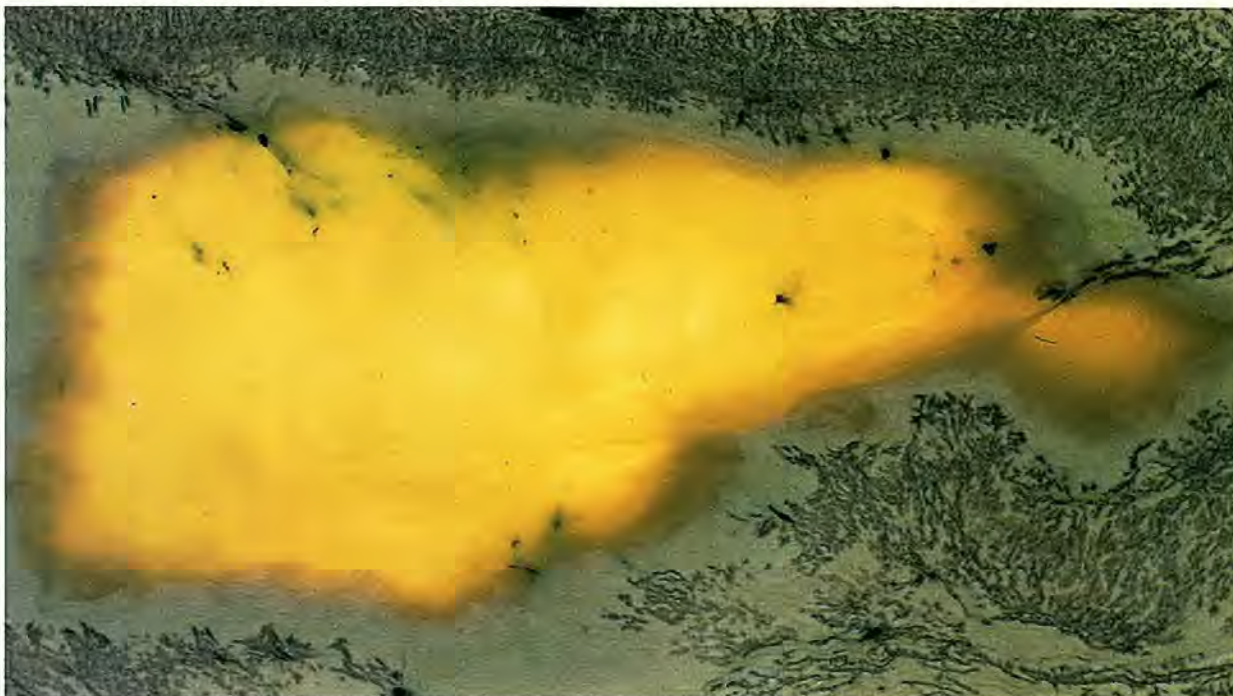
Jade artefacts dating back to the Pre-Classic (2000 BC-AD 300) have been uncovered during archaeological work on Maya civilisations in Mexico and it is known that the Aztecs introduced the stone to the conquering Spanish. The material is a jadeite, some of which is similar to the Burmese jadeite in hand specimen though it differs in certain physical and mineralogical aspects. Jade was as highly esteemed by the Aztecs as it was by the Chinese. It was used sparingly for ceremonial objects and ornaments which were restricted to the Emperor and his nobles. Carved pieces became more valuable by virtue of the labour involved in working the hard material as the jade was cut and polished using nothing harder than the ground jade itself. Large pieces represented a superb effort and for ceremonial objects this was considered as part of the sacrifice.

A definite source for the material has not yet been established though small alluvial occurrences have been found in the Motagua Valley in Guatemala. Archaeological findings suggest that this area was a centre for jade-working and distribution.

Alluvial boulders of nephrite occur in areas of the Fraser River, British Columbia, and it is the basis of a young thriving business. The jade was used extensively by the Salish Indians for cutting tools rather than for ornamental use. Larger jade artefacts were property evidence of the wealth of the owner. The Fraser River artefacts spread to other native tribes who recognised the superiority of jade implements over others by placing a high value upon them. Jade was cut and worked by the Indians for hundreds of years until their implements



Traditional chinese figurine in Honan nephrite jade. From the collection of Jim Wilson. Height: 22cm. Photo: John Fields/Australian Museum.



Heather McLennan/Australian Museum

Amber jade rimmed with white, dendritic skin found at 'Rywung' near Tamworth, NSW.

were replaced by the iron tools of the white traders. Jade from this area was first sold in 1957 and has only recently become a lucrative business. The colours occur in the usual range of nephrite though the better quality, translucent, emerald green is extremely rare.

The New Zealand greenstone is either nephrite jade ('pounamu') or a translucent bottle-green variety of serpentinite called bowenite ('tangiwai'). Both were worked by the Maoris for the manufacture of implements, weapons and ornaments. Generally, serpentinite is softer than nephrite and would have been used for ornaments rather than for tools or weapons.

The Maoris regarded greenstone as having supernatural powers and were careful in the choice of colour and texture for particular pieces. Some greenstone artefacts such as the 'hei-tiki', a pendant in human form, and the 'mere', a flat club, gained value from their contact with a succession of ancestors by acquiring 'mana' a form of good fortune from the gods. They were given personal names, and powers were attributed to them. Such ceremonial objects were passed from generation to generation and played an important role in family history.

The nephrite is found as boulders in the river beds of the Teremakau and Arahura on the west coast of the South Island. The fast-flowing rivers are steeply sided and the boulders have to be carried out by helicopter to Hokitika where they are carved into thousands of unimaginative pendants and cabochons. The tourist trade is very demanding and, even with the export restrictions on the rough jade, supplies are running short.

Australia has only recently realised its potential for the jade industry and its supplies come from two major deposits of nephrite: one just south of Tamworth, New South Wales and the other at Cowell, in the Eyre Peninsula, South Australia.

The Tamworth jade occurs in a variety of colours from a clear pale green to a dark spinach green reminiscent of

the New Zealand nephrite. It is found associated with talc and serpentinites of the Great Serpentine Belt which extends intermittently for 350km from south of Warialda to the east coast between Newcastle and Port Macquarie. The nephrite forms lens-shaped bodies, and outcrops at the surface as white weathered boulders with a central core of coloured material. White, black and mottled brown talcs and a coloured chalcedony are associated with it.

The first nephrite was discovered in 1964 by Colin Moore as alluvial boulders in a creek. He mined 43.86 tonnes of the material and exported 24.48 tonnes to Hong Kong where it was used to carve ornaments. Mining lapsed until 1971 when two local people from Tamworth discovered another deposit outcropping to the north of the first deposit. Alex Taggart and David Bragg spend their spare time prospecting and when they asked Harold and Loys Pitt for permission to prospect over their property they were looking for the 'petrified asbestos' that was rumoured to exist at Rywung. Instead they found talc and what they suspected was jade. Pieces were sent to various institutions for examination but confusion about the exact identity of the material existed for some time because it was firmly believed that there was no jade in Australia. News of the Australian nephrite attracted a Texan carver, John Hull, to Australia in 1977. He had spent some time carving jade in Guatemala, an influence evident in some of his Australian work. During his stay at Tamworth he built up a successful business and received many requisitions from Sydney for his art.

Harold and Loys Pitt are graziers who mine the nephrite which occurs on their property. It outcrops in a small hollow and can be traced up into the adjacent hillside. The Pitts have installed a diamond saw on the spot to cut the boulders into slabs, which they sell to lapidaries and hope to sell overseas. Their interest in jade

has passed to the rest of their family, and their son, Ian, who studied jade-polishing techniques in the Hokitika workshops, has produced some fine polished pieces for jewellery and ornaments. Most of their nephrite is a pattern of flowing bright and dark greens with patches of translucent pale bluish green, but unusual amber coloured and 'speckled trout' varieties are unique to this locality.

Stan Lever is a local who has been very active in jade exploration in the region. He and Alex Taggart are partners in a company called the 'Four Explorers', which owns several of the leases and eventually hopes to export nephrite to Hong Kong where one of the partners is presently arranging buyers. The company's pride is a deposit called the 'Great Wall of Jade'. It stands about 5 metres high and it is weathered to a white colour in places. There is little to suggest that it is solid jade but the practised eye can quickly differentiate between it and the serpentinite on either side of the wall.

Cowell is a small fishing port situated in Franklin Harbour on the east coast of Eyre Peninsula. The jade occurs as lens-shaped bodies which appear as jagged outcrops above the surrounding farmlands. The geology of the deposit is quite unique because the nephrite is not associated with serpentinite-type rocks as for other world localities but has been formed by the metamorphism of impure dolomite. Chemically and texturally, the jade is similar to overseas material but the colours are different. Eighteen colours, varying from yellow-green to pale green, to dark green and black, have been recognised, though the traditional vivid green colours have not yet been found. The highest quality nephrite is the fine-grained black variety which takes a very good depth of

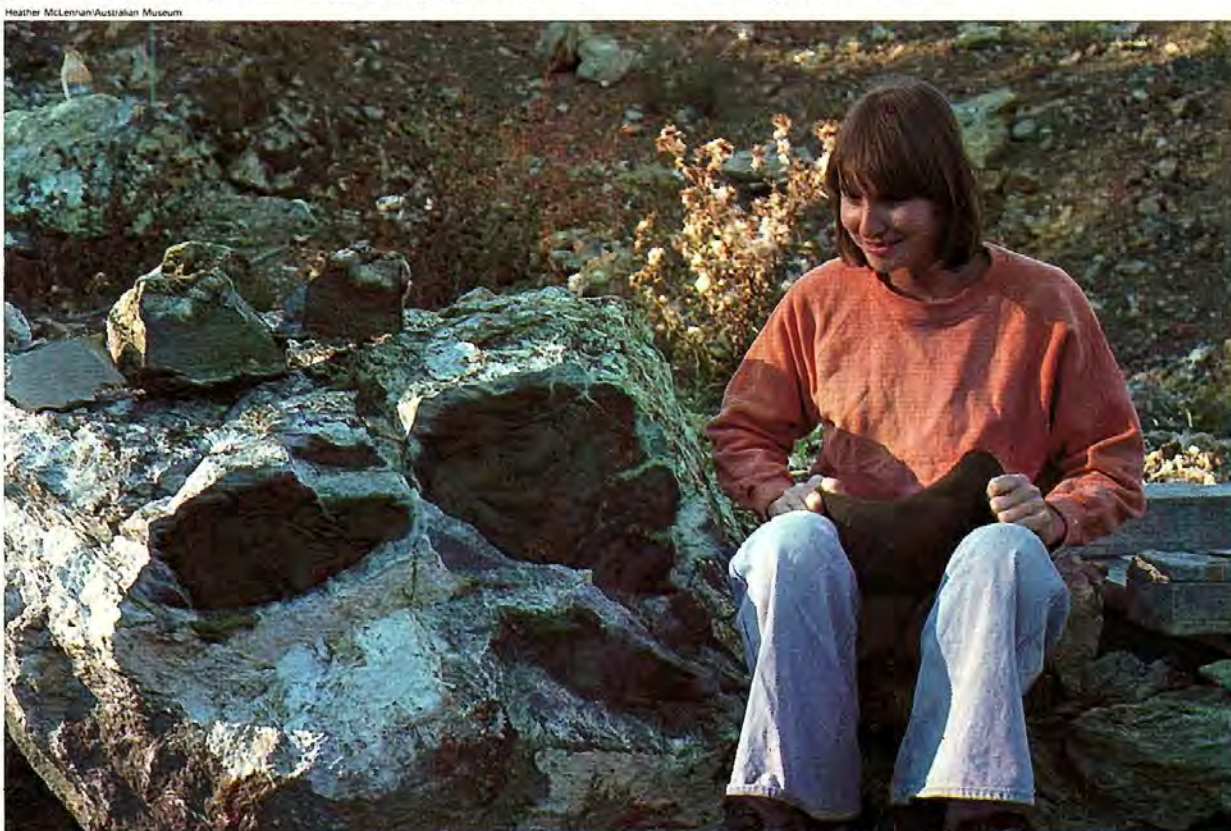
polish important in commercial grading. The black and dark green jades are the most abundant in the area but there is sufficient diversity to meet any artistic needs and the quality is well up to world standards.

The jade was discovered in 1965 by Harry Schiller, who owned a wheat farm in the district. He noticed the extreme toughness of the material and obtained analyses which identified it as nephrite. He was involved in two attempts to develop the deposit by companies which mined several hundred tonnes in the form of boulders: the largest weighing over six tonnes. The last company was eventually taken over in 1976 by Cowell Jade Pty Ltd, which was formed by three members of the South Australian branch of the Gemmological Association of Australia. The company produces jewellery and ornaments in its own workshop at Cowell and exports rough jade to India and New Zealand. Prospects look good for the Cowell jade. Lapidaries and carvers are showing a keen interest in the material and the South Australian Department of Mines has estimated the potential value of the deposit at a conservative twenty million dollars.

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Sue Pitt sitting alongside a sawn boulder of jade at 'Rywang' near Tamworth, NSW.



THE DISAPPEARING CRAFT OF SANTA

BY ALEXANDRA YUILLE

These are some of the traditional designs woven in using black banana fibre. These designs originated on Santa Cruz: line four represents diamond shape fish, line five fruit seeds, and line six is the shark's tooth pattern. The other patterns are of recent origin and have no significance attached to them.

In November 1977, the author spent a month on the island of Santa Cruz learning Nvecha weaving. Loom weaving is almost unknown in the Pacific south of Micronesia and east of Indonesia. In the Solomon Islands, only the people on three small eastern outlying islands—Ontong Java, Sikaiana and Santa Cruz—have traditionally woven on a loom. Today, it is only on Santa Cruz that a handful of men continue to weave on a back-strap loom using banana fibre.

Santa Cruz is a peaceful tropical island that has had minimal contact with the Western world. Despite this, the effects of gradual incorporation into a cash economy, and other Western influences are beginning to be noticed and felt on the island. Although most of the women still follow a traditional life-style, caring for their children, and raising crops and animals, particularly pigs, many of the men are seeking and obtaining jobs with a cash income. They may work in a trade store, fell timber for a large company, grow copra for cash or become school teachers. This has coincided with a demise in the number of people practicing traditional crafts and customs. Whereas fifty years ago there were many men weaving on Santa Cruz, today there is only one man weaving regularly and another two or three who know

the craft and weave occasionally.

Nobody knows for certain the origin of weaving in the Pacific. Prehistorians postulate that the loom moved down through Micronesia to Santa Cruz from Malaysia with successive ocean voyagers and migrations. The people on Santa Cruz explain its origin differently. They tell a very beautiful story, retold here as it was told by Selwyn Balu and translated by John Mealue, in order to retain its original flavour.

"This is the story of how a certain species of banana, used for Nvecha weaving, and the Handloom came to be known in Santa Cruz."

Long, long ago, a man went out to sea fishing. He dropped his line with a hook tied on the end. But when he wanted to pull the line back, the line would not come. His hook had caught on rocks beneath the sea.

He was worried because it was the first and the only hook in Santa Cruz. Santa Cruz was the only world known to him. He had borrowed the hook from a man who had lent it to him on condition that he return it. All who had used the hook obeyed the rule so that the hook was able to be used by many other

Below: Warping up and inserting heddles.

ALEXANDRA YUILLE is an Australian weaver and anthropology student with a special interest in exploring ethnic weaving techniques not previously recorded. She spent a month in the Santa Cruz Islands learning and researching the traditional weaving techniques. She collected weavings for the Solomon Islands Museum and artefacts and weavings for the Australian Museum.



men. It was a very precious item for the people, being valuable, useful and famous.

"Oh, what shall I do", he said. "I cannot go home without the hook. The man who lent it to me will be very angry with me if I do not return it today. I cannot return home without the hook."

He realised that the only thing he could do was to dive into the sea to get it.

So he jumped into the sea and down he dived until he came to the hook. But as soon as he arrived at the end of the line, he realized that he was in dry space and on land, there, under the sea. He was in a village. The hook had accidentally got caught in a rafter of one of the houses in that undersea village. The men who were in the house had noticed the man pulling on the line.

Before he could rescue it, they had come out to see what was causing the rafter to rise and fall, and had taken the hook into the house.

He followed after them and came to the front door of the house. The men inside, on seeing him, asked, "What do you come here for?"

"I've come to get my hook", he told them, "but you have taken it inside the house."

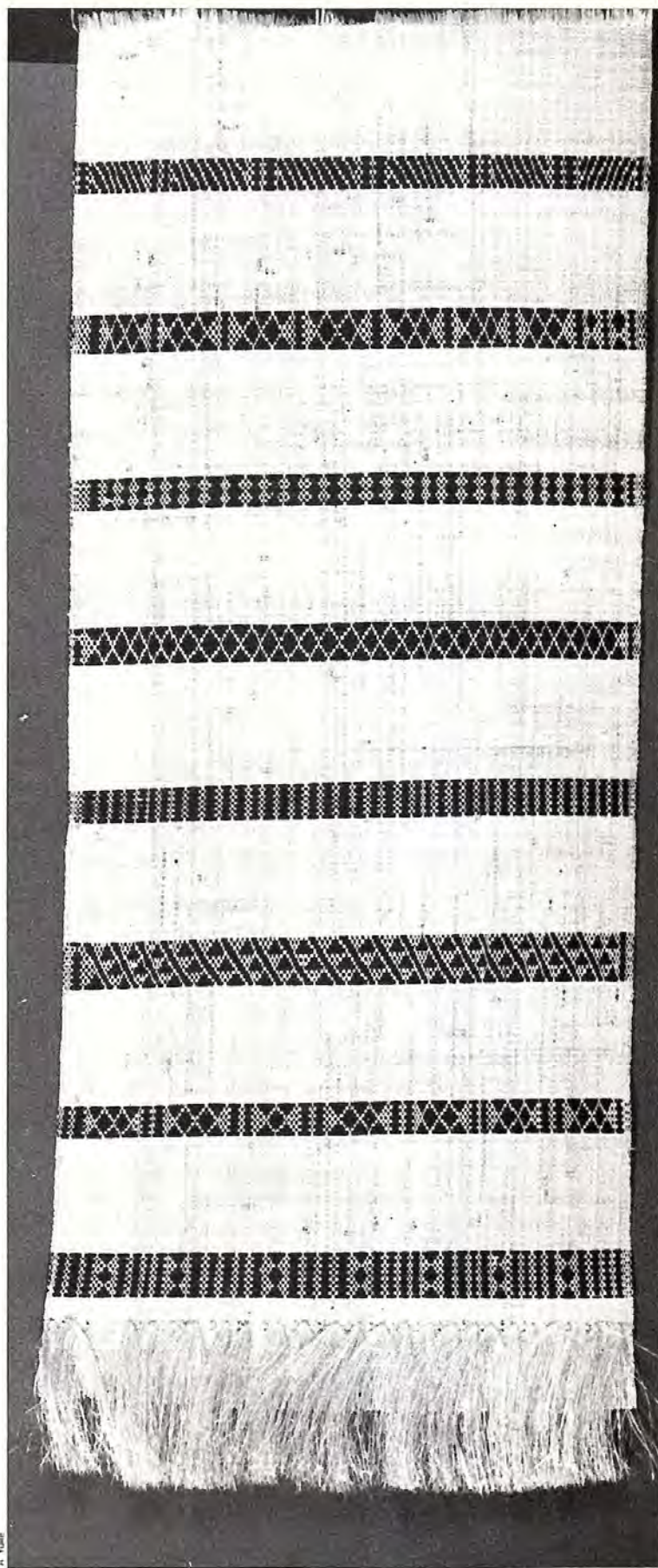
"Then come along inside", they summoned him.

Accepting the offer, he entered. He stayed with them for several days.

During his days with them, he learned the craft of weaving on the handloom. He noted how the threads were being extracted from a particular species of banana plant which was only found growing in the undersea village. He was there at just the right time for the people were all preparing weaving materials from the banana plants. Compared with the whole process, preparing the materials of banana threads is the hardest.

They were organised in teams so they were able to prepare materials quite easily. They would assign different groups to different stages in the preparation and they would leave the actual weaving on the loom to their most skilled weavers who were usually the old men in the community. The several stages in the preparation which each group was assigned to do, were cutting, thinning, splitting into threads and then, in the final stage, the weaving itself. He was able to see everything involved in the complete process and participated in doing each task in order to learn all about the craft of weaving.

One day, while they were all sitting around a hearth



A. Yule



Selwyn Balu's brother, Jonas Kapulu was taught to weave ceremonial costumes for men. This is an example. The top row is the single kernelled nut design and the third row is the double kernelled nut design.

at the centre of the house, his friend asked him, "When do you want to return home?" The man answered, "I don't mind when; any day is all right with me."

"Well, then you may go home tomorrow", his friend said.

"Very well, I shall go tomorrow, but there is one thing I want to take back with me—a young banana plant".

An old man sitting at one corner of the house heard what the man was asking and enquired, "What was it that your friend asked for?"

The man's friend told him that he had asked for a young banana plant.

"Yes, he certainly may have one to take back with him, but you have to chop the top off. Don't let him have it with its top, so that it does not continually bear several bunches of bananas one after the other as the banana trees do down here in the undersea world. By cutting its top off, it will bear only once and then the tree dies in the same way that their banana trees do in the land of the sunshine. You know, they are already fortunate with coconut trees in their world of sunshine which continually bear bunch after bunch on one tree, and if they also have banana trees which bear bunches in the same way, they will be a step ahead of us—so let us be equals. They have coconut trees bearing repeatedly on the same tree, so we have banana trees bearing in the same way."

The following day he was ready and his friend gave him a young banana plant without its top. His friend walked him as far as the edge of the under-sea, dry-space land. "I'll leave you here", said his friend, "and you may go on".

"But how do I go on from here? I do not know how to find my village from here," the man said.

So his friend took some magic herbs and rubbed his face with them. On opening his eyes again, he was surprised to find himself on the land of Nendo.

He went to his village carrying all his materials including a half-woven mat still fixed to the handloom and the banana plant. Once he got to his home, he quickly planted the banana. He found a suitable place where he could work quietly with no one to disturb his work, in a dry cave not too far from the village. He fixed the handloom to the walls of the cave and began to work. The people who were interested, came out to watch him weaving and soon the news spread to other parts of Santa Cruz. People were beginning to either purchase or exchange the finished mats with other articles from him.

The banana plant grew into a big plant and produced more suckers which he planted out into a garden. The people who had learnt to weave, came and asked him for banana suckers which they also planted into big gardens. Soon Santa Cruz came to be abound with this species of banana. The tradition of weaving has continued ever since.

While the beginnings of Santa Cruz weaving may remain a mystery, there can be no doubt that the traditional designs found on Santa Cruz all originate from the island. These designs are made by using an inlay or pick-up technique with black banana fibre. Two species of

Selwyn Balu learnt to make this traditional Santa Cruz bag from his father. Here he has created a new pattern using traditional design elements.



banana have a black stem which is used for this purpose, so there is no necessity to dye banana fibre in order to make patterns. There are four traditional designs still in use: First, a series of straight lines which represent the narrow black seeds of the fruit of a tropical vine, *Aristolochia* sp. The Santa Cruz name for this design is *nungi tabao* which literally means the teeth or seed of the *tabao* fruit. Second, a diamond shape which represents a small diamond shaped fish which is common in the area. This is a Golden-finned Triggerfish (*Hemibalistes chrysopterus*), which is about 12cm long and too small to be eaten. Both the fish and the weaving design are known locally as *Bu*. Third, a design based on shark's teeth and known as *nungi tonipo*; and fourth, the most complicated design, based on two varieties of a nut. One of these nuts has a single kernel, the other, has a double kernel. These nuts, known on Santa Cruz as *nina* and *nina iobe* respectively, are both *Canarium indicum*.

One of the weavers, Selwyn Balu, continues to create new patterns; however, none of these are based on concepts or designs found in his environment and he attaches no meaning or names to them.

Banana trees are felled at the base when the fruit is ripe. The leaves and fruit are removed and the stem of the plant is left outside and upright until required by the weaver. The stem of the banana tree is made up of a series of vertical sheaths that are peeled off and laid out in the sun for a few hours. It is the outside sheaths that produce the coarsest fibre while those at the centre, are the finest. Each sheath of approximately 2.5 metres long and 25 centimetres wide, is cut in half along its length and laid on the ground with the outside down, ready for scraping. Scraping banana fibre is an arduous task and takes a great deal of skill. All the moisture and cellulose must be scraped away to leave the outer skin of the sheath. This is hung up to dry and then divided into widths of one to two centimetres suitable for weaving. The lengths of fibre are knotted to make the warp and weft.

Weaving is done on a backstrap loom. The front and end beams are hammered vertically into the ground so that the warp can be wound directly onto the loom. The heddles are positioned during warping up. The loom with warp, is then positioned for weaving.

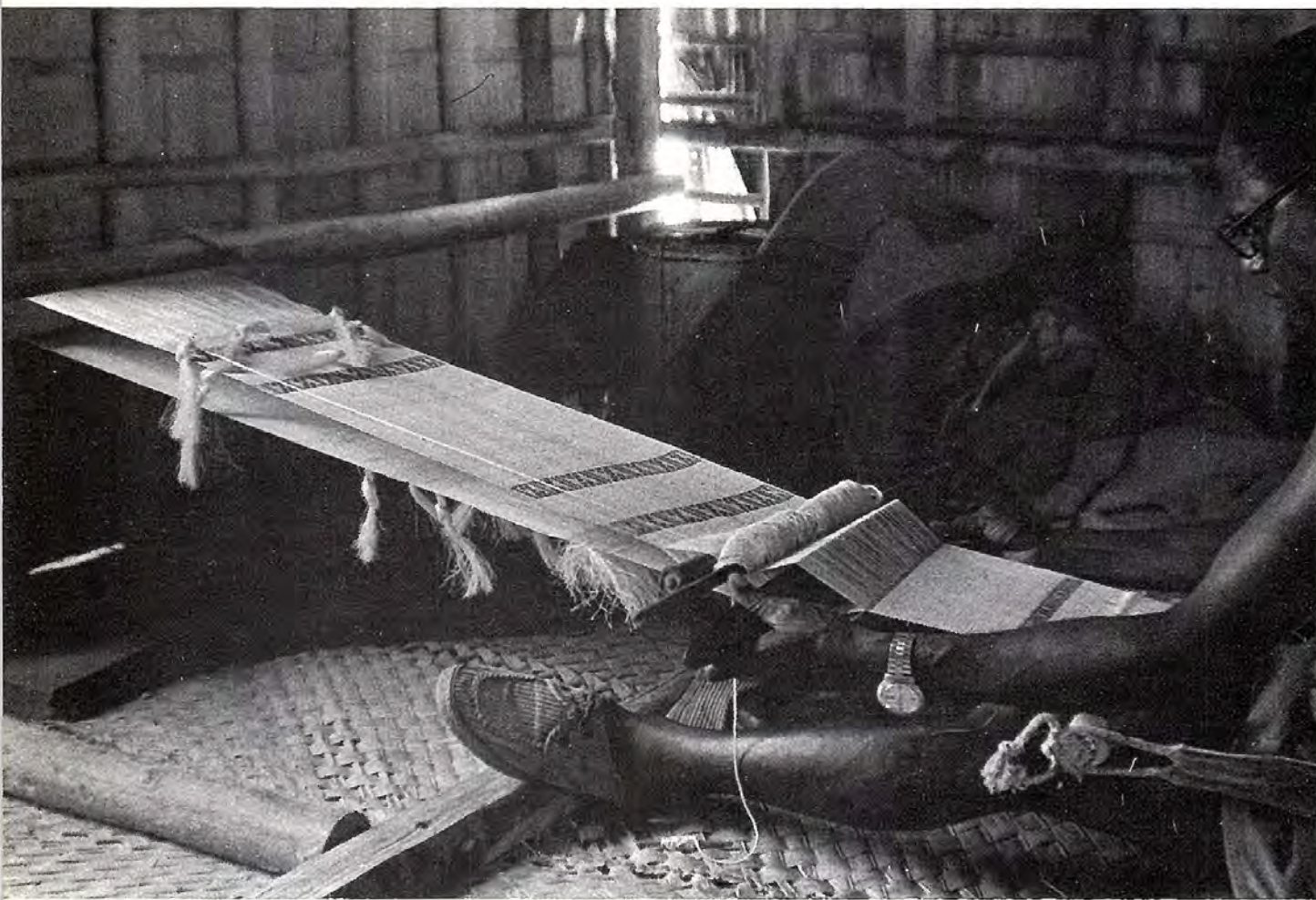
On Nendo, the largest island in the Santa Cruz group, weaving was and has remained, a male occupation. The craft is passed on within families from father to son, with each family having its own distinctive range of designs. While each weaving family might employ similar concepts for designs—for example, the single- and the double-kernelled nut, there would be variation in detail between each family's pattern.

Selwyn Balu, the weaver from whom the author learnt to weave on Santa Cruz, had been taught by his father to make the traditional Santa Cruz bag using the two designs of the diamond or fish pattern and the shark's teeth pattern. His eldest brother, Jonas Kapulu, had been taught to weave ceremonial costumes for men using a design based on the concept of the single and double kernelled nuts. With the advent of missionaries on the island, many of the rituals associated with pre-Christian

beliefs disappeared from use. As a result of the consequent decline in the demand for these costumes, Jonas Kapulu now weaves only one each year.

The second son, Joshua, was taught by his father to make money mats. These mats were one fathom by half a fathom (six feet by three feet) in size and carried no patterns. They were traded with the people from the nearby islands of Vanikolo and Utupua for red feathers. The Vanikolans and Utupuans used these mats as a minor form of currency, while the people on Nendo used the red feathers to make coils of red feather money. On Nendo itself, the same mats were used as burial shrouds. These mats are no longer used on Nendo, Vanikolo or Utupua, and Joshua no longer weaves.

ing. Sadly, it seems unlikely that any of Jonas' or Selwyn's sons will continue the craft of weaving. The opening of a school on the island in 1942 has meant that even less time is available for the sons to learn the craft, and the increasing contact with the cash economy of the outside world has opened up more employment opportunities. But this is not the total explanation. For while the answer given to the question, "why aren't your sons learning to weave?" was always, "they want to make money" Selwyn Balu appeared and proudly claimed himself to be, one of the wealthiest men on the island. Perhaps the true answer is that it is more exciting to work in the trade store and handle European goods than to sit and weave items that arouse little interest either



Selwyn Balu, one of the few remaining weavers on Santa Cruz.

Selwyn Balu, the only one on the island weaving daily, has taught himself to weave all the patterns which he has seen on the island. However, despite his ability to weave his brother's single and double kernelled design, he has never woven a ceremonial costume.

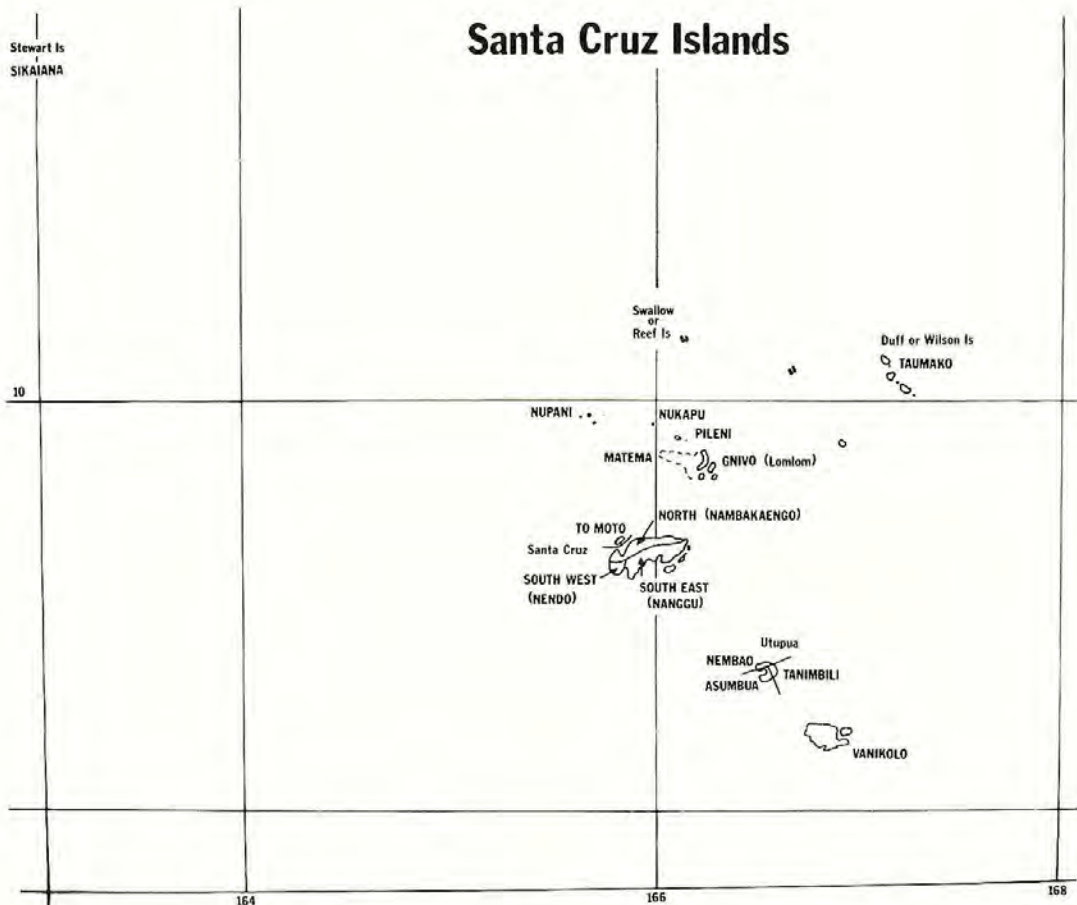
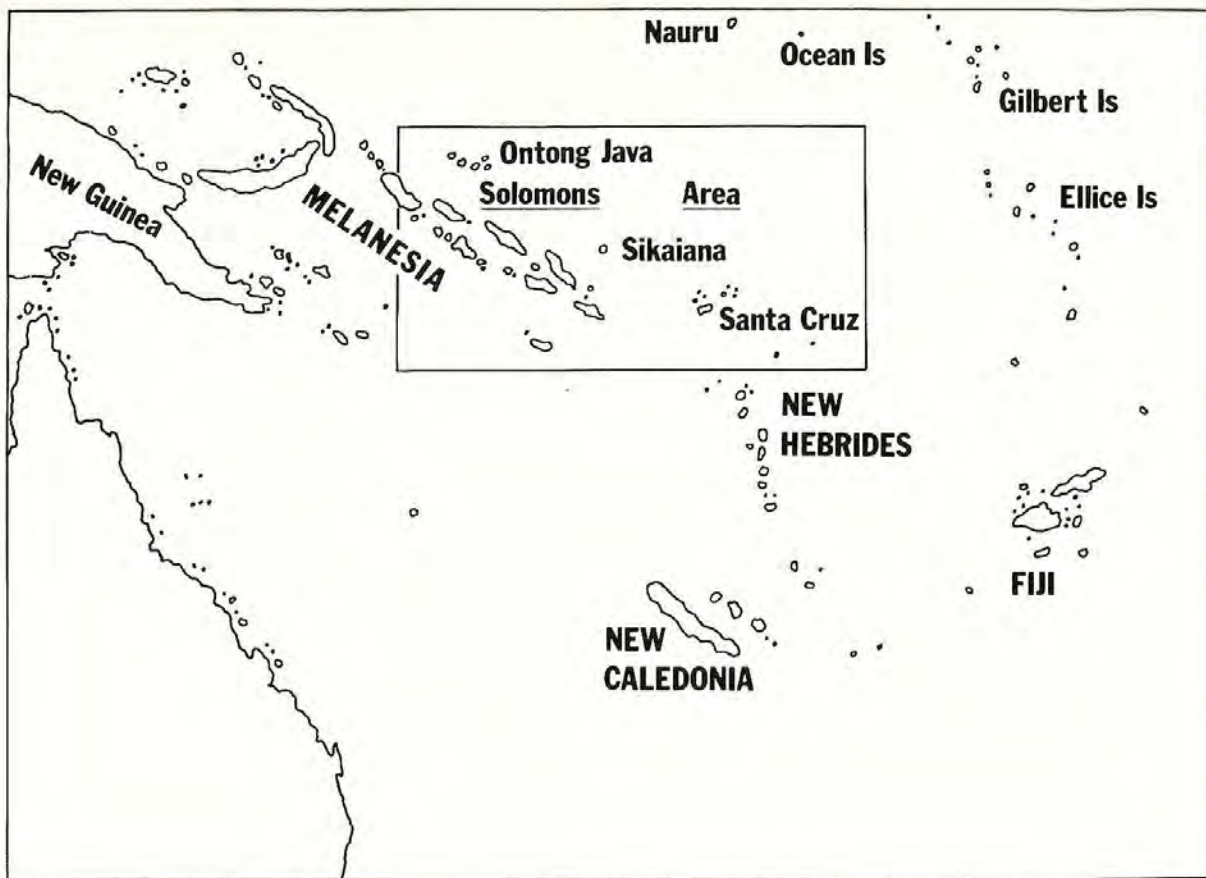
Despite the fact that Jonas and Selwyn are brothers, they do not share the same surname. Children on Santa Cruz are named after the people who contribute money and other forms of wealth to the marriage of the parents. This naming process applies to both first and second names. While the tradition of naming children in this manner has continued, the tradition of passing knowledge and crafts from father to son is rapidly disappear-

among local people or among Europeans.

It would indeed be sad if the tradition of passing the knowledge of crafts from father to son was to one day disappear from the small island of Santa Cruz. Yet this outcome also seems inevitable as the handful of men who continue their art of weaving grows fewer in number day by day.

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IN REVIEW

SOCIAL ORGANISATION IN ABORIGINAL AUSTRALIA by Warren Shapiro, *The Australian National University Press Canberra 1979, 135 pages Unillustrated, \$14.95.*

Aboriginal kinship is among the more complex and at times confusing of anthropological studies. Professor Shapiro claims that his book is written for the "generally educated reader", which suggests it might be an attempt to reduce the intricacies of Aboriginal social organisation to a palatable form free of much of its esoteric terminology. However, the reader who expects this will be sadly disappointed. Perhaps this is because difficult issues can never be discussed simply—except maybe by an occasional genius. But in this case it seems that Shapiro's true intent is less to present hard facts simply, than to attack some of the more conventional views held by anthropologists about Aboriginal kinship and affinity.

Like a zealous sapper reducing a labyrinthine and seemingly secure enemy position to rubble, Shapiro demolishes skilfully some well entrenched ideas. To do this he draws largely from his own primary data, won during 16 months of fieldwork among Aboriginal groups in Arnhem Land, supporting his argument further from recent field studies by some of the younger anthropologists working in the same region. He demonstrates how in earlier studies the ideological concepts of Aborigines about their kinship were often accepted uncritically by anthropologists, whereas a different picture can be revealed by examining carefully the societies as they actually function. We read too, how earlier research was almost exclusively by male anthropologists gathering information from male Aborigines, whereas in recent years the views of Aboriginal women obtained by female anthropologists like Annette Hamilton have helped to give a more balanced view of Aboriginal society.

My only doubts concern the broader application of Shapiro's message which seems (by implication at least) to be directed at Aboriginal society as a whole when the main evidence to support his view comes from a relatively small corner of the continent. Be that as it may, Shapiro's book is essential reading for students of Aboriginal social organisation.—*Ronald Lampert, Curator of Anthropology, The Australian Museum.*

KULINMA: LISTENING TO ABORIGINAL AUSTRALIANS by H.C. Coombs. *Canberra: Australian National University Press, 1978. 250 pages, illustrated, \$18.50.*

Dr H.C. Coombs is well known for his role as Director-General of Post-War Reconstruction, as Governor of the Reserve Bank, and as Chancellor of the Australian National University. In more recent years he has achieved prominence in Aboriginal affairs, a task that began in earnest when he was appointed Chairman of the Council

for Aboriginal Affairs. The Council was set up by the Holt government in 1967 in response to an overwhelming 'yes' vote at a referendum on questions concerning the improvement of Aboriginal legal status. Today at an age when most men are well past retirement, 'Nugget' Coombs continues actively to support the cause of Aborigines—seen as a minority group at the mercy of a largely apathetic and sometimes oppressive society whose attempts to help Aborigines are usually misguided.

His book is a collection of papers written between 1968 and 1977. Viewed sequentially, the papers not only give an overview of Aborigines in contemporary Australian society, but also reveal how the author's thinking developed as his experience with Aborigines grew. Thus most of the early papers are rather shallow appraisals of general topics while later articles probe some of the deeper complexities of specific issues. Also because of the broad time range over which they were written, the different papers sometimes carry messages that are incompatible. Some written in 1970 use bare statistics to depict Aboriginal social handicaps, notably in health, education and housing. More recent papers review the advent of today's movements back to traditional homelands and the revival of traditional culture generally, particularly in northern Australia. If this is the direction of current Aboriginal aspirations, should we then measure their social conditions with a European yardstick? Perhaps a community which chooses to live largely as nomadic hunter-gatherers and whose elders prefer to pass on their own languages and customs to their children should not be expected to reach average facility in the standard Australian educational system, still less to reside in houses of comparable standard to those of sedentary Europeans. Even a slightly higher death rate than the Australian average might be an inescapable corollary of choosing a hunter-gatherer life style, though diet and hence health should be immeasurably better than that of Aboriginal fringe dwellers in outback townships. However, a different case should be made for urban southern Aborigines whose aims could be expected to be closer to those of Europeans, and to whom discussion of social handicaps as recognised by Europeans is more applicable. Even so, the strength of any cultural revival movement among urban Aborigines should not be underestimated.

The picture is obviously more complicated than the author portrays it. Notably, the different life styles and ambitions of urban and tribal Aborigines do not always allow them to be lumped together under one general set of Aboriginal statistics even though both share the common goal of gaining a better deal from the white majority.

To achieve this and give Aborigines what they really want, rather than what most of us think they should have, we should do what the author suggests in the title of his book and start "listening to Aboriginal Australians".—*Ronald Lampert, Curator of Anthropology, The Australian Museum.*

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