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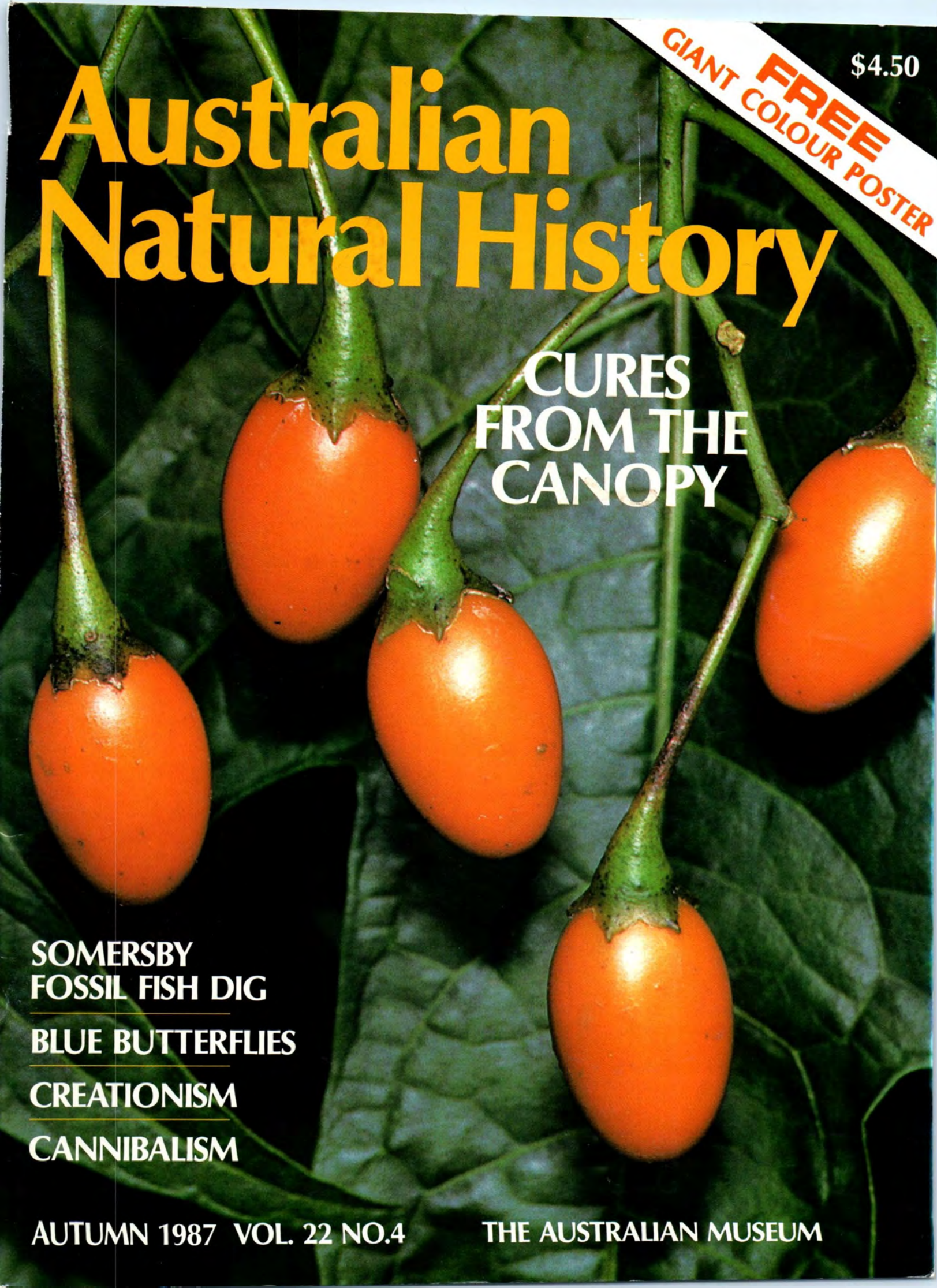


CURES FROM THE CANOPY

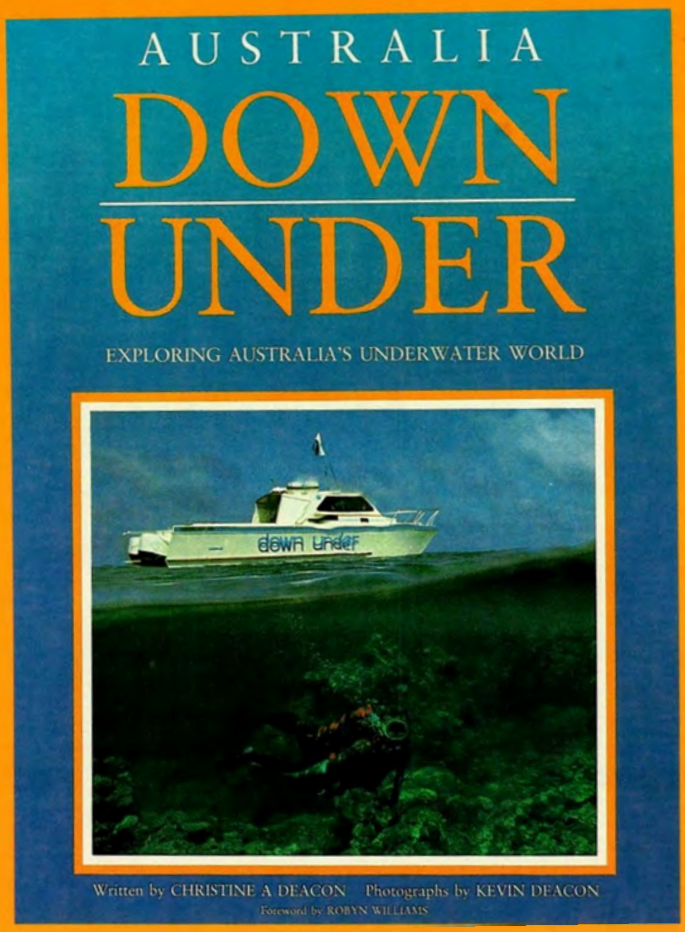
SOMERSBY FOSSIL FISH DIG

BLUE BUTTERFLIES

CREATIONISM

CANNIBALISM

AUTUMN 1987 VOL. 22 NO.4 THE AUSTRALIAN MUSEUM



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Front Cover

The kangaroo apple, *Solanum aviculare*, is a source of steroids for the contraceptive pill. Read how Australian native plants have contributed to medical science in the article on page 184. Photo: Tim Low.

EDITORIAL International Intrigue

Scientific investigation is back-breaking work. This was painfully evident to ANH staff when we spent a day at the Somersby quarry fossil site, carefully removing layer after layer of shale to uncover fossil fish that had not seen the light of day for 220 million years. It was exciting to be involved in a project that has had massive support from the company that operates the quarry, Montoro Resources Ltd. Such public-spirited companies set an example to other corporations, both here and overseas. They receive favourable publicity and science progresses: everyone gains. Read more about the Somersby dig over the page.

Indeed, scientific research depends on support above and beyond financial outlay—free flow of information is vital. As Robyn Williams points out (see page 165), science *should* be the world's most international concern, for without the exchange of ideas and discoveries, much time-consuming research is needlessly duplicated or suppressed, holding back progress. The need for internationalism in science is also brought to light in the article on the Noisy Scrub-bird (page 189). Detailed understanding of this rare bird has resulted from an international co-operative project that should serve as a model for future studies of rare species. Likewise, "Cures from the Canopy" on page 184 shows that Australia's native plants have a lot to offer medical research world-wide if more detailed studies can be carried out.

—Fiona Doig, Editor

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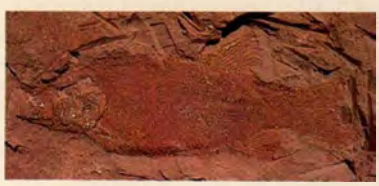
The rock covering more of the fishbed is removed by backhoe as the Museum team excavates a rare specimen of an ancient xenacanth shark. Photo: Alex Ritchie.

THE GREAT SOMERSBY FOSSIL FISH DIG

By Alex Ritchie



A *Promecosomina* specimen.

Photo: Alex Ritchie

Hundreds of volunteers flocked to the Somersby fossil site, devoting much time and a lot of energy to recovering nearly 700 fossil fish from one of the richest fossil finds ever in New South Wales. Alex Ritchie, Head of the Australian Museum's Division of Earth Sciences, recounts the backbreaking work and the excitement of discovery.

I was made an offer I couldn't refuse—and one that I didn't quite know how to handle. "That's the Australian Museum's site! We'll hold it for you and work around it until you're ready. Then we'll put in heavy equipment to open it up. It's up to you to work out how you want to tackle it."

We were standing in a huge quarry looking at a two-metre-thick shale layer exposed in a sandstone rockface. "How much shale is in there?" I asked. "Oh, about 6–10,000 tonnes" was the reply. The offer came from Dr Bruce Walpole, Chairman of Central Coast Sands, which operates a large quarry for building and construction sand near Somersby, ten kilometres west of Gosford, New South Wales.

I knew the quarry well, having visited it on many occasions since 1972. In that year Gordon Hattley, an employee of Gosford Brickworks on the Central Coast, noticed well-preserved fossil fish in loads of shale arriving at the plant from the quarry. Hattley notified the Mines Department and the Australian Museum in Sydney, and several of us visited the quarry site soon afterwards to investigate the finds.

They weren't the first such discoveries on the Central Coast. In the 1880s over 400 fossil fish specimens were recovered from the Railway Ballast Quarry on the western outskirts of Gosford. The fish fauna, described by Sir Arthur Smith Woodward of the British Museum (Natural History) in 1890, was rich and varied. The fossils were preserved in grey shale layers—of a freshwater lake deposit laid down around 220 million years ago, during the Triassic Period at the beginning of the Age of Dinosaurs.

The Somersby quarry uncovered another of these Triassic shale layers, containing a rich fossil fish fauna. By a stroke of luck, on my first visit to the Somersby quarry in 1972, I arrived on

A volunteer digger, having just uncovered a *Promecosomina* specimen. Photo: Kathie Atkinson.

Aerial view of fossil site, located on the floor of a new settling dam. Photo: courtesy Montoro Resources.

the very morning that an observant bulldozer driver, John Costigan, found and saved a superb fossil of a large pike-like fish, *Saurichthys*. It wasn't complete, the rear third was missing, but the whole fish must have reached about a metre in length. Costigan generously donated his find to the Australian Museum.

About eight years later he made another remarkable discovery in the same quarry—a fossil lungfish called *Gosfordia*, after the town near which it was found. Fragmentary specimens of *Gosfordia* had been found in the old Railway Ballast Quarry in the 1880s but the Somersby specimen was the first complete example to be discovered. Costigan sold it to an amateur collector, Colin Chidley, but, when the rarity and scientific importance of the find became clear, the latter passed it on to the Australian Museum where it is now one of the fossil treasures on permanent display in the Hall of Fossils.

In the days when most excavation was done by hand the quarrymen watched closely as the rock came out and were able to salvage many important fossils. In an age of increasing mechanisation the physical separation of the quarrymen from the material being excavated has greatly reduced the chances of such finds being made, except on rare occasions. Although we visited the Somersby site several times between 1972 and 1984, we could usually collect only from the shale dumps or from the exposed face of the shale layer. Most finds were from loose blocks, very few were found *in situ*. Many more were recovered by a keen student, Peter Watson, who found at least seven or eight different types of Triassic fish in the deposit.

In early 1986 the situation changed dramatically. The Somersby lease had recently been taken over by Montoro Resources Ltd and the quarry was operated by their subsidiary, Central Coast Sands, whose management included two geologists, the Chairman Dr Bruce Walpole and his Co-director Mike Turbott. As part of a major development program for the site a large quantity of rock, including the fish-bearing shale layer, had to be excavated to make way for a new settling dam.

Fortunately Bruce Walpole and Mike Turbott were aware of the scientific importance of the fossil remains contained in the shale.

Dr Walpole contacted me and offered the site to the Australian Museum for a properly controlled excavation and recovery project. We were promised ample time and all available resources of the company to help us in this gigantic task. As Dr Walpole put it, "It's our way of putting back a little of what we have been taking out of the landscape. I don't think any of us could have slept at night if we hadn't tried to save the fossils!"

In early July I inspected the site with Robert Jones, my Collection Manager, and we began planning how we would tackle the mammoth project. Obviously the two of us could do little by ourselves—we needed to find and train a small army of volunteers. The firm meanwhile brought in heavy earth-moving equipment, carefully removed the thick overlying layers of weathered yellow sandstone and uncovered the shale layer ready for us to start excavating.

For someone used to limited exposures of fossil deposits it was a daunting sight—a bare exposed shale platform 100 metres by 60 metres and about two metres thick. Buried within it we knew there were hundreds, probably thousands, of fossil fishes but we didn't know where. From previous finds we knew that at least seven or eight different types of extinct fish were present, and probably more that would be quite new to science.

A small announcement in the *Sydney Morning Herald*'s Column 8 alerted the public to our need for volunteers. This produced an astonishing response—hundreds of phone calls and a steady stream of visitors, all eager to take part. On weekdays an average of about 20 volunteers turned up to dig and on weekends the numbers rose to between 30–50. The sight of so many people digging determinedly in such a small area, accompanied by a deafening chorus of hammers on chisels, presented an unforgettable scene. With such assistance the Museum team was able to open up and carry out a systematic search in one of the richest fossil sites ever found in New South Wales with spectacular results.

The management of Montoro Resources made it clear from the start that the fossil site was available to the Australian Museum team for as long as we needed to carry out a proper detailed excavation and that this could be extended if the discoveries warranted it. Co-operation on this scale is virtually unknown in Australia and sets a fine example for other companies in the mining and quarrying fields. We initially estimated a period of six weeks, in fact the excavation program was carried out for eight weeks—seven days a week. Although we both supervised the operation, Robert Jones bore the brunt of the effort when other commitments kept me back at the Museum.

Systematic investigation of the shale deposit began with the use of a large backhoe controlled by a skilful operator, Bob Ferguson. He dug a series of trenches on a grid pattern over the whole area, cutting down to the sandstone underneath the shale and giving us a three-dimensional look at the whole deposit. The trench sides were then excavated by hand to locate the fish-bearing layers and the backhoe was brought in to strip off the overlying rock to within 10–20 centimetres of the fossiliferous layer.

The painstaking task of locating and uncovering the fossils was then carried out by the Museum team and hundreds of enthusiastic and hard-working volunteers. The public support we received far outweighed our wildest expectations and the results we obtained bear witness to their efforts.

When we started to excavate, several problems soon became apparent. The Triassic shale deposit was so weathered that in places it was almost a soft clay. The rock didn't split apart neatly into layers to reveal the fossils and we developed a special approach to locate and recover the fish fossils. The most useful tool proved to be a 10–15 centimetre wide brick-splitting chisel, a bolster. The face of the rock was carefully chiselled back to uncover one layer after another. In many parts of the deposit the fossil fish were so abundant that it was usually only a matter of time before a nose or a fin appeared. We asked volunteers to call Robert or myself when this happened. We could usually tell at a glance if it was a common form, in which case we advised the volunteers on the best method to uncover it and left them to get on with the job. If it was a rare form we took over the recovery ourselves. Everytime a good find emerged most of the diggers crowded around to admire it before returning to their own patch with a fresh burst of enthusiasm.

Our volunteers came from every part of Sydney and the Central Coast and from as far afield as Wollongong, Orange and Newcastle. We even had some from Canberra and Brisbane. They came from all walks of life, young and old, students and teachers, housewives, or unemployed. Others took leave from paid jobs to participate in what they clearly considered to be an exciting and an unusual hands-on experience. Some came for one day, others returned time after time, fascinated by the experience and spurred on by the challenge to find more and better specimens. Few of the volunteers had ever dug up a fossil before, far less a complete animal.

All of the fish in this remarkable deposit were complete to the last fin-ray indicating that fossils preserved in the shale layer, laid down in an ancient freshwater lake around 220 million years ago, were the result of a mass-kill phenomenon. We estimated that over 1,500 fossil fish were located and about 660 of the best preserved and most important specimens were recovered for scientific study.

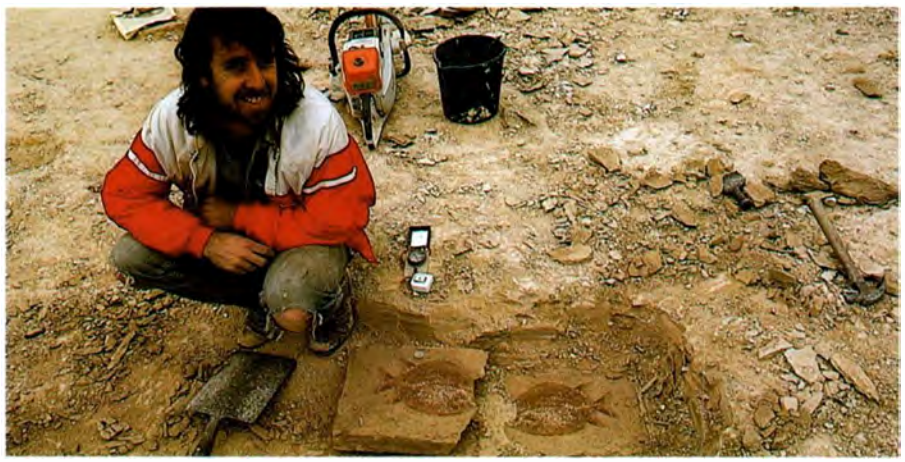
Of the ten types of extinct fish now known to be present in the deposit one type predominated, making up about 95 per cent of the sample. It belonged to a group found world-wide in rocks of Triassic and Jurassic age dating from between 220–180 million years ago. The local form is known as *Promecosomina*, but has variously been called *Semionotus* and *Zeuchthiscus* as ideas on its relationships have changed through the years. Analysis of the very large sample now available from Somersby should enable a full analysis and reconstruction to be prepared to settle the question of its identity once and for all. Most volunteers found at least one *Promecosomina* but it wasn't uncommon for someone to uncover up to five or even ten fish in a small area, the specimens crowded together and even lying on top of one another. At one point early in the dig we had over 130 complete fish exposed at one time on the top of the shale lens. Where possible the specimens were left in the ground until Peter Watson came along to measure them and plot their exact position and orientation.

A second form, the deep-bodied *Cleithrolepis*, normally the commonest fish in the Triassic rocks of the Sydney region, was quite rare at Somersby, accounting for only two to three per cent. That meant we were engaged in an inexorable numbers game. On average we had to uncover some 19 specimens of *Promecosomina* to find one of the others, or about 98 specimens of *Promecosomina* plus *Cleithrolepis* to get one of the really rare members of the fish fauna.

Two of the most important finds were almost complete specimens of a strange freshwater shark, *Xenacanthus*, specimens of which have long been known from quarries at St Peters, Sydney, and near Bowral but not previously from the Gosford area. We conservatively estimated that each fossil shark represents about 2,000 hours of digging. One thing is certain—without all the assistance we would have had little hope of finding such specimens.

Most of the rarest finds were discovered by volunteers. Susan Parsons, the gardening correspondent of the *Canberra Times*, read about the dig and decided to take part. Shortly after arriving at the quarry she was handed a hammer and chisel and directed to a spot just vacated by another digger. Within a short time she uncovered the head of a fish, called over Robert Jones and realised from his reaction that she had found something unusual. It proved to be a beautiful, complete specimen of *Saurichthys* about 50 centimetres long, the best of only four we discovered in the eight week project. Andrew King, a volunteer from

See no fossils, hear no fossils, find no fossils . . . Three members of the Parramatta Lapidary Club dig for fossil fish, regardless of the rain and mud. Photo: Alex Ritchie.



Andrew King, a volunteer digger from Sydney, found one of the largest and finest specimens of *Cleithrolepis*. Photo: Alex Ritchie.

Which way up? The 'push-me-pull-you' plant next to a *Promecosomina* specimen. Photo: Kathie Atkinson.

Sydney, found the deep snout of a large fish and called me over. I was able to remove the top half in one piece to expose one of the largest and finest specimens of *Cleithrolepis* we have ever seen.

Frank Cheshire from Springwood in the Blue Mountains had a good day on his first visit, finding two *Cleithrolepis* as well as several of the common *Promecosomina*. With his appetite whetted he returned a week later for another go. Just before we packed up for the day to avoid an advancing thunderstorm he uncovered the tail of a xenacanth shark disappearing into the rock, the second of the two specimens we recovered. The rare find was quickly covered with tarpaulins and left overnight. Frank had to drive all the way back from the Blue Mountains the following day to see it being uncovered and cut out. It was a remarkable specimen. It appears to lack the long pointed spike that protrudes from the back of the skull of other specimens found elsewhere, indicating that the Somersby xenacanth sharks are probably new to science. An intriguing feature of the first shark discovered a few weeks earlier was the presence of claspers on the pelvic fins, clear signs that it was a male. The second specimen discovered by Frank Cheshire lacked this feature and probably represents a female of the same new species.

Fossil plants were surprisingly rare in the Somersby shale deposit and usually not well preserved but several fine specimens were recovered. One strange plant, discovered by Stuart Norrington of the Macleay Museum in the University of Sydney, presented us with a problem. It was virtually complete, about 50 centimetres long but we had difficulty deciding which way up it was, whether the thin shoots coming off one end represented the roots or the leaves—a 'push-me-pull-you' plant! Another surprising discovery was a unique specimen of a largish shrimp-like crustacean, an unexpected find in a Triassic *fresh-water* deposit.

Although the Somersby dig is finished we still face a major task in cleaning up and preserving the 660 fish specimens we brought back to the Australian Museum. The soft clay rock in which they are preserved has to be hardened by impregnation with dilute resins. Detailed measurements of the whole population sample have to be carried out. Although the best specimens will be retained in the collection, good examples will be sent to other museums around Australia. The surplus provides us with a marvellous store of exchange material to offer museums around the world. It is a means of economically obtaining fine specimens for our own collections and displays.

We ended the dig slightly frustrated by the knowledge that we hadn't found certain kinds of animals we know to be present at Somersby. From Peter Watson's earlier finds we know that a second type of shark is present in the fauna but no more specimens turned up. Neither did we find any more specimens of the distinctive lungfish, *Gosfordia*. We had also hoped to find a skeleton (or even a few bones) of a labyrinthodont amphibian, a large salamander-like animal. Remains of such animals are known from the Triassic rocks of St Peters and Brookvale in Sydney as well as from the Gosford Railway Ballast Quarry only a few kilometres from Somersby. Such discoveries always depend on serendipity; we know that they are there but not in the bit that we sampled so intensively.

We are heartened however by the knowledge that the Somersby shale deposit is not the only one of its kind in the area. It continues underground to the east of where we were digging and may well be exposed in future quarrying operations. If, or when, this happens the management of Montoro Resources has assured us that we will be informed in plenty of time and given another opportunity to investigate these fascinating deposits. The shale lenses of the Sydney Basin form a unique part of Australia's heritage. They represent a form of time capsule and windows through which we can study the life of the distant past. □

IN THE RED

by Gordon Claridge

Ever wondered what those long red windrows are that you see on the ocean from aircraft?

Chances are that if you were in the tropics they'd be aggregations of countless millions of microscopic blue-green algae (*Oscillatoria erythraea*). These algal blooms have sometimes been so extensive that they have been recorded on satellite images and even observed by space shuttle astronauts.

Blooms are characteristically a rusty colour (hence their common name Red Tide) but pass through a range of greenish yellow colours as individuals mature, through to black and eventually white as they decay. The angle of

An aerial view of blue-green algae (*Oscillatoria erythraea*). Blooms pass through a range of colours as individuals mature. Although not red here, they are characteristically a rusty colour, hence their common name Red Tide. Photo: Ralph and Daphne Keller, ANT.

Handfuls of the blue-green algae *Oscillatoria erythraea*. Photo: L. Zell.

the Sun's rays and the state of the sea also affect the observed colour.

Each individual *Oscillatoria* (or *Trichodesmium*, as it was known until recently) floats at the surface by means of an internal gas-filled chamber, which it regulates to move up and down in the water. What you actually see on the surface, therefore, are mostly the dead or dying representatives of a much larger population deeper in the water. The gas chambers are also thought to play a secondary role in shielding the organism's sensitive photosynthetic membrane from the strong sunlight of the tropics.

Each *Oscillatoria* is composed of individual filaments only .01 millimetres in diameter. Fifty or more of these individuals clump together, forming colonies that look, with the naked eye, like sawdust or, microscopically, like miniature wheat sheaves. Within the clumps individuals slide over each other, but maintain the same overall shape of the colony.

The macroscopic similarity to sawdust has earned *Oscillatoria* another common name—'Sea Sawdust', but sawdust isn't the only thing they resemble. On 5 June 1770 the crew of the *Endeavour* was startled to see what looked like a shoal just ahead of their bows. Imagine their surprise, and relief, when the shoal slipped harmlessly down either side of the ship! Joseph Banks, the botanist on board, collected a sample and examined it under the microscope. He found that it was "formed by innumerable small atoms".

Besides sawdust and shoals, Cook's sailors often mistook *Oscillatoria* for spawn. Today many people still confuse it with coral spawn and some even refer to it as 'whale sperm'. It is concentrated by wind into great rusty surface streaks. Coral spawn and *Oscillatoria* can usually be distinguished by a number of factors. Firstly, coral spawn seldom occurs in the vast quantities that characterise *Oscillatoria*. Secondly, in the initial stages of decomposition, *Oscillatoria* turns verdigris green and gives off an offensive odour similar to chlorine or iodine, eventually turning white. Coral spawn initially turns pink and then white but has no noticeable odour. The easiest way to distinguish them, however, is the time of year at which they occur. Coral only spawns in certain lunar phases in early November and December. *Oscillatoria*, on the other hand, may be seen at any time of the year, although it is generally more widespread in the summer months between October and March.

With regard to its 'primitiveness' *Oscillatoria* is on the borderline between algae and the more primary bacteria. It can reproduce simply by regeneration of broken filament sections, yet it shares with plants the ability to produce energy and oxygen by photosynthesis. Not only this, the

organism can absorb nitrogen from either the water or the atmosphere and fix it in its tissues, thus becoming a living fertiliser in the low nutrient waters of the tropical Pacific Ocean. *Oscillatoria* thus takes advantage of nitrogen run-off from excess farm fertiliser used on the land. Consequently, it can be a very sensitive environmental indicator of cultural eutrophication.

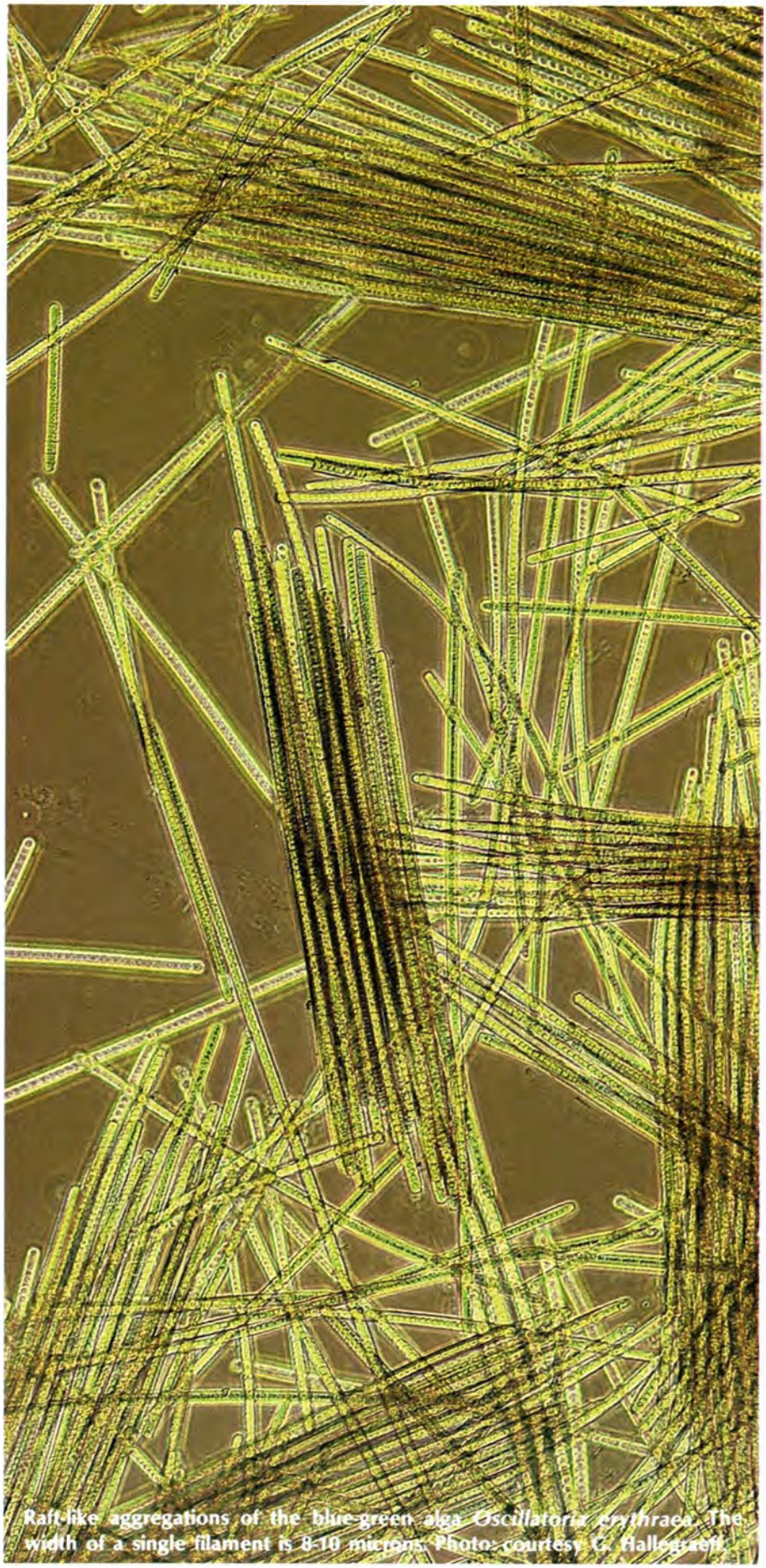
Not all of the effects of *Oscillatoria* are beneficial. When large quantities are piled up by wind and current in shallow water, they can kill other organisms by consuming all the oxygen in the water as they decompose. At sea they may be so numerous that they kill fish by clogging their gills. They have also been known to clog the nets of fishermen.

As mentioned before, this decomposition process is accompanied by a foul odour, and when massive amounts of *Oscillatoria* have washed up, for example, on Sydney's Bondi Beach, the resulting mess has been mistaken for sewage pollution. This misidentification is enhanced by the red-brown colour taken on by the rotting mass at one stage in its decay. Later in the decomposition process it may appear quite black and give rise to reports of oil pollution.

Although Red Tide normally occurs in the tropics, it is sometimes sighted in temperate waters. Some scientists believe that the occurrence of *Oscillatoria* in the temperate waters off New South Wales, for example, is a normal event, caused by masses being caught up in the eddies of the East Australian Current. Others suspect that these dense algal blooms are a relatively recent phenomenon, resulting from an increased supply of nutrients caused by sewage discharge, detergents and fertiliser runoff.

The decay of *Oscillatoria* has been impressing mankind for millennia. As it decomposes, the filament walls rupture and release a water-soluble pigment (phycoerythrin) that is blood-red in colour. The Red Sea owes its name to blooms of blue-green algae, and the references in the Bible to the sea turning to blood may refer to the release of this pigment.

Despite its having captured our attention for so long, *Oscillatoria* still remains something of an enigma, for it is extremely difficult to keep alive in the laboratory after it has been collected in the field.□



Raft-like aggregations of the blue-green alga *Oscillatoria erythraea*. The width of a single filament is 8-10 microns. Photo: courtesy K. Hallegraeff.

photoart

BEHIND THE MASK

PHOTOGRAPHY
BY RIC BOLZAN

AUSTRALIAN MUSEUM

To the people of the Sepik River in Papua New Guinea, face masks are traditionally sacred objects thought to represent ancestral spirits associated with particular descent groups. They are usually kept in the ceremonial men's houses, where they are called upon for assistance during important ceremonies such as the building of a new canoe or ceremonial house, or the initiation of young men into the spirit cult. They are sometimes worn by performers at these ceremonies and are decorated with brightly coloured flowers and leaves, shell and teeth valuables, and fringed with dried sago or coconut leaves, which are attached through holes pierced around the edges. Among the Murik people of the Lower Sepik, each mask is individually named and has personal belongings such as a plaited basket, spear and spear-thrower.

Mask from Bena Bena, Eastern Highlands.

Mask from the Lower Sepik River, East Sepik Province.

Mask from the Eastern Highlands Province.

In the Highlands, use of masks is uncommon and does not appear to be traditional. In some areas, masks are worn by performers for comic relief at exchange festivals, but do not have the same religious significance as their Sepik counterparts. Most Highlands cultures concentrate rather on body decoration to make statements about social and religious values.

The masks depicted here come from the Australian Museum's Anthropology collections and were all photographed as part of the collection documentation process. Together with information about the source and history of a collection, the photographs form an accurate record of each object at a specific point in time and are valuable tools for efficient collection management. A photographic catalogue of a collection minimises the handling of fragile objects. It is also a ready reference for research, educational and exhibition purposes. So the photographer works with these needs in mind, using specialised photographic equipment and lighting techniques to capture as much detail as possible.

Objects increase in value to museums if we know how and where they were made and by whom, how they were used, what the designs and symbols used mean, and any stories relating to them. The Sepik Documentation Project in the Anthropology Division is using photographs like those depicted here to achieve this goal, by taking photos of our Lower Sepik items back to their place of origin and asking informants what they remember about them. Quite a lot of information can be obtained in this way, especially from older people, who were children when the items were first collected. The information will be preserved in writing in our Museum and the Papua New Guinea National Museum for their descendants.

In the museum context, these photos are much more than 'art'.□

—Susan Thomsett

Mask, Yuat River, East Sepik Province.

Mask from Dallmann Harbour, East Sepik Province.

Dance mask, Andua Village, East Sepik Province.

'Brag' mask, a representation of a warrior ancestor, from Murik Lakes, East Sepik Province.

Flute mask, Ramu River, Madang Province.

Kangaroo Island

"Several black lumps, like rocks, were pretended to have been seen in motion by some of the young gentlemen, which caused the force of their imaginations to be much admired; next morning, however, on going towards the shore, a number of dark-brown kanguroos were seen feeding. . . The kanguroos had much resemblance to the large species found in the forest lands of New South Wales, except their colour was darker. . . a delightful regale they afforded, after four months privation from almost any fresh provisions. . . In gratitude for so seasonal a supply, I named this southern land Kanguroo Island."

So wrote explorer-navigator Matthew Flinders on 20 March 1802 in the account of his circumnavigation of Australia.

Those "dark-brown kanguroos" are still common on the island, mainly in Flinders Chase National Park. Today we know this species is not the Eastern Grey Kangaroo (*Macropus giganteus*) but its close relative the Western Grey (*M. fuliginosus*), which extends across the continent from the south-western corner, eastwards to south-eastern Australia and northwards across the inland plains to Queensland. It can be distinguished from the Eastern Grey not only by its darker colour but also by the strong odour of the males. It was only in recent years that scientists agreed there were two species but I remember Eric Worrell (from Gosford's reptile park) telling me many years ago he could separate the animals by their different odours.

An interesting conservation experiment was carried out after the establishment of Flinders Chase National Park in 1919. Alarmed by the shrinking numbers of wildlife on the mainland, due to introduced competitors such as livestock and rabbits and also predators like the fox and feral cat, it was decided that islands, safe behind their sea moats, offered ideal places to keep some threatened animals in safety.

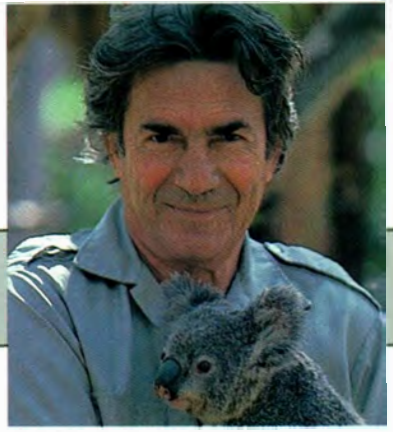
Mallee Fowl (*Leipoa ocellata*) were brought over in 1923 but they failed to establish viable populations. More success, however, came with the introduction of a pair of Cape Barren Geese (*Cereopsis ceropsis novae-hollandiae*) in 1923. Another two pairs were released in 1932 and two more pairs in 1936. By 1947 one hundred birds were reported and in 1983 seventy nests were located and 130 chicks reared. Among other introductions, six Koalas from Victoria were released and today there is a thriving population in the Chase. The Platypus was another successful immigrant, although the Southern Hairy-nosed Wombat (*Lasiorhinus latifrons*) and the Boodie (or Burrowing Bettong, *Bettongia lesueur*) failed to take hold. Perhaps the most dramatic of all the animals of the island is the Australian Hair Seal (*Neophoca cinerea*), sometimes called the Sea Lion because of the tawny mane of the males. This species is unique to Australia.

At Seal Cove on the southern shoreline there is a a large colony of Hair Seals. It makes up about ten per cent of the total Australian population of about 5,000 animals. I know of only one other place (in Argentina, South America) where it is possible to drive your car near a beach, walk a hundred metres and find yourself among a colony of seals.

Fur seals are close relatives but the Hair Seal was more fortunate than these creatures since it lacks the soft underfur that made the animals so valuable for the skin trade. In spite of this, Hair Seals were once hunted for the oil they provided. Today their range is still smaller than it was at the time of the first European settlement when it extended as far east as the Bass Strait islands.

Kangaroo Island is now the easternmost point of Hair Seal breeding colonies, while to the west the animal

Admiralty Arch.



OF VINCENT SERVENTY

An Australian Hair Seal or Sea Lion.

Western Grey Kangaroos at Flinders Chase National Park.

ranges as far as Rottnest Island, some reaching the Abrolhos Islands off the coast near Geraldton.

Males weigh about 300 kilograms and are nearly two metres long. Females are shorter and lighter, yet still touch 80 kilograms, and the seals are large enough to defy most enemies except humans and the large White Pointer Sharks (*Carcharodon carcharias*) that roam those seas.

Mothers usually give birth between October and December although this season may last until January. Further studies at Seal Bay on Kangaroo Island, and also at Dangerous Reef also in South Australia, indicate births can take place at any time and there appears to be an 18 month rather than a yearly cycle. This pattern seems to be indicative of a year-round plentiful food supply and favourable climate. If this proves to be true it would be unique among members of the seal family.

Some years before on an island near Rottnest I had been filming seals in the water. I wanted next to film the seals coming onto the shore. But being naturally curious, my problem was how to get them to leave us and the sea. Carol solved this by swimming to the beach. As soon as she lay on the sand all the seals followed and lay in a neat row alongside her.

Since my visit to Kangaroo Island was during the breeding season, I knew it was important to take care in approaching a mother with her baby. I found later that when I approached a prostrate seal by crawling it took little notice. It is the upright posture which is taken as a challenge and produces strong reactions.

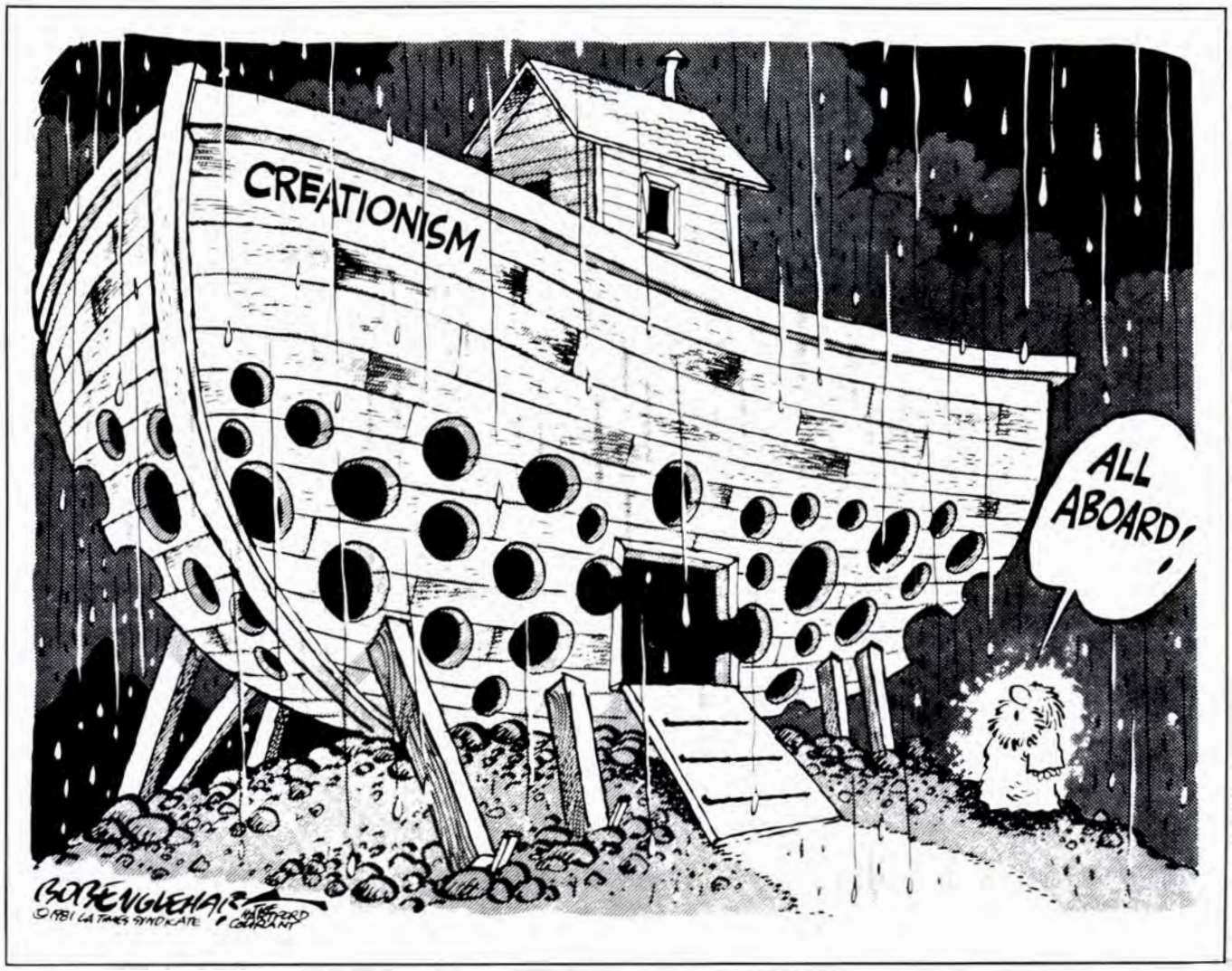
So I approached with body to sand and camera to eye but, using a new camera with a wide-angle lens, I hadn't realised just how close I had got. The mother reacted violently, charging with mouth wide open and teeth potentially damaging. I leaped back with such vigour that I broke a bone in my foot. For the rest of my stay I hobbled.

As well as a wealth of animal and plant life the island has other attractions. The scenery is spectacular with the best known landforms being the Remarkable Rocks and Admiralty Arch. The first is truly remarkable—great granite boulders weathered into sculptural forms, reminiscent of the work of Henry Moore. The Arch is also dramatic, framing a wild sea with New Zealand Fur Seals (*Arctocephalus forsteri*) sporting in the waves. These are more elegantly shaped than the Hair Seals, with pointed noses.

Fortunately the management of this island is sympathetic to conservation. Seal Cove is only one of 15 conservation parks while Flinders Chase covers the western third of the island. For the rest of the island human occupation has been more gentle than in most other farming areas in Australia, while the various small villages add interest to the rural scene.

Certainly for the naturalist Kangaroo Island will always be a magnet. □

Photos: Vincent Serventy.



CREATIONISM:
NO PLACE IN THE SCIENCE CLASS

Due to the enormous (and mostly favourable) response to Robyn Williams' contribution on *Worrying About Creation 'Science'* (ANH Vol. 22 No. 3, Summer 1986), we thought it appropriate to reproduce in part the letter that Professor Michael Archer, from the University of New South Wales, wrote to the New South Wales Assistant Minister for Education, The Honourable Mr R.J. Debus, in June 1986. It is in reference to the impropriety of teaching 'scientific' creationism in New South Wales schools.

For the past two years I have risked a self-inflicted frontal lobotomy as a result of reading everything currently available that promotes the cause of the 'scientific' creationism movement.

Having thoroughly digested this stuff, there is not the slightest doubt in mind that it would represent the gravest of mistakes to recommend, for whatever reasons, the teaching of any aspect of this sophistry in the science classes of public schools. Its only legitimate place in a public school education would be in a course on the history of religious movements. It is, by its ministers' own admissions, not science.

The basic fabric of the Australian educational system is under siege here. Queensland has fallen; other States are at risk. The stakes in this contest do not just concern the content of school science classes. Having failed for two centuries to insert religion into science classes by way of legitimate scientific investigation, creationists are now trying to force it in through the back door of schools by bullying and blackmailing school teachers and politicians. So what is also at stake here is the rational procedure by which the content of school courses is determined.

The United States Constitution provides a legal basis for the

separation of church and State. While we do not have such a legal basis, surely we must recognise the essential wisdom of this decision. To muddle the two systems up preludes a collapse in the ability of students to think critically.

We do not have a responsibility, let alone the time, to teach students every idea system known. Hence we must be selective. The basis for selecting the content of science has been determined by the history of the ideas themselves. If hypotheses have repeatedly been tested and found wanting, those are among the ideas that should not be pulled out of the dust bin and promoted as science alongside others which have been tested and found plausible.

Creation 'Science' as Taught

To teach what 'scientific' creationists want taught in geology will mean telling students among other things: that the Earth (as well as the whole Universe) is only about 6,000 years old; that the vast majority of the fossil record formed in one year from a flood that occurred 4,000 years ago; that all dinosaurs, lions, snakes and venus fly traps ate plants until Adam sinned in the Garden of Eden (prior to which time there was no death); that after the flood receded 3,999 years ago, all kinds of organisms on Earth landed on a volcano in Turkey and walked (slithered or whatever) from there to every other continent on the then flood-devastated Earth without stopping along the way in any inappropriate places (which explains, for example, why there are now no Platypuses in Turkey); that the whole of continental drift including the breakup of Pangaea and Gondwanaland took place in the last 4,000 years; that dinosaurs survived the flood 4,000 years ago by being on the ark and persisted to become the legendary fire-breathing dragons we read about in story books; and so forth *ad absurditum*. This is the 'science' that Creation 'scientists' want taught in science classes.

Behind the Mask

Consider these published statements by Henry Morris, the Director of the Institute for Creation Research.

"The only way we can determine the true age of the Earth is for God to tell us what it is. And since he ***has*** *told us, very plainly, in the Holy Scriptures that it is several thousand years in age, and no more, that ought to settle all basic questions of terrestrial chronology."* (Morris 1974 in *The Remarkable Birth of Planet Earth.*)

"For those who believe in Creation, therefore, physical processes and evidence that indicate an immense time scale must be explained away. Only those processes or evidence commensurate with a short (ie. 6,000 years) time scale can be accepted for use in creationism." (Morris 1974; same reference.)

"It is not too difficult to demonstrate that the entire concept of evolution is not only anti-Biblical but also utterly unscientific. That is, it is not too difficult to demonstrate this to one who is willing to think in terms of Biblical and Christian presuppositions." (Morris 1974; same reference.)

"The Biblical framework, therefore, requires that we categorically reject the fossil record as a record of the history of life on the Earth." (Morris 1974; same reference.)

"If something like this [evolution] *really happened, early in post-diluvian history, then Satan himself is the originator of the concept of evolution."* (Morris 1974 from *The Troubled Waters of Evolution.*)

...'Scientific' creationism... is not scientific; it is religion masquerading as science."

These quotations, taken from their own literature which was intended to present the case for 'scientific' creationism, make plain the real basis for this movement. It is not scientific; it is religion masquerading as science. The main message of these statements is that facts that do not fit the 'scientific' creation model of a young Earth (approximately 6,000 years old), a six (literal 24-hour) day period for the creation of the whole Universe and the existence of the Biblical Flood, must be explained away. Morris, at least, is perfectly honest about this blatantly unscientific approach. He is openly zealous about his Christian fundamentalism and knows that God has instructed him to get the Bible back

> "Ironically, Creation 'scientists' declare that Creation 'science' cannot be falsified and hence it cannot claim to be science."

into science classes. Creation 'scientists' in Australia have precisely the same mission. All of the books on creationism that I have now read were supplied to me by the Queensland Ministry for Creation 'science' in Brisbane.

Hypotheses, Theories and Models

Ideas that seek to explain facts are hypotheses, scientific and Creationist alike. Hypotheses that are rigorously tested and nevertheless withstand those tests become elevated to the status of theories. Bodies of theories that overlap in their area of interest and that seek to explain different aspects of the same general body of facts are called models. Evolution is just such a model. It is an enormous body of theories, hypotheses that have survived the gruelling mill of continuous testing. Throughout the history of the development of this model, hypotheses that have *not* withstood rigorous testing have eventually been shelved in favour of others seeking to explain the same data but which have also withstood efforts to falsify them.

Thus one of the main criteria by which science is judged is its ability to be falsified. Without this ability, it is difficult if not impossible to determine the relative merits of different ideas that seek to explain the same body of facts.

Ironically, Creation 'scientists' declare that Creation 'science' cannot be falsified and hence it cannot claim to be science. While it is my contention that their 'science' is in fact non-science, this is *not* because it cannot be falsified: it can and has been repeatedly falsified for the last century.

For example, there are many potentially falsifiable predictions that arise from Creation 'science' hypotheses about the history of the Earth. To name just one, they would predict that evidence for all kinds of organisms should be found in the earliest rocks that contain any form of life because, according to Creation 'science', all kinds of organisms were created during a single literal week. Thus, for example, clams, sharks, ichthyosaurs, seals and humans should occur in the same well-known Precambrian rocks (dated at 3.5 billion years old by geologists) that in fact appear to contain nothing but primitive single-celled prokaryotic organisms (blue-green algae and bacteria).

In fact, all of the kinds of organisms have *not* been found in Precambrian rocks. Most do not make their first appearance until more than three billion years later in Earth's history. These actual first occurrences do, however, support evolutionary predictions about the history and relationships of life on Earth such that, using the examples given, clams appear first and humans last.

In the same way, the Creation 'science' hypothesis that the Earth and the Universe are no older than about 6,000 years (or even 20,000 years as some 'liberal' Creation 'scientists' allow) leads to the prediction that nothing on Earth should be found to be any older than that date. This prediction has been repeatedly falsified by every scientific examination possible from radiometric dating involving many different and independent isotopic pairs to a consideration of the vast thickness and complexity of the Earth's sedimentary rocks. In fact, our present understanding of the great age of the Earth's sediments began with 19th century Creation geologists who were among the first to realise, after studying the rocks themselves, that Bishop James Usher's Biblically determined date for the Creation of the world of 22 October, 4004 BC, could not possibly be correct.

Nevertheless, despite falsification, Creation 'scientists' continue to hang on to their cherished hypotheses as though they had never been tested. This is why Creation 'science' is not real science—not because its hypotheses cannot be tested, but because when they have been tested and falsified, Creation 'scientists' refuse to abandon or even modify those hypotheses, ideas that were placed on the shelf by real scientists over a century ago. In clinging to these falsified ideas in spite of the evidence, they quite clearly demonstrate themselves to be advocates of a particular fundamentalist religion—not science.

Religion and Science; Apples and Oranges

Religion and science certainly do overlap in concern about the fact of existence but, in their approach to

comprehending this fact, they differ in aims as well as methodology. One concerns itself with the spiritual part of the Universe and the spiritual reasons for existence, while the other concerns itself with the material aspects of the Universe. Science cannot in any way threaten the validity of a spiritual part of the Universe because it is impossible to use the methodology of science to examine hypotheses about spirit. Anyone who declares that science can disprove or is intent on disproving the existence of God has no right to regard himself as a scientist because in making this foolish declaration, he demonstrates that he does not understand the distinction between the nature of science and that of religion. But equally, it should not be the purpose of religion to dictate to science what can or cannot be attributes of the material part of the Universe.

Blackmail and Indoctrination

The Creation 'science' ministry does attempt to determine, on the basis of their interpretation of scripture, what is and what is not acceptable scientific understanding. It is their conviction that belief in God, and acceptance of the probability of evolution and an old Universe, are utterly incompatible with the teachings of the Bible. They claim that acceptance of the scientific understanding of evolution automatically involves a denial of the existence of God.

In order to impress this ideology on children, they encourage Australian parents to indoctrinate their children before they are old enough to make rational judgements for themselves. The following instruction to parents (from Chapman, *"Hints for Christian Parents"* *Ex Nihilo* vol. 6(4): 26-27) clearly demonstrates the approach of Creation 'scientists' to the 'education' of children:

"Begin when they are very young. Read to them over and over again the story of God's creation until they have it firmly fixed in their memory. Read to them about God's wonderful creatures from colourful story books, but make sure you have read the stories carefully to ensure they contain no hint of theistic evolution, progressive creation, day-age or gap theory."

"Teach your children about the fallacies of evolution before they learn about its supposed truth at school. . . And then you will have to work at pointing out these facts to your children as they grow old enough to understand. . . remind them that dinosaurs are only big lizards which were made on the fifth and sixth days of creation."

"To use these texts as if they were God's laboratory notebook is almost certainly to misunderstand their nature as well as purpose."

The aim here is to set up within the uncritical child a mental framework that will be, they hope, immune to rational reassessment in later life. In suggesting that Creation 'science' be force-fed to uncritical children, its promoters clearly demonstate awareness that this religion is incapable of selling itself in the open market place of ideas. In order to avoid the risk of rejection by children or tomorrow's adults, it must be imprinted now in children before they reach the age when they can make rational judgements for themselves.

In the case of adult Christians, they have no qualms about stooping to theological blackmail. For Christians who see no conflict in spiritual and scientific understanding, Creation 'scientists' promise, on behalf of God, eternal damnation. This vicious blackmail, besides having no scientific substance or original Christianity to recommend it, comes terribly close to being an insult to God. For by what divine proclamation do they presume to determine for God the methods he was and was not allowed to use to effect his Creation?

Theistic Evolution

To millions of Christians, the possibility that God's method of creation was evolution seems entirely plausible and in no way threatens either their faith in God or in the Bible as a divinely inspired text. After all, it says nowhere in the Bible precisely *how* God created. If evolution was God's method, how could he possibly have explained this complex process to the original writers of the Bible 3,000 years ago when they had neither the vocabulary nor remotely suitable understanding of biochemistry or genetics to even begin to make the account understandable to the people of that time. And even if they could have written such an account, what would have been its purpose if it could not have been understood for

another three millennia?

All of this also presumes that God was under some kind of obligation to humans to give an accounting of himself and his activities in the Bible as if scripture were to God what a laboratory notebook would be to a scientist. This too seems a bit presumptuous. Instead, as many theologians have pointed out, the Genesis accounts appear to contain much deeper truths than a simplistic literal reading will provide. In particular, they set out to explain the relationship of man to God and the purpose of God's Creation. Surely, these are the vital messages God would have intended man to understand, basic truths about the spiritual relationship of man to God. To use these texts as if they were God's laboratory notebook is almost certainly to misunderstand their nature as well as purpose.

Creation 'Science' in Theology?

My point in all this is most emphatically not to ridicule the Creation 'science' cosmology *per se* any more than it is to declare as foolish the many thousands of different and equally untestable cosmologies accepted as absolute Truth by other peoples in other areas of the world. As a religious faith, Creation 'science' is probably as valid as any of the rest of the world's religions (although I have no idea how or if one can compare the relative merits of religious faiths one to another). For this reason I am reasonably convinced that it deserves a place in education in discussions of comparative mythology or religion or if not there at least in a course on the development of religious thought.

But it definitely is also my point here to make clear that what Creation 'scientists' promote as 'science' is a parody of the real thing—and it is this misrepresentation that demands attention by everyone concerned about our capacity to distinguish science and logic from superstition and sophistry. Wherever else Creation 'science' *does* belong, it does *not* belong in Australian science classes.

In summary, I would offer the following response by noted biologist C. Loring Brace to the Creation 'science' movement in the United States:

> *"The creationists have complained that it is unfair for a teacher to present only the scientific evidence for evolution. To do this, they claim, is 'a process of indoctrination, and the school degenerates into a hatchery of parrots'* [Morris 1974, p. 178 in *Scientific Creationism* (public school edition)]. *But the scientific evidence for evolution can be examined, questioned, and tested—as the creationists themselves have been doing for over a century in the effort to discredit it—which is a splendid demonstration of just how science works. Creation, on the other hand, as its own supporters freely grant, is 'inaccessible to the scientific method.' No 'scientific experiment' can be devised to test it since 'the Creator does not create at the whim of a scientist'* [Morris 1974, p. 5, same reference]. *It is creation and not evolution, then, that is 'indoctrination,' and if students are required to spend equal time learning it in the public schools, these institutions would indeed degenerate into a 'hatchery of parrots.'"* (Brace 1983, p. 276 in *Scientists confront creationism.*)□

ROBYN WILLIAMS World Safari

On 27 October 1986 an extraordinary television program was broadcast live around the world to celebrate the 25th anniversary of the World Wildlife Fund. From over 15 locations: in arctic Norway, in the remote Galapagos Islands, on the shores of the Hudson Bay, in central India, in Sichuan Province, at Taiaroa Head on the southern tip of New Zealand's South Island, from Tidbinbilla, we did our stuff. . . we, meaning that I was lucky enough to take part.

The head of the BBC's famed Natural History Unit in Bristol, John Sparks, asked me many months before the event to be involved in *World Safari* and when you're dealing with the man who produced David Attenborough's *Living Planet* series, and much of *Life on Earth*, you know the project will be of the highest professional standard. John is one of those rare broadcasters to come from a solid academic background (he has a PhD in the ethology of birds) and his special interest led to the series on the history of the study of animal behaviour, *The Discovery of Animal Behaviour*, seen on ABC TV a couple of years ago.

That was one reason I agreed to take part (I'm normally reluctant to go anywhere near television as it consumes so much of one's time. Besides I'm too scruffy.) Another was because the Australian end of the production was being handled by our own ABC TV Natural History Unit based in Melbourne. It also has a brilliant record, with producers like John Vandenbeld, Dione Gilmour and David Parer. They are now in the process of filming an ambitious series called *The Nature of Australia* to rival *Life on Earth*. It will go to air in 1988.

The final reason was, of course, the animals, and the scientists who study them. Science is, or should be, *the* most international and co-operative of professions. More than sport with its rivalries, or the arts with its self-absorption, or politics with its deceits, scientists *must* communicate openly with each other or research fails. We have seen many sad examples of its failure, not least the way 500,000 of today's researchers are tied up in military R & D. Other failures of internationalism include Lysenko (Stalin's geneticist), Nazi 'research' (if you dare call it that) and the present ownership of information and technique by powerful corporations.

But when science does go international the thrill, at least for me, is unequalled. There we were, on that October day, with commentators on six continents sharing their concern for the global environment. In 90 minutes we travelled via satellite all over the planet, meeting the likes of Sir Peter Scott in Slimbridge, Jaques Cousteau in Paris, Prince Philip in China, Rajiv Ghandi in India, Stefanie Powers in Alaska, David Suzuki in Canada and Nicolai Drosdov in Moscow. (Nicki Drosdov, who became a fan of 'Skippy' when he visited Australia long ago, is the David Attenborough of the USSR. He has put Skippy and other aspects of our wildlife on TV so that scores of millions of Soviet viewers are now familiar with Australian natural history.)

When we actually went to air it was evening in Europe and breakfast time in Australia. I sat on a wet log holding forth on kangaroo shooting, talking live with David Attenborough in London. I had not done a five minute live-to-air presentation before and having a debut in front of several hundred million viewers in Europe, North America, Africa, China, India, USSR and Australia, had interesting effects on my adrenal system.

Was the exercise worthwhile? That's up to the viewers. I was somewhat disappointed that the contributions of some countries were largely pre-recorded and of the 'fluffy animal' variety. And I was peeved that *World Safari* was largely ignored by the television reviewers and newspapers, with the honourable exception, as always, of *The Age* in Melbourne. The doings of Linda Evans and Joan Collins a million miles away fill columns every day, but hardly a sentence about one of the most difficult and original television experiments in history!

But for me the program was a brilliant success, if only for one reason: internationalism. There we were looking at a small planet whose immense natural variety faces one unified problem—survival. And there on our screens, from members of the royal family to prime ministers and explorers like Thor Heyerdahl and geneticists like David Suzuki, we were saying one thing: without the science we're sunk.

There was an immediate practical outcome too. Vincent Serventy told me that the talks on kangaroo culling he attended soon after in Canberra were inclined to yield to the Queenslanders' desire to increase the kill quota. But when Vincent remarked on the dreadful image we're acquiring around the world as killers of wildlife, apparently, the meeting had second thoughts. We are guardians of this country's plants and animals, not only for ourselves, but for the rest of the planet. □

QUIPS, QUOTES & CURIOS

The *Archaeopteryx* Controversy

There has been much hooha over the last year about the authenticity of the *Archaeopteryx* specimen– until recently the world's oldest known bird, intermediate between reptiles and modern birds. The specimen, found in the Late Jurassic (140–150 million years old) lithographic limestone deposits in Solnhofen (Bavaria) in 1861, was sold in 1862 to the British Museum. All hell broke loose when Sir Fred Hoyle and others claimed through a series of articles in the *British Journal of Photography* (March, April and June 1985) that the specimen was a hoax. Because of the subject's immense popularity and the serious implications of this claim (creationists leapt at this opportunity to discredit evolution), and particularly because the claims came from the renowned British astronomer and science fiction writer, the story received widespread media coverage. But the subsequent evaluations and refutations of the claim were left to the scientifc publications, and so the general public went without knowing the full story.

The controversial *Archaeopteryx* specimen. Photo: John Fields.

Hoyle's Hoax Hypothesis goes something like this: someone painted a layer of cement (consisting of pulverised limestone from the quarry) onto the two surfaces of a split block of limestone from Solnhofen that contained a small dinosaur skeleton. Modern-day feathers were then pressed into the cement overlying the fossil. The forger then offered the amended fossil for sale to the British Museum, at the time when Richard Owen was Director of Natural History. Hoyle even provides the motive. He suggests that Owen, a brilliant anatomist, would have realised the specimen to be a fraud but nevertheless bought it at great cost in the hope that his old adversary, Charles Darwin, would use it as proof of his 'theory of evolution by natural selection', only to be told later that it was a hoax. Darwin's supposed embarrassment was apparently meant to be worth more to Owen than his own inevitable drop in reputation.

Hoyle's Hoax Hypothesis fails on structural and motivational grounds, much of the former provided by Alan Charig of the British Museum (*Science* 1986, vol. 232, p. 622).

First, if a layer of cement had been added to the fossil, the slab and counterslab would not match perfectly. But, in fact, they do– right down to the position of the smallest hair-line cracks and dendrites (intricate branching lines formed by precipitation of manganese dioxide). Second, how was the forger supposed to manufacture and amalgamate the individual ligaments that attach each feather to vertebra, or the other bird-like features of the skeleton, such as an appropriate wishbone, bird-like 'retroverted' pubis and perching foot? And third, was the forger supposed to have tampered with another specimen found in 1877, *and* passed his method of forgery on to his descendants who did it again to other specimens found in the 1950s? Hardly likely.

On the motivational grounds, Hoyle's hypothesis only makes sense if Owen was a creationist. But he wasn't. He believed that God created the world *and* the mechanism of evolution, which eventually shaped it. Although he opposed Darwin's theory of evolution, it was the actual mechanism which was in dispute, not the process in general, as Stephen Gould recently made clear in *Natural History* (1986, vol. 95, p.16).

Darwin believed that selective pressures imposed by environmental change led to structural evolutionary change. Owen believed that laws internal to the nature and structure of organisms, that is the 'laws of form', set the pathways of evolutionary change, and that structures most variable within groups would be the most likely to change through time. He claimed *Archaeopteryx*'s tail to be evidence for his method of

evolution, for the tail—the structure most variable in a vertebrate skeleton and with its supposed greatest potential for change—was the feature that marked the greatest difference between *Archaeopteryx* and modern birds. In fact, it was Owen then, not Darwin, that used the specimen in support of his own theory of evolution —not the actions of a man that knows the specimen to be a fake.

Such misinterpretations could only derive from someone unfamiliar with palaeontology in general and *Archaeopteryx* in particular. In fact, Hoyle misinterpreted *Archaeopteryx*'s long tail flanked with rows of feathers as a single large feather.

It just goes to show that the opinions of a scientist, no matter how well known, on matters outside his or her own field of expertise, may be incorrect and irrelevant. When they also unjustly smear the reputation of a long dead and respected member of that field, they should be treated with the contempt they deserve.

A Teatillating Titbit

Geoff Smith is a Sydney plumber and honorary ranger with the New South Wales Wildlife Service. Aided by his wife Christine and some inventive insight, he is responsible for saving the lives of many native marsupials. From his humble kitchen oven, Geoff produces a number of specialised marsupial teats, which he distributes to zoos, vets and animal shelters world-wide.

A surprisingly simple idea, Geoff first hit on the need for such teats in 1974 when he tried to rear baby kangaroos . and wallabies orphaned by road accidents and shooters. Discovering that baby human and lamb teats were too large, and eye-droppers or syringes inappropriately shaped and sized to administer the more than 100 millilitres of formula required four or five times a day, Geoff decided to make his own teat.

Using a non-toxic, non-tasting, local rubber, Geoff

A selection of Geoff Smith's teats. Photo: Alby Adams.

made up a number of different shaped moulds and experimented with various coagulates to give the teats the correct strength and flexibility. Kangaroos' natural teats are long and narrow (at the later stages of lactation they are about the width of a pencil and seven centimetres long) and go well back into the joey's mouth. He produced a few such teats for his own use, and some of his friends, sharing the same interest in rearing orphaned animals, also asked for some. He then started making four or five per week.

A shorter teat was next developed for wombats and Koalas (application of this teat has been extended to rearing puppies and small joeys and wallabies) and then a finer (that is, more sharply-pointed) teat was designed for possums and flying foxes, which was later found suitable for kittens. Although Geoff usually sticks to making these three basic teat types, he is able to vary the strength and shape of them to match any animal's specific requirements. As word spread and demand grew, production has increased to a steady one thousand per week. At 80 cents a pop, business is thriving.

A number of zoos use Geoff's teats. Melbourne Zoo has used the fine possum teat to successfully hand-rear baby Cottontop Tamarins; and a large, rather phallic-looking teat was 'tailor-made' to rear their Pygmy Hippos. The kangaroo teat is used by the Jackson Zoological Park, Mississippi to rear baby South American Giant Anteaters; and the Los Angeles Zoo in California has extended the application of the short teat to rearing two African primates—the Greater Galago and the Ring-tailed Lemur. □

Application of the short teat was extended to rearing a Ring-tailed Lemur. Photo: Neal Johnston, LA Zoo.

AUSTRALIAN NATURAL HISTORY MAGAZINE

POSTER

Red and Green Kangaroo Paw

Anigozanthos manglesii

The Red and Green Kangaroo Paw (*Anigozanthos manglesii*) is the largest flowered member of a group of 12 species of kangaroo paws, all of which are bird-pollinated and confined in the wild to south-western Australia. The popular appeal of the vivid floral colouration and unique flower shape of *A. manglesii* led to its proclamation as Western Australia's floral emblem in 1960.

The species is named after Captain James Mangles, who collected seeds of the species during a visit to the infant Swan River Colony (Perth) in 1831. The seeds were shipped to England and the species described and illustrated by the Scottish horticulturalist David Don from plants successfully grown in cultivation.

Red and Green Kangaroo Paws range from Shark Bay southwards down through the western heathlands, forests and coastal plain woodlands to the Scott River area on the south coast of Western Australia. The species usually grows in well-drained deep sand, but extends onto limestone soils near the coast, and loams and lateritic gravels in forest regions. It is commonly seen on road and railway verges or in recently burnt vegetation as it favours open communities where sunlight can reach the soil surface. Mild heat pretreatment usually increases germination, suggesting that the species is a post-fire opportunist.

Red and Green Kangaroo Paws produce 1–50+ upright flowering stems as tall as 1.2 metres. The stems emerge from flattened fans of erect fleshy grey-green leaves 10–40 centimetres long and up to 15 millimetres wide. Northern populations (subsp. *quadrans*) have once or twice branched stems and an orange-red colour at the base of the flowers, whereas populations south of Badgingarra (subsp. *manglesii*) are single-stemmed and coloured rich red as in the plant illustrated here.

Photo: R. Morrison, Weldon Trannies.

The Red and Green Kangaroo Paw is recognised internationally for its horticultural potential and is used in the Australian export and local cut flower industry. Hundreds of thousands of the stems are harvested in the wild and from wildflower farms in Western Australia, most of which are destined for European flower markets. The plants remain an important component of natural ecosystems in Western Australia. Their conservation in reserves such as Kings Park or Kalbarri National Park is all the more important because of their wide popular appeal among an increasingly international community.

—Dr Stephen D. Hopper

Australian WILD FOODS

Text and Photos by Tim Low

Common Apple-berry (*Billardiera scandens*) is one of the best-known of the wild foods of south-eastern Australia. This is variety *sericata*, with furry leaves and fruits.

When is a Berry?

It's easy to find wild foods in the Australian bush but usually difficult to muster up a good feed. This is because most of our wild foods are tiny fruits or berries, often no bigger than peas. Most of these fruits have tiny seeds dispersed by birds, and the meagre layer of pulp is just sufficient to attract a silver-eye, fairy wren or honeyeater.

Australians are inclined to label all small fruits as 'berries' which is a misnomer, for 'berry' has a precise botanical meaning unrelated to size. Strictly speaking, it refers to certain succulent fruits containing more than one seed. Thus tomatoes qualify as berries, whereas most small forest fruits, containing only one seed or stone, do not.

The Common Apple-berry (*Billardiera scandens*) is a true berry. Its sausage-shaped greenish fruits, only 1.5 to 2.5 centimetres long, contain several tiny seeds. Apple-berries ripen year-round, turning translucent and dropping to the ground. Aborigines appreciated their sweet floury flavour, resembling over-ripe Granny Smith apples.

Common Apple-berries were also eaten by Australia's

Sweet Apple-berry (*Billardiera sericophora*) is distinguished from Common Apple-berry by its smaller flowers and clustered berries, which are a delicacy, although filled with gritty seeds.

Pearly Devil's Twine (*Cassytha filiformis*) is unmistakeable, with its pearl-like fruits and tangled stems. The fruits taste sweet and juicy. This plant was twining among grass on a beach on Bribie Island in southern Queensland.

first white settlers and earned a mention in what was probably the first published book on Australian Plants. *A Specimen of the Botany of New Holland* by James E. Smith (1793) introduced the apple-berry thus: "In compliance however with those who do not look so deep into natural knowledge, we here introduce to their acquaintance almost the only wild eatable fruit of the country we are about to illustrate." Smith's elegant description included the advice that the berry was "said to have a very fine flavour, not unlike a roasted apple". This was strong praise, for Smith concluded with the rejoinder that "Amid all the beauty and variety which the vegetable productions of New Holland display in such profusion, there has not yet been discovered a proportionable degree of usefulness to mankind, at least with respect to food".

Common Apple-berry grows as a small shrubby creeper, usually one or two metres high. It has greenish or pale yellow flowers, borne singly, and slender leaves with wavy or straight margins. Its habitat includes shady eucalypt forests, rainforest margins and heaths, from Tasmania to southern Queensland.

Genus *Billardiera* commemorates the great French naturalist Labillardiere, who botanised in Tasmania in 1792–93. It includes 14 species and, in addition to *B. scandens*, a couple of others also have succulent berries once eaten by Aborigines.

Sweet Apple-berry (*B. sericophora*, previously called *B. cymosa*) grows only in heaths, mallee scrubs and on coastal dunes in western Victoria and eastern South Australia. Also a creeper, it has bluish, greenish or cream flowers, straight-edged leaves, and flowers and berries borne in clusters. The tiny berries are unusual in having a pronounced aniseed flavour. Indeed, *B. sericophora* could be renamed 'Sarsaparilla Berry'.

The fruit of the Pearly Devil's Twine (*Cassytha filiformis*), although 'berry'-like, is no berry. The pearl-like fruits contain only a single stone. The fruit is borne upon a twining leafless vine that looks like tangled string. This has earned it some eerie colloquial names such as 'Devil's Guts' and 'Blackfellow's Twine'.

The devil's twines (*Cassytha* spp.) are plant parasites. They need no leaves or roots, but penetrate the tissues of nearby plants, stealing away moisture and nutrients, although they also produce chlorophyll and can photosynthesise. Australia has 14 species, all found in sandy infertile places, especially on heathlands and coastal dunes. The fruits of most, if not all, are edible, although few are very tasty. They are variously four to 15 millimetres long; rounded, oval or ridged; any colour except blue; and often with a resinous sticky taste. In lists of wild foods they are often listed as 'berries'.

Apple-berries and devil's twines are the main vines with edible fruits in the open forests of south-eastern Australia, although the Pearly Devil's Twine, illustrated here, is a tropical species. It ranges from northern New South Wales to the coasts of Western Australia, and flourishes on dunes behind beaches, its seeds carried across by birds. The white berries, whoops! fruits, are really quite tasty.

Happy eating!

A Fasu man in ceremonial dress. The Fasu are located in the Southern Highlands Province of Papua New Guinea and were traditionally cannibals. Photo: J. Weiner.

CANNIBALISM: why not?

by James F. Weiner

What are humans that we should find them so tasty? Our fascination with cannibalism does not seem to be so much a historical development—that is, the result of contact with 'savage cannibals' during the European Age of Exploration—as much as it is both a possibility and an alternative written into the core logic of human culture itself. Much more so than incest, torture, sexual perversion or genocide, cannibalism is—*for Westerners*—the most basic dehumanising act. And yet cannibalism was, by certain non-Western peoples' own admissions, practised far more widely than any of the other above-mentioned abominations. Because it apparently contravenes the most basic and minimal requirements we set for human decency, it seems that some Western anthropologists require the most inordinate proof of the existence of cannibalism. They demand a verification that they would not ordinarily insist upon regarding, for example, torture of captives or head-hunting. Yet there is no reason not to consider such acts to be as blatantly dehumanising as cannibalism.

By claiming, as William Arens has done in his book *The Man-eating Myth* (1976), that there is not one instance of cannibalism that has actually been observed by a Westerner, he pre-empts a consideration of what a belief in cannibalism tells us about a people's view of the world. Denying that cannibalism actually took place is also to dismiss a consideration of the way ideas pertaining to the practice of cannibalism articulate with other theories such as food-sharing, kinship and consumption.

A 'parable' might help here. In a lecture I recently gave concerning the practice of sorcery among the Foi people of interior New Guinea, I described the complicated procedure of sorcery medicine manufacture, which certain Foi men related to me while I was living with them. From my two-and-a-half years of field work there, I summarised the results of numerous disputes and conflicts arising over sorcery accusations that I had witnessed, not to mention all of the earlier cases recorded by patrol officers. I explained how the fear of sorcery was an abiding concern of Foi people and suggested a possible pattern to sorcery accusations (most commonly, men who were indulging in adultery feared being ensorcelled by their lovers' husbands). Finally, I demonstrated how the manipulation and manufacture of sorcery substance (a powder) represented a symbolic

inversion of Foi procreation theory, and that Foi men perceived an analogy between sorcery substance and women's menstrual blood, which they believe is extremely harmful to adult men. And yet, when one student asked me "Did you ever see sorcery substance?" and "Did any of those men actually admit to owning or making sorcery substance?", my answer had to be "No". No one will openly admit to practising sorcery because, until recently, accused sorcerers were often killed in revenge. Despite the central role of sorcery beliefs in Foi culture, the 'proof' of its practice remained as indeterminate as the Foi's own admitted cannibalism of former times. Yet to therefore deny that the Foi actually did manufacture sorcery substance would add little to our understanding of its meaning for the Foi themselves.

As anthropologists such as Gillison, Sahlins and Lindenbaum have eloquently described in a recent anthropological work entitled *The Ethnography of Cannibalism* (Brown and Tuzin 1983), cannibalism is a common theme, both in myth and practice, in those societies in which the meat of animals mediates social relationships between people. In such societies, there are intimate and profound associations between the sharing of food, the recognition of ties of shared bodily substance that comprise their domain of kinship, and the embodiment of such values in the domestic and wild animals—pigs, marsupials and so forth—that mediate such kinship relationships. Characteristically, the flesh of such animals is given as bridewealth payments, tributes to chiefs and in ritual exchanges of foodstuffs between men and women. Cannibalism, as I have argued elsewhere (Weiner 1986), is the mirror image of a social system that is based on the *consumption* of animal flesh and its *exchange* for people; cannibalism is the *consumption* of people and hence, more importantly, the *denial* of exchange.

The Daribi people of New Guinea, who are closely related to the Foi both linguistically and culturally, had specific rules concerning the practice of cannibalism. As Wagner in his book *The Curse of Souw* (1967) explains:

"Only adults and aged persons are eaten, and may eat the dead. Members of the nuclear family do not ordinarily eat one another, for the relationship is too close. . . With the exception of [cross-cousins], *only members of one's own clan may be eaten."* (p. 146)

If this was fantasy, or a conspiracy on the part of the Daribi, it is an oddly consistent fantasy, one that is congruent with Daribi rules concerning incest, family composition and clan definition. Even if the Daribi did not eat their dead relatives—and why should they admit to doing so if such an act is so repugnant?—their formulation of its significance is too homologous with other parts of their social ideology for us to dismiss it as unmotivated fabrication.

"What are humans that we should find them so tasty?"

Arens suggests that the willingness of many anthropologists to accept stories about cannibalism at their face value is a function of their obsession with the bizarre and the exotic. I fail to understand why anthropologists should be criticised for pursuing facts about 'bizarre and exotic' practices. Anthropology, as much as psychology, is concerned with the entire spectrum of humanity's social and mental creativity. From the point of view of any ethical system, there are always two points somewhere on that spectrum that represent respectively the saintly and the hideous forms of such creativity. Arens has, of course, invested his own ethical point of view in the argument, for example, in disdaining to hide his own revulsion at the practices—some true, some fanciful—that the anthropologist Ronald Berndt (1962) reported for the Fore people of the Eastern Highlands of New Guinea. Despite his plea for 'objectivity' and a dispassionate assessment of real facts, Arens is unwilling to believe that such people as the Fore were "so far removed from what we and the rest of the world accept as conforming to common standards" (1976, p. 100). What he means is common standards of *decency*, as defined by Western culture, as if decency was an innate characteristic of humanity.

If there is indeed such a thing as 'world-wide common standards' then one can only conclude, from a consideration of the evidence from Chile, Kampuchea, Uganda and South Africa (to name just a few societies), that such standards are 'more honoured in the breach than in the observance'. It is precisely the assumption that there are no 'common standards' among human societies that defines anthropology as the investigation of cultural differences. One perhaps can also invoke the Mannichaean perspective that the more stringent and restricted is one's definition of 'common decency', the more diabolical will be its breaches. And, of course, the more we are obsessed with cannibalism (and witchcraft, and sorcery, and human sacrifice, and so forth) as *isolated phenomena*, the more opaque will the totality of tribal society remain, and the more firmly will academics such as Arens uphold the stereotype of 'savage society', however passionately they seek to do otherwise. □

Suggested Reading

Arens, W., 1976. *The Man-eating Myth*. Oxford University Press: New York.

Berndt, R.M., 1962. *Excess and Restraint*. University of Chicago Press: Chicago.

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Wagner, R., 1967. *The Curse of Souw*. University of Chicago Press: Chicago.

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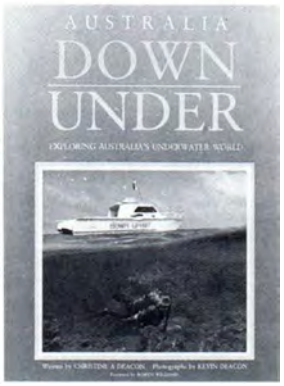
BOOK REVIEWS Fathoms to Fossils



Australia Down Under: Exploring Australia's Underwater World

Christine A. Deacon. Photos by Kevin Deacon. Doubleday, Sydney, 1986, 272 pp. $35.00.

At first glance the high quality colour photographs of divers and coral could mislead one into believing that *Australia Down Under* is just another diving book. After a second look, you might notice that one diver is painting under water and another is preparing to enter what looks like a bore-hole in the middle of the desert, and you might begin to think that this book could be more interesting. It is.

The text represents years of research by the author, Christine Deacon, and this is evidenced by the range of topics covered. The first chapter, "Exploring Underwater", looks at the varied reasons why people go to the expense and effort involved with entering a foreign environment. Christine explains what training and equipment is needed, and what rewards can be expected whether you want to dive for recreation or profit.

In the chapters "Diving Coral Seas" and "Southern Sojourn" the reader is taken to all the popular diving spots around Australia. However, this is more than just a travelogue as the descriptions are given by divers who are so familiar with the territory that they have pet fish and favourite ledges in areas that most people only dream of visiting. As you meet Humpy the Blue Groper and have sea snakes looking at their reflection in your face mask, the marine environment takes on a life and character that few people have witnessed.

"Caves and Caverns" is not a chapter for the claustrophobic and tells of places only the most experienced divers get to see. Reading of divers' exploits in underground caverns, which are three kilometres from the cave entrance and fresh air, is more exciting than an adventure novel.

The extraordinary range of wildlife that can be encountered under water is covered in "Bizarre and Beautiful". With stories of friendly cuttlefish, playful moray eels and sharks that can detect the human heartbeat, these are not dry zoological descriptions.

"Shipwrecks and Skeletons" is a chapter which gives the reader an insight into wrecks, not only as interesting diving territory but as monuments to the exploration and exploitation of the South Pacific. As the author traces the history of each wreck, many surprising aspects of Australia's past are revealed.

The final chapter, "Conserving the Last Frontier", could stand as a practical approach to conservation of all types of environments. The author discusses how well existing and proposed marine reserves cater for commercial and recreational needs while still allowing for conservation of resources. The marine environment is not regarded as an isolated system and it is pointed out that marine reserves cannot be managed effectively if terrestrial and estuarine systems are ignored.

As Robyn Williams points out in the foreword, so little money is spent on marine research in Australia that much of the knowledge of our vast coastal wilderness comes from amateur diving enthusiasts. The information in *Australia Down Under* is far from amateurish but contains an element of empathy with the marine environment that few scientists achieve.

Australia Down Under contains so much information that much of it is, of necessity, abbreviated. I would have liked to have seen a list of further reading so that items of interest could be followed up. The reader can get lost in the maze of information as there are no minor headings within the chapters.

Confusion is added by the fact that two Christine Deacons (the photographer, Kevin Deacon's, first and second wives) feature in the book. With quotes from Kevin and the two Christines, and a tendency for Christine, the author, to mix tenses in some passages, the reader can get as lost as a cave diver with a faulty light.

However, the quality of the photographs and the information in the text will hold the interest of the most avid diver, the armchair naturalist, or even those who baulk at paddling on Bondi Beach in midsummer. As long as you are interested in adventure or intelligent conservation issues, this book is a must for your library.

—Lucy Hodgson

Uncovering Australia's Dreamtime

Michael Archer, Suzanne Hand and Henk Godthelp. Surrey Beatty & Sons, Sydney, 1986, 32pp. $7.50.

This cheerful, informative booklet is possibly unique among Australian publications. It has been written with two purposes in mind: to enable every Australian to share in the thrill and exhilaration of the remarkable discoveries already made at Riversleigh, and to give them a chance to contribute towards further research in the area since sales of the publication are to fund this, one of the world's most exciting fossil deposits. Mike, Sue and Henk are to be congratulated on both counts. The fossil deposits of Riversleigh hold the secret not only to life on our continent 15 million years ago, but to the paths of evolution of Australia's entire mammal fauna. Their imagination and initiative in raising funds for the project by appealing to the public is to be commended.

The highly attractive booklet, a progress report on the Riversleigh project, is

logically arranged. To set the scene, the extraordinary Australian discoveries are explained, the position of the drifting southern continents put in perspective, and life on land during the Miocene graphically illustrated and described. The enthusiastic young authors explain the process of releasing the fossils from their 'stone encasements', emphasising the constant stream of excitement experienced during the search, discovery, collection, preparation and study of the fossils.

"Adding to the Prehistoric Menagerie" heads the next chapter in which we learn more details of the more-than-a-hundred new species already recovered from Riversleigh, more than doubling the total number of fossil land mammals known for the whole of the Australian continent prior to 1983, the date of the first significant Riversleigh finds.

What of the future of this palaeontological El Dorado? We are made acutely aware of the urgency of 'getting on with the job'; natural erosion of the sites will be a problem if the project is delayed and overseas palaeontologists are waiting in the wings... Australian fossils should remain in Australia. We are alerted to the ways we can assist this important research.

The key events in the history of discovery of the Riversleigh fossils are summarised together with some personal asides that help the reader share something of the awe, privilege and elation that accompanies the uncovering of a window on the past. There follows a generous double-page of acknowledgements; it is impossible to mount a program for large-scale recovery of such treasures without a legion of helpers and a mountain of material assistance; our 'gang-of-three' is obviously thankful for all help that has so far been forthcoming.

Riversleigh is Australia's first truly integrated national palaeontological project—over 27 Australian scientists have already been involved and by the time all the scientific papers have been written up, there will be many more. It is pleasing to see that, after the references, an easy-to-comprehend glossary of terms is included together with an ecological time-scale and a record of life in Australia.

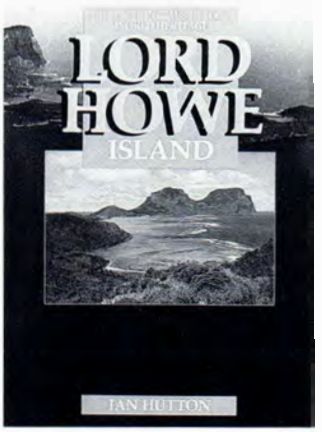
In short, it is a booklet that will not be out of place in any home, in any library or on any laboratory bench. It will be especially welcomed by school teachers, both primary and secondary, as it is truly an inspiration to any young scientist. The price will not worry anyone as purchasers will have the satisfaction of knowing that they have contributed to a first class, truly Australian research project.

—Ruth Mawson and Malcolm Stewart

Discovering Australia's World Heritage: Lord Howe Island

Ian Hutton. Conservation Press, Canberra, 1986, 157 pp. $24.95.

One can easily forget that tiny Lord Howe Island, 700 kilometres north-east of Sydney, is part of Australia. Yet this isolated volcanic island, only 11 kilometres long and less than three kilometres wide, is a treasure trove of natural wonders. In



its dark forests lurk 57 unique species of plant, including four different tree ferns, three palms and a pandanus. Also endemic to the island are many spiders and insects, and five birds, including the famous Lord Howe Island Woodhen (*Tricholimnas sylvestris*), recently snatched from extinction by a captive breeding program.

Lord Howe is becoming popular as a naturalist's destination, especially following its 1981 World Heritage listing. Seventy per cent of the island is Permanent Park Preserve, much of it dissected by walking trails.

In his splendid field guide, Hutton describes and illustrates all of Lord Howe's birds, reptiles (there are only two), trees, shrubs and climbers. As well, he discusses briefly the fish, invertebrates, history, geology, and the prospects for bush-walking, snorkelling and beachcombing.

Hutton has done a good job. His text explains exactly where to find the endemic Pumpkin Tree (*Negria rhabdothamnoides*), its affinities with other plants and its season of flowering. Several of the spectacular plants and birds are illustrated by colour photos, although the fine drawings and plant keys are entirely adequate for identification.

(Hutton does not deal with the island's numerous herbs and grasses, but the serious naturalist interested in these may consult the Sydney Botanic Gardens journal *Cunninghamia* [vol. 1, no. 2, 1983], which lists every plant species on the island and describes in detail the vegetation and climate.)

Hutton's book has one major defect—an altogether inadequate index, which omits most of the plant and animal names cited in the text. He might have devoted more coverage to the island's recently exterminated birds, which are listed but not described or illustrated. Also, the plant captions on page 32 are back to front.

Lord Howe has certainly witnessed its share of extinctions. As Hutton explains, since Lieutenant Ball claimed the island as a British possession in 1788, nine of the 14 endemic birds, a wingless stick insect and a land snail have become extinct—all as a consequence of human activity. Other extinctions occurred somewhat further in the past: the bizarre Horned Turtle (*Meiolania platyceps*), with horny head and clubbed tail, is known from fossils only, and the many large succulent fruits on the island suggest the existence, until recently, of either fruit bats or large fruit-eating birds.

—Tim Low

All these books are available from the Australian Museum Shop located in the Museum at 6-8 College St, Sydney. Phone: (02) 339-8350.

LETTERS Gorilla Warfare?

Wartime Carrots

In David and Pamela Maitland's article on eyes (page 513, ANH 1986, vol. 21 no. 12) they mention that during World War II British night-fighter pilots were provided with carotene- and Vitamin A-rich foods (carrots) to prevent night-blindness. They write that Vitamin A is essential for production of rhodopsin pigment, which in turn is essential for sensitivity of the rods in the eye, the rods being important for night vision. Their explanation may well be correct, but another version of the story goes like this: During the war and unbeknownst to the Germans, the British had developed radar—enemy ships and planes were being knocked out with uncanny accuracy. To keep the Germans off the track of the radar secret, the British spread the story that they were eating lots of carrots which miraculously improved eyesight. Whether the Germans believed it or not is unknown. Equally unknown is how much truth there is to this tale.

—Hector Davies
Melbourne, Vic.

Gorgeous George!

The article *Confessions of a Taxidermist* by Lisa Whaite (ANH vol. 22 no. 2, 1986) mentions the preparation of a Gorilla specimen. The photograph showing the animal being dissected by a headless taxidermist (most likely me, judging by the artistic posture of the rubber-gloved hands) was taken about nine years ago. You may be interested to learn what happened to the specimen after this photograph was taken.

As the skin was removed, the body was carefully sketched and measured, and the bones removed and meticulously cleaned. The skin was placed in a vat of preserving solution. Since we had no particular use for a Gorilla in our exhibitions at the time, the skin remained in liquid storage until August 1986.

During that year we started the production of a new gallery, dealing with human evolution. Finally, we had a spot for George, our Gorilla. Alison Titchen, the Museum's sculptor–preparator, modelled a one to ten scale sculpture of the animal. Using this model and the measurements and sketches prepared nine years ago, we carved a life-sized sculpture out of rigid polyurethane foam. The sculpture must be an exact replica of the living animal, since the skin has to fit it perfectly. Shaved paper-thin and tanned with the greatest of care, the skin was fitted to the foam body. Hands, feet and face were handled separately. These were also skinned, mounted on modelled plastic forms and freeze dried. Freeze drying preserves fine detail without shrinkage.

George became quite famous. He was flown free of charge to Launceston to take part in the South Pacific Preparators Conference, and featured in the *Sydney Morning Herald*, *Launceston Examiner*, and several radio interviews that were conducted.

George is back in Sydney now and temporarily residing in the Museum's boardroom. Although I'm sure he finds life interesting there, I know that he eagerly awaits the time when he can step into the limelight again. This time will come in 1988, when the Human Evolution Gallery opens its doors to the public.

—George Hangay
Australian Museum

George the Gorilla with his chief preparator Peter Keszei. Photo: Kate Lowe.

THE BLUE CONNECTION: Butterflies, Ants and Mangroves

By Peter Samson

Butterflies belong to a number of different families, six of which occur in Australia. The largest of these is the 'blues' family (Lycaenidae), containing about 140 species or more than one third of the total Australian butterfly fauna.

The blues are mostly small, unobtrusive butterflies, usually blue or violet on the upperside of the wings, although other colours, particularly orange, do occur. The colour can be brilliant and many of the species are quite beautiful.

The life cycle of some blues is unique among butterflies. In many species the immature stages, particularly the caterpillars or larvae, spend part or all of their lives in association with ants. Ants attend the larvae in ones and twos or in large numbers, depending on the type of lycaenid. A cross-section of the different relationships between blues

A freshly-emerged female of Illidge's Ant-blue. The fluffy scales on its head, legs and body may act as a physical hindrance to any ants that attack it during its emergence from the pupa inside an ant nest. Photo: P. Samson.

and ants can be seen in the butterflies that frequent one particular habitat—a mangrove community at Moreton Bay in south-eastern Queensland. Four blues live and breed in this community.

The Blues of Moreton Bay

The Saltpan Blue (*Theclinesthes sulpitius*) is a small, drab butterfly. The upperside of its wings is dull brown and the hindwing has a short tail. Hindwing tails occur in many lycaenids and may have a protective function, distracting would-be predators from the butterfly's head and body. The Saltpan Blues fly close to the ground near the larval food plant, which may be one of several different species of saltbush. Larvae may be attended by ants of various species but some are also found without ants in attendance. The relationship apparently depends on the chance occurrence of ants on the plants on which the larvae are feeding.

Two blues in the genus *Hypochrysops* are also found at Moreton Bay. The Copper Jewel (*H. apelles*) is a rich orange on the upperside of the wings with brilliant jewel-like markings on the underside. The Dull Jewel (*H. epicuris*) is a dull blue on the upperside and is less brilliantly marked beneath than the Copper Jewel. Both butterflies are strong fliers but spend much of the time resting on mangrove leaves where they are surprisingly inconspicuous, despite the bright markings on the underside. Their larvae feed on mangrove leaves, but on different mangrove species. The Copper Jewel feeds on both the Red Mangrove (*Rhizophora stylosa*) and the Spurred Mangrove (*Ceriops tagal*), whereas the Dull Jewel feeds only on the Grey Mangrove (*Avicennia marina*). The larvae and pupae are always attended by large numbers of ants. Each butterfly has its own characteristic ant in attendance: the Copper Jewel is attended by a species of *Crematogaster*, easily recognised by their pointed abdomens, while the Dull Jewel is attended by a small species of *Iridomyrmex*. The ants form colonies in hollow branches and a mangrove plant may house colonies of either species of ant, but not both. The adult butterflies are probably able to sense the presence of the correct ant on their food plant before they lay eggs, in this way maintaining the usual association of butterfly, ant and mangrove.

Two Saltpan Blues. Photo: P. Samson.

The fourth lycaenid at Moreton Bay is Illidge's Ant-blue (*Acrodipsas illidgei*), named after a collector of Brisbane butterflies early this century, Roland Illidge. The butterflies are small; males are brown and females blue on the upperside of the wings. They are not abundant and are usually seen flying weakly among the mangroves or resting on them. Eggs are laid on the surface of hollow mangrove branches and larvae are found within these branches in nests of *Crematogaster* ants, the same ants that attend the Copper Jewel.

Ant-eating Habits of Illidge's Ant-blue

The larval feeding habits of Illidge's Ant-blue, and the six other related species in the genus, have been a mystery. Larvae have sometimes been found in ant nests a considerable distance from any likely food plants and they have proved difficult to rear in captivity. It has been assumed that they are myrmecophagous, that is they feed on the ants themselves. Such feeding would be unusual but not unique, for other blues are known to be myrmecophagous, including one tropical Australian species, the Moth Butterfly (*Liphyra brassolis*). However, as I explain in the following story, myrmecophagy by Illidge's Ant-blue is

The Copper Jewel. Photo: Jim Frazier.

no longer mere assumption.

Having obtained eggs from a captive female of Illidge's Ant-blue, I was able to observe the behaviour of larvae as they hatched. The newly emerged larvae were quite inactive, in contrast to those of other lycaenids which immediately search for food. So how do they make their way into an ant nest? A possible answer was found when one of the tiny larvae was placed on the surface of a mangrove branch containing a colony of *Crematogaster* ants. The ants appeared excited upon discovering the larva, touching and stroking it with their antennae. An ant then picked up the larva in its mandibles and carried it into the branch. This experiment was repeated several times with the same result. One larva raised its abdomen high off the branch when approached by an ant, as if to encourage this carrying behaviour. Unfortunately I could not determine the food of these small larvae, although one that had clearly fed and grown since hatching was later found inside the branch. I subsequently collected a large larva from a Grey Mangrove at Moreton Bay, and reared it to maturity in a length of glass tubing with a supply of ants and their brood. In this way I observed the caterpillar eating ant pupae, proof of myrmecophagy by this butterfly.

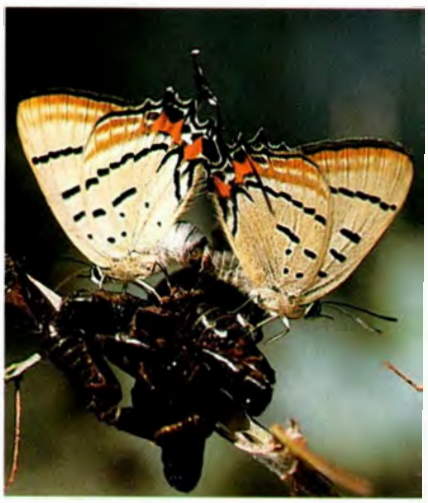
Based on these observations I believe that, in nature, the ants pick up the newly emerged larvae and carry them to the nest. Once there the caterpillars are parasitic on the ant colony. The large caterpillars feed on the ant brood, probably large larvae and pupae. The small caterpillars may similarly eat ant eggs and small larvae, but it is also possible that the ants feed them in the same way they feed their own offspring, and that the caterpillars only become carnivorous later in their development.

We see that the larvae of all four blues occurring at Moreton Bay live in ant associations. In the case of the Saltpan Blue, the association is non-specific and facultative, that is, it is not

This unique sequence of photographs may explain how small larvae of Illidge's Ant-blue find their way into the nest of their host ant, *Crematogaster* sp. A larva, having just hatched from its egg (A). An ant finds the larva and palpates it with its antennae, whereupon the larva raises its abdomen almost vertically in the air (B). The ant seizes the larva and carries it away, presumably to the ant nest (C). Photos: P. Samson.

Illidge's Ant-blue eating an ant pupa. Only the head is left and soon this will also be eaten. Photo: P. Samson.

This larva of Genoveva Azure (*Ogyris genoveva*), one of Australia's largest and most beautiful blues, although as yet not found at Moreton Bay, shows clearly two of the ant-attracting organs common to most blues. The black spots along each side of the larva are spiracles, the openings of the breathing tubes. Just behind and to each side of the last pair of spiracles are the tentacular organs, one of which is everted. Midway between these is Newcomer's organ, with a droplet of exudate glistening in its opening. The attendant ant is a sugar ant (*Camponotus consobrinus*). Photo: P. Samson.



A pair of Imperial Blues mating. A male waits around the pupae until a female emerges and then mates with her immediately. Photo: Densey Clyne.

essential for survival. The jewels live in associations that are specific and probably obligatory. Illidge's Ant-blue lives in a specific obligate association in which the attendant ants have become the food, and without them the larvae could not survive. Among Australian blues, about 40 per cent of species live in more or less specific associations with ants; the remainder have non-specific associations or are never attended by ants at all.

What's the Attraction?

Larvae of blues attract ants using the secretions produced by special organs, not found in other caterpillars. Much of our knowledge of the nature and function of these organs and their secretions has come from the research of Roger Kitching, Naomi Pierce and associates, previously based at Griffith University in Brisbane. Each larva when mature usually has three different types of ant-attracting organ. On its back towards the rear is a transverse slit called the 'honey gland', or 'Newcomer's organ' after its discoverer. This produces droplets of a solution of sugars and amino acids, which are imbibed by the ants. Behind and to each side of Newcomer's organ are a pair of retractile 'tentacular organs'. One or both of these are intermittently everted for a few seconds when the larva is active or disturbed. Unlike Newcomer's organ, the tentacular organs do not produce an exudate. They may release a volatile secretion that mimics one of the pheromones that the ants normally use for communication, perhaps the alarm pheromone which functions to both attract other ants and alert them to danger. The third type of organ

consists of many tiny epidermal glands called 'pore cupolas'. The pore cupolas of one Australian blue, the Imperial Blue (*Jalmenus evagorus*), have been found to secrete amino acids, a highly attractive food source for the ants. In addition, in certain species such as Illidge's Ant-blue the pore cupolas may secrete a substance that mimics the ants' brood pheromone, causing the ants to transport and tend the larva as if it were one of their offspring.

Why have some blues evolved these special organs? What benefit is there in ant-attendance that must outweigh the cost of producing the secretions that maintain the association? One hypothesis is that the ants protect the blues against attack by predators and parasites. The immature stages of butterflies live a hazardous existence. They may be eaten by spiders, assassin bugs and paper wasps, or parasitised by ichneumon wasps and tachinid flies whose own larvae feed and grow inside their host. Attending ants might protect blues against these natural enemies. In a study of the Imperial Blue butterfly, mortality caused by other insects was higher if attending ants were removed, supporting this hypothesis. However, some species, even though they may be constantly attended by ants, have still been heavily parasitised. An alternative hypothesis has therefore been proposed, which acknowledges the fact that ants are themselves important predators of many insects—by producing secretions that attract or appease ants, lycaenids may prevent these same ants from eating them. The two hypotheses are not mutually exclusive, however, and lycaenids may gain multiple benefits from their ant associations.

Managing Mangroves

The four butterflies from Moreton Bay are only some of the blues that breed in mangrove communities in Australia. In southern Queensland, the River Mangrove (*Aegiceras corniculatum*) is one of the food plants of the White Lineblue (*Nacaduba kurava*), although this butterfly rarely occurs at Moreton Bay. Several additional species are found in central and northern Queensland feeding on the mangroves themselves, on mistletoes parasitic on the mangroves, or on epiphytes such as orchids and the unusual 'ant plants' (*Myrmecodia* spp.).

Mangrove communities in southern Queensland are in danger from land development and reclamation. Two of the butterflies discussed, the Saltpan Blue and the Copper Jewel, have wide distribution ranges and the Copper Jewel is also found outside mangrove habitats in northern Queensland. The Dull Jewel is more restricted, being found only in mangroves in southern Queensland and northern New South Wales. However, Illidge's Ant-blue has only been found in a few localities between Hay's Inlet and Burleigh on Queensland's Gold Coast.

Such an unusual butterfly deserves protection—not directly, however, for this would only discourage amateur collectors or induce them to break the law, place an inflated monetary value on specimens and discourage scientific observations (such as those reported here). Rather, the few known *habitats* of Illidge's Ant-blue should be preserved.□

RARE & ENDANGERED Eastern Australian Und

Since their discovery in the 1920s, the underground orchids of Australia have evoked a great deal of interest from the scientific world and the general public. The idea that a plant, much less an orchid, could flower under ground seemed implausible. At the announcement of its discovery it must have seemed like one of those tall tales of strange creatures from the Antipodes that abounded soon after Australia was colonised.

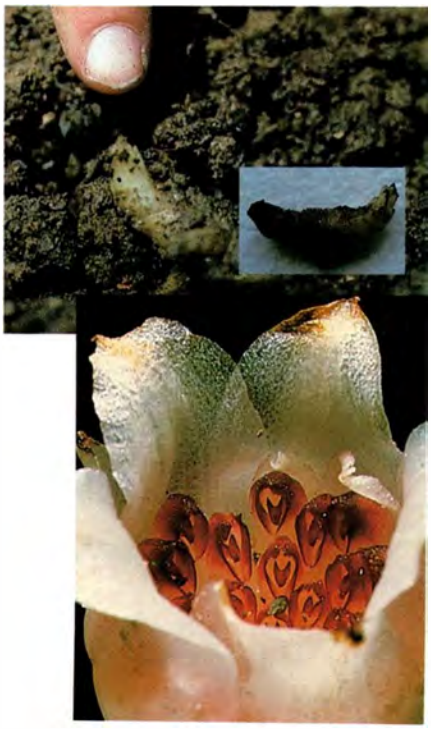
The Western Australian Underground Orchid (*Rhizanthella gardneri*) is cream to flesh pink in colour. It was described in 1928 after its discovery by a farmer who noticed it among the roots of a Broom Honeymyrtle (*Melaleuca uncinata*) that had been turned over during recent ploughing. The flowers are pollinated by small insects (flies, termites, beetles) that are probably attracted by the flowers' smell, which is similar to decomposing fungi.

Remarkably, less than four years after the discovery of *R. gardneri*, a second species was unearthed, this time on the opposite side of the continent near Buladelah in New South Wales. The Eastern Australian Underground Orchid was discovered by an amateur naturalist while digging up another orchid, but one which flowers above ground, namely *Dipodium punctatum*. It was initially described as belonging to a new genus and species *Cryptanthemis slateri* but subsequent research has shown that the two species have similar morphological features and hence are now placed in the one genus—*Rhizanthella*.

The unusual habit of these orchids makes locating them extremely difficult and, until recently, both taxa were seen only on a few occasions. Following extensive field studies in Western Australia, around 150 plants of *R. gardneri* have now been located in a number of separate sites. The key to location of this orchid was its known association with *Melaleuca uncinata*.

In contrast, *R. slateri* has been seen on only a few occasions: a year later at the original site; in 1957 near Dave's Creek in the Lamington Plateau National Park, south-eastern Queensland; and in 1974 during the excavation of a home garage at Wentworth Falls in the Blue Mountains, New South Wales.

Original location site of the Eastern Australian Underground Orchid. Photo: M. Clements

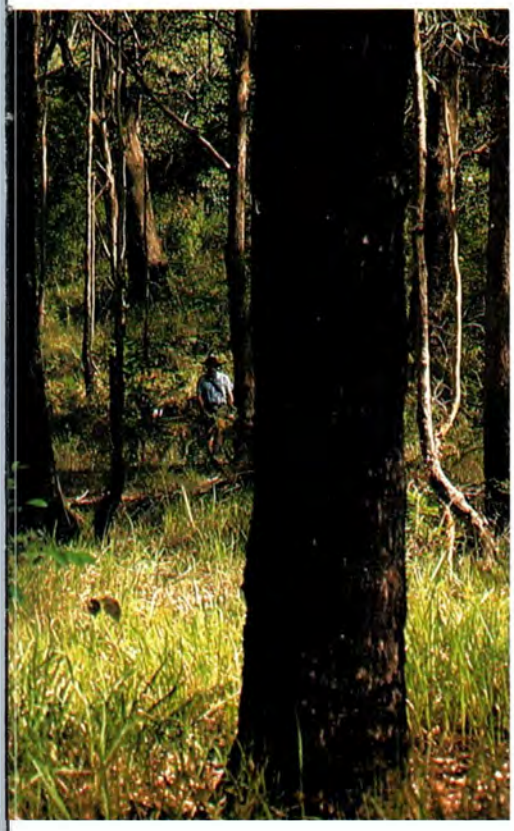


Unlike the western species, which has now been studied extensively in the field and in the laboratory, little is known about the biology of *R. slateri*. There was no known associated host species, as is the case with *R. gardneri* and the bottlebrush *Melaleuca uncinata*, nor was there an apparent

The Eastern Australian Underground Orchid after its rediscovery in 1985. Inset: The same plant with soil removed. Note the early stage of flower development on right-hand side. Photo: M. Clements.

The flower of the Western Australian Underground Orchid. Photo: Andrew Brown.

erground Orchid



habitat preference for the species. It was thought that if it were to be discovered again it would be by accident rather than by deliberate searching. As it turned out this was not the case.

Research carried out on the mycorrhizal (root) fungus isolated from *R. gardneri* showed that it formed an ectomycorrhizal association (that is, on the surface of the root, rather than inside) with *Eucalyptus* species as well as *Melaleuca uncinata*. The orchid gains nutrients from the fungus, which in turn has a mutually beneficial symbiotic relationship with the larger tree or shrub species. Because the orchid has been found at sites where there was no apparent association with a tree species, the possibility was raised that the associated plant of *R. slateri* may be any one of a number of myrtaceous species. It was decided, therefore, to revisit the original site at the flowering time of the orchid (November to December), and to look for and search around possible association species of, for example, the genera *Callistemon, Leptospermum, Eucalyptus, Angophora* and *Melaleuca*, if present.

On 9 November 1985 the authors started to search around the roots of a large *Eucalyptus* tree in an area thought to be the original site of discovery. After 15 minutes searching unsuccessfully, interest was transferred to the ground around a small (two metres tall) *Melaleuca* shrub. Ectomycorrhizal roots were soon found among its roots so the searching continued in a one metre radius of the shrub. Within minutes of locating two non-flowering plants of *Dipodium punctatum* at a depth of about ten centimetres, the first plant of *R. slateri* was located. It was in a state of early flower development.

After recording the details of the habitat and position of the plant, it was removed and washed so that it could be photographed. At this point two more specimens were found. These plants were left undisturbed in the hope that they may flower.

Rhizanthella slateri grew in a small gully in which the soil was a grey clay covered in a three to five centimetre thick layer of leaf litter. The vegetation was a *Eucalyptus* forest with an open understorey consisting predominantly of numerous small shrubs and herbs. Much of the surrounding area had been disturbed at some time in the past as the site was littered with mine tailings.

On a subsequent visit to the site, flowering material could not be located nor were the original plants of *R. slateri* found. Despite this disappointment at least something is now known of the biology of *R. slateri* and, more importantly, it has been demonstrated that it is possible to locate plants of the species by deliberate searching.

Studies on the associated mycorrhizal fungus are continuing as indeed is the search for more specimens. The site of the rediscovery is on State forest land and has been designated an area not to be disturbed. The orchid is protected by law. □

—Mark Clements and Jenny Groves

The kangaroo apple *Solanum aviculare*, a source of steroids for the contraceptive pill, has orange or scarlet egg-shaped berries 1.5 to 2.5 centimetres long. Photo: Tim Low.

Cures from the Canopy

By Tim Low

Rainforest is nature's medicine chest, a mossy-green supermarket of cancer cures and antibiotics; log it and you forfeit your future. So say Australia's conservationists, pleading for the Daintree and other rainforest remnants.

But how fair is this claim? Although Australia has both rainforest and world-class medical institutes in her backyard—a circumstance unique in the world—the fact remains that, of the hundreds of major commercial drugs, only a couple owe their genesis to Australian rainforest plants. It is not an impressive score. Are the conservationists wrong? Or did Australia just miss the boat? The answer lies somewhere in the history of medical exploration in Australia.

Australia's first colonists were not slow to try wild medicines. Epidemics of scurvy and dysentery raged among the first convicts, and English remedies were in exceedingly short supply. Native Currants (*Leptomeria acida*) growing in the woods about Port Jackson gave some relief from scurvy, and ruby-red resin oozing from eucalypts proved "very serviceable in an obstinate dysentery that raged at our first landing", according to First Fleet officer David Collins, writing in 1789. Oil distilled from 'Peppermint Tree' leaves (*Eucalyptus piperita*) aided digestion of the somewhat slim rations, and the leaves of the wild sarsaparilla plant (*Smilax glyciphylla*) furnished a wholesome all-round tonic.

As Australian settlement unfolded, bush medicines continued to play a part and some were even chemically investigated. The pioneers in this field were the Brisbane father and son, Drs Joseph and Thomas Bancroft. These days, doctors would be struck off the list for experimenting on their pets and patients, but the Bancrofts had a free hand and some interesting discoveries resulted.

One plant investigated by Joseph Bancroft was the Native Pepper (*Piper novae-hollandiae*), a common rainforest climber with heart-shaped leaves, closely related to the Asian

The pods of the Moreton Bay Chestnut split when ripe to reveal large rounded seeds, three to five centimetres wide, which contain the alkaloid castanospermine, a potential cure for cancers. Photo: Tim Low.

Unripe fruit and flower of the kangaroo apple, *Solanum laciniatum*. Photo: I.R. McCann, ANT.

vine that supplies commercial pepper (*P. nigrum*). Aborigines chewed Native Pepper leaves for sore gums, and Bancroft used extracts to treat gonorrhoea and stimulate gums. The leaves are not pleasant to taste but produce a tingling sensation approaching numbness, which lasts about 20 minutes.

Dr Bancroft's most enduring discovery centred on a corkwood (*Duboisia myoporoides*), a small tree of the rainforest. Bancroft had heard that Aborigines gouged holes in this tree and poured in water to drink later as a narcotic brew. Aborigines also hurled corkwood branches into pools to stupify eels, which they cooked and ate. Bancroft, discovering that small doses of the plant dilated the pupils of his pet cat and dog, applied the drug during ophthalmic surgery, with excellent results. Other doctors discovered that the plant relieved inflammations and 'night sweating'. Corkwood attracted international interest and was even an export item to Germany, fetching prices last century of up to one shilling per pound.

As Australia moved into the twentieth century, corkwood and other local medicines eventually gave way to commercial synthetic preparations from Europe and America. Organic chemistry became fashionable, the remedies of the Aborigines and pioneers were forgotten, and even eucalyptus oil, which held its place in many medicine chests, came to be imported from cultivated forests of Spain and Portugal.

Native medicines only became significant again during World War II, when supply lines of strategic drugs were cut. Hyoscine, an alkaloid extracted from corkwood, proved ideal for treating shell-shock and air-sickness, and during the war years about 200 kilograms of this drug were collected by culling wild trees. War-time sentiments about drug self-reliance continued in the post-war years and culminated in the remarkable Phytochemical Survey of Australian Plants.

During the late 1940s and '50s the Survey tested 4,000 species for alkaloids, by then a major focus of medical research. Len Webb, the Survey Botanist, at first tested plants at random but soon found that rainforest plants contained the alkaloids. Almost 500 alkaloids were discovered, nearly half of them new to science.

To understand why alkaloids proliferate in rainforest, Len Webb suggests that alkaloid production be considered as 'luxury metabolism'. All plants produce poisons to repel insects and other plant eaters, and rainforest plants rely especially on alkaloids (and glycosides, also very useful as medicines). Alkaloids are potent poisons but their manufacture uses up nitrogen, a precious resource which the plants need themselves for growth. In open-forest soils the nitrogen is too scarce to divert into poisons, and so the plants produce 'cheaper' (and less potent) nitrogen-free toxins, like terpenes, tannins and especially essential oils—those fragrant compounds so characteristic of Australia's eucalypts and tea trees. (The legumes of open forests, which can trap atmospheric nitrogen, are the exception: they often produce alkaloids.) Only within rainforests is the nutrient base rich enough to allow for a proliferation of alkaloids and, indeed, up to 28 have been recorded from one plant (the northern Queensland *Galbulimima belgraveana*).

Conservationists are therefore justified in stressing the medicinal potential of rainforest. This is despite the failure of the Phytochemical Survey, which was only a preliminary study, to produce any tangible economic returns: for as far as we know, none of the 200 new alkaloids were developed into commercial drugs. However, Len Webb says we cannot be certain, for an American pharmaceutical company, which conducted the tests, may have suppressed promising results for commercial gain. On the other hand, new drugs have to be proved better than existing ones to justify the economic outlay in marketing.

The survey did, however, stimulate ongoing interest in Australian rainforest plants. And with the emphasis now on anti-cancer research, a number of our rainforest plants, including the Moreton Bay Chestnut described below, show great promise. To date, however, Australia's rich rainforests have yielded only two pharmaceutical crops, the kangaroo apples and corkwoods.

Kangaroo Apples

The synthesis of steroids in the 1940s helped spawn the sexual revolution of the 1970s. Steroids gave us the contraceptive pill, not to mention the corticosteroids, which are used to treat asthma, allergies and arthritis, and to make sex hormones for menopausal disorders, infertility and impotence.

The use of steroids in medicines is an elegant idea. Certain plant chemicals, the steroidal saponins, so closely resemble human hormones that they can be converted into synthetic equivalents–'the Pill' being the most famous example.

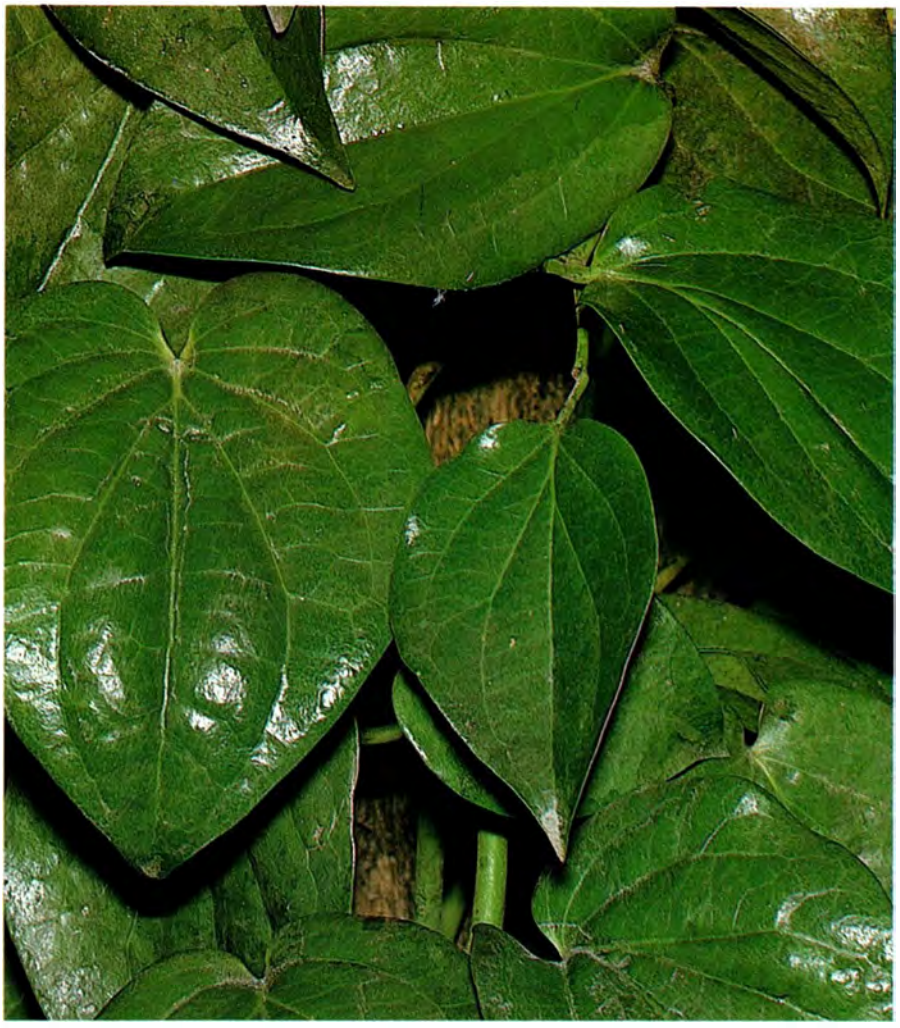
Commercial steroids were first produced from two yams (*Dioscorea composita* and *D. mexicana*) growing wild in Mexico. In the 1970s the yams were a declining resource–their habitat was diminishing, cultivation was proving impractical and the Mexican Government had imposed steep price hikes. A world search for alternatives began some decades ago, spearheaded by Russian and Hungarian scientists. They developed a highly successful steroid industry, providing the contraceptive requirements of all eastern Europe, based upon two Australian rainforest plants.

The kangaroo apples (*Solanum aviculare* and the very similar *S. laciniatum*) are common shrubs of rainforest edges and shady banks in eastern Australia and New Zealand. *Solanum laciniatum* grows also on coastal dunes. Their leaves are dark green and often lobed, and the purplish flowers are followed by orange or scarlet egg-shaped berries, which are edible although not very tasty.

Kangaroo apples are members of the chemically diverse potato family (Solanaceae), the source of many of our drugs and foods, including tobacco, pituri, corkwood, tomatoes, eggplants, capsicums and tamarillos. The saponin in kangaroo apple leaves is solasodine, an alkaloid very similar to the disogenin in yams, and is easily converted to steroids. The Russians maintain vast kangaroo apple plantations, mainly of *S. laciniatum*, and even featured the latter on a stamp commemorating medicinal plants. Chemists in Australia and New Zealand have called for a local solasodine industry but, despite ongoing research in eastern Europe, Cuba, Japan, India and Egypt, no Australian industry has emerged. An opportunity lost?

The leaves of the Native Pepper contain a benumbing substance that alleviates the pain of sore gums. Native Pepper is a common liana of rainforests north of Narooma, New South Wales. Photo: Tim Low.

The corkwood hybrid (*Duboisia leichhardtii X myoporoides*), grown commercially in southern Queensland, yields more hyoscine, used to treat motion sickness, than either parent species. The flowers resemble those of *D. myoporoides* but the tiny fruits are egg-shaped like those of *D. leichhardtii*. Photo: Tim Low.



Corkwood

Corkwood is the big success story of Australian pharmacology. The plant Bancroft tested on his pets in the 1870s is now a commercial crop in southern Queensland. Each year Australia exports 1,200 tonnes of the dried and powdered leaves to West Germany, Japan and Switzerland, representing half the world market in hyoscine.

There are actually two species of corkwood that produce hyoscine and related alkaloids. *Duboisia myoporoides*, the common species, is a small tree of rainforest margins in eastern Australia, New Guinea and New Caledonia; *D. leichhardtii* is restricted to inland southern Queensland, where it grows in vine thickets and bottle tree scrubs—the so-called dry rainforests. Both species have slender leaves, corky bark and tiny black berries. The flowers are white, although the petals of *D. leichhardtii* are finely tapered, distinguishing it from the blunt-flowered *D. myoporoides*.

Corkwood leaves contain various alkaloids, including nicotine, but the important one is hyoscine, used to treat motion sickness, stomach disorders and the side effects of cancer therapy. Several overseas plants also produce hyoscine but none yields as much as a hybrid of the two corkwoods (*D. leichhardtii* X *myoporoides*), cultivated in the Burnett district west of Gympie.

During the war a Sydney company, Felton Grimwade & Duerdins, extracted hyoscine locally, but nowadays the powdered leaves are exported and the drug extracted overseas. Australia's share of the market is by no means secure—India and Indonesia now grow corkwood, and Japan, one of our major markets, is experimenting with a hybrid tolerant of cold climates.

Cancer Cures?

Kangaroo apples and corkwoods are important medicinal plants but the drugs they provide are by no means unique. Kangaroo apple alkaloids resemble those in yams, and hyoscine in corkwood occurs also in thornapples (*Datura* spp.) and Belladonna (*Atropa belladonna*). The development of a uniquely Australian drug product still lies in the future. Presenting the best prospects are several rainforest trees that have shown anti-cancer activity.

The Native Pepper (*Piper novae-hollandiae*), investigated by Bancroft, is one prospect: in Australian tests the plant showed activity against lung cancer in mice. Another possibility is Coast Tylophora (*Tylophora crebriflora*), a vine from Queensland and New South Wales rainforests. One of its two alkaloids, tylocrebrine, retards leukaemia in mice and trials have reached the clinical stage in America. Another promising candidate is Scrub Yellowwood (*Baurella simplicifolia*, previously called *Acronychia baueri*), a nondescript rainforest tree with alkaloids in its corky bark. One of these alkaloids, acronycine, shows anti-tumour activity against a wide range of cancers.

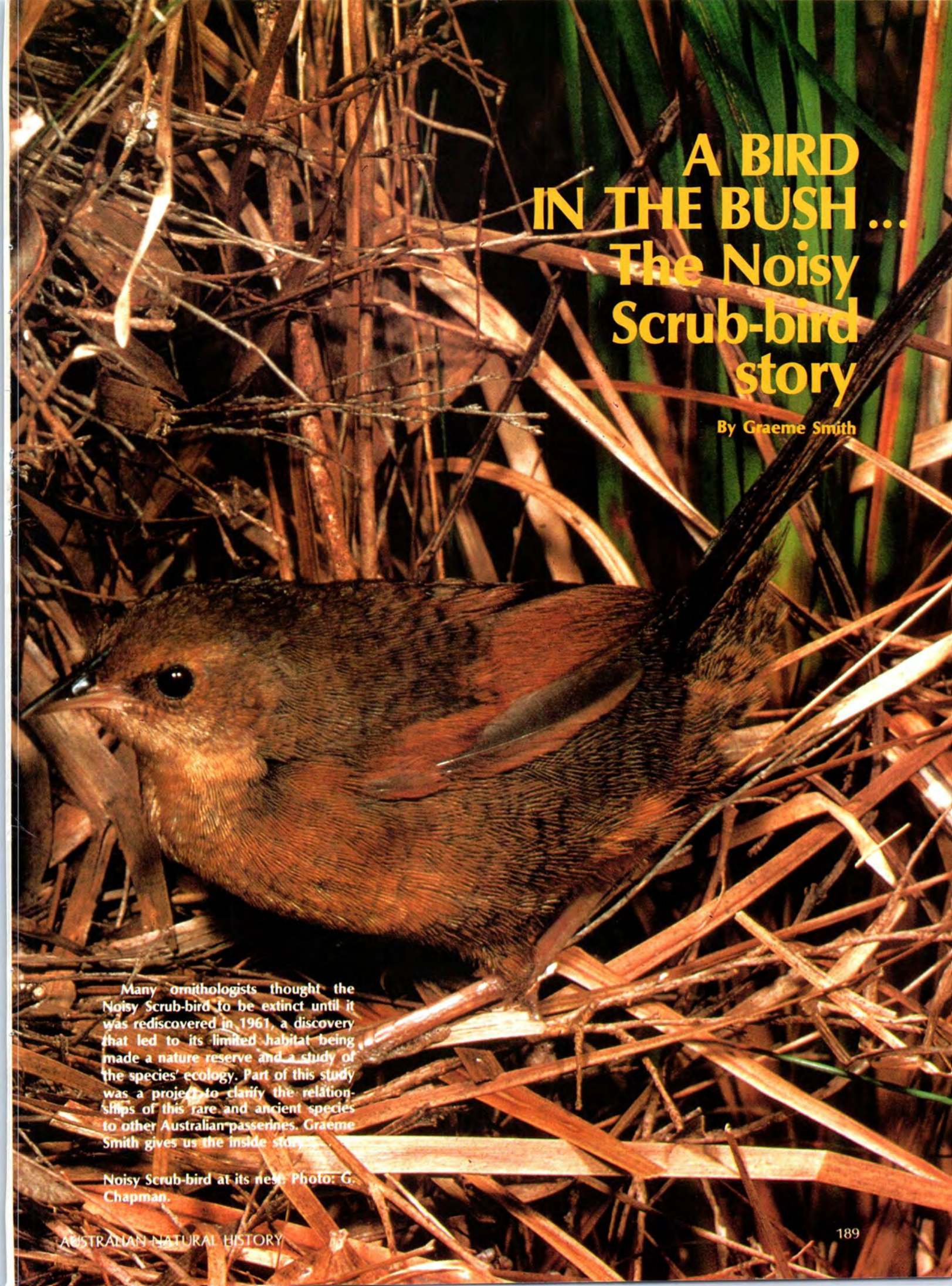
The latest great Australian hope, however, is the Moreton Bay Chestnut or Black Bean (*Castanospermum australe*), a handsome tree of rainforest riverbanks north of Coffs Harbour. One of the largest of Australia's legumes, it is easily identified by its striking orange-red pea flowers and by the dark pinnate leaves, which smell of cucumber.

In autumn, Moreton Bay Chestnuts produce enormous seeds, rich in starch, which Aborigines gathered for food. The seeds are highly poisonous but tribes found ways of leaching away the toxins by grating, soaking and later baking the seeds. One of the toxins they removed, the alkaloid castanospermine, was tested recently by the Fred Hutchinson Cancer Research Centre in Seattle, USA. The alkaloid was found to interrupt metabolism in rat cancer cells, forcing them to revert to normal. So impressed was the cancer institute, they have imported 500 kilograms of the seeds, many of them gathered from Brisbane gardens where the tree is widely cultivated.

Moreton Bay Chestnut may just provide a major cure for cancer, and Australian rainforests will win the reprieve they deserve. But the reprieve may be short-lived. For, by curing cancer, human populations will soar and more people will impose yet more demands on dwindling resources, including rainforest. The rainforest may be destroyed by those whom it may save. □

A BIRD IN THE BUSH... The Noisy Scrub-bird story

By Graeme Smith



Many ornithologists thought the Noisy Scrub-bird to be extinct until it was rediscovered in 1961, a discovery that led to its limited habitat being made a nature reserve and a study of the species' ecology. Part of this study was a project to clarify the relationships of this rare and ancient species to other Australian passerines. Graeme Smith gives us the inside story.

Noisy Scrub-bird at its nest. Photo: G. Chapman.

The recent publication of a series of articles on the morphology of Australia's rarest passerine, the Noisy Scrub-bird (*Atrichornis clamosus*), was the outcome of an outstanding international co-operative project that should serve as a model for future studies on rare species.

The project had its beginnings at the Ornithological Congress in Canberra in 1974. There I met Dr Mary Clench and Prof. Charles Sibley. Mary Clench had been working for some years on the feather patterns of lyrebirds and scrub-birds, but was hampered by the lack of good specimens. The Noisy Scrub-bird skin she had examined was over 100 years old and in poor condition, having been preserved in rum! Charles Sibley had for some years been studying the relationships of Australian birds using egg white proteins and had recently started using the DNA hybridisation technique. Prior to the conference Charles had published an article on the relationships of lyrebirds using egg white proteins. This study indicated that lyrebirds were most closely related to the bowerbirds and birds of paradise, thus elevating lyrebirds from the more primitive sub-oscine group to the more advanced group of passerines, Oscines. However, there have since been other interpretations. Apart from its intrinsic interest, a knowledge of scrub-birds' relationships is important in understanding the evolutionary ecology of the Australian avifauna which, in turn, allows a fuller interpretation of the species' ecology.

At that time I was in the middle of an ecological study of the Noisy Scrub-bird. One of my first tasks in 1970 was to do a complete census of the population using the number of singing males as an index of the adult population. The result was 45 males. By 1974 the population had steadily increased to 66 singing males. Therefore it seemed reasonable that one bird could be collected without adversely affecting the population.

Waste Not, Want Not

After the Congress I started the long process of obtaining a permit to collect a single Noisy Scrub-bird, and Mary Clench and I started sounding out colleagues who might be interested in working on the specimen. We finally ended up with six Americans, three Australians and one Belgian.

In June 1975 Ministerial approval was given for the collection of one Noisy Scrub-bird. By this time we had decided to collect a breeding female in 1976 and use her chick in our captive breeding program.

In mid July 1976 we had located a nest at which we could trap the female. By August 3 (Tuesday) the egg had hatched and the chick was seven days old and growing well. I then alerted Shane Parker of the South Australian Museum whom Charles Sibley had contacted to do the delicate job of bleeding the bird. Every drop was vital, as in a bird of this size we would be lucky to get the minimum volume of blood required for the tests. On the following Sunday afternoon I picked Shane up from Perth airport and we drove to Two Peoples Bay, some 40 kilometres east of Albany on the south coast of Western Australia and some six hours by car from Perth. The next day the weather was terrible with gale force winds and sleet. At midday, with colleague Les Moore, we set off to set the trap in the densely vegetated steep gully where the nest was located. Ninety minutes later we had the female and her chick and headed back for our hut, wet and cold but elated. When we arrived back Shane extracted the blood, spleen and liver and we took detailed measurements and plumage descriptions. The specimen was then carefully preserved in formalin. Meanwhile, the chick was being fed small insects we had collected that morning. That evening we drove back to Perth, and dropped Shane off at the airport and the chick with Lexie Nicholls who would rear it until it was able to be moved to our aviary.

Three-day-old Noisy Scrub-bird chick. Photo: L. Moore.

Having collected the specimen, the next step was to arrange for the various State and Federal export permits and the USA import permits. This was a lengthy process because the governmental regulations for rare and endangered species were designed to control commercial trade, not *bona fide* scientific enquiry. Such a situation tends to discourage scientists from undertaking such studies, often to the detriment of the species being protected. By March all was ready and the specimen was sent to the USA, arriving in perfect condition a few days later. The blood (meanwhile frozen) for Sibley required a different set of permits and finally arrived in July 1977. Meanwhile in America, Mary Clench had organised the sequence in which the specimen would be examined, in order to prevent any damage that would hinder later investigators. This planning paid off and by 1978 the study was finished. In December of that year the specimen, now down to bare bones on one side but relatively intact on the other, was returned to the Western Australian Museum.

This single specimen was studied by ten scientists with the result that we now have an excellent knowledge of the morphology of the Noisy Scrub-bird, in fact, as good as that for any other passerine and better than most. However, what we lack is a knowledge of individual variation in the species. In terms of the relationships with other birds, the studies claim that

scrub-birds and lyrebirds are each other's closest but still distant relatives. Instead of being placed in a separate suborder of the Passeriformes, (the sub-Oscines), they should be placed with the typical passerines (suborder Oscines) but with no clear cut affinities to other groups.

It is possible to suggest that the scrub-birds and lyrebirds are part of an early radiation of Australian songbirds (suborder Oscines). The origin of the scrub-bird may go back as far as the Eocene (55-40 million years ago) when much of southern Australia was covered by *Nothofagus* rainforest, in which the ancestral scrub-birds are believed to have evolved. From the Miocene onwards climatic changes resulted in the contraction of this rainforest, which became extinct in the west and confined to small pockets along the east coast. By the time Europeans discovered Australia, there were two species of scrub-birds, the Noisy Scrub-bird confined to the south-west corner of Western Australia and the more common Rufous Scrub-bird (*A. rufescens*) found on the coastal plains and ranges of northern New South Wales and the south-east corner of Queensland.

Noisy Scrub-bird nest in a sword sedge (*Lepidosperma angustatum*) clump. Photo: G. Chapman.

Noisy Scrub-bird nest with side cut away to show nest cavity and egg. Photo: G. Chapman.

History and Habits

What then are the history and habits of this interesting survivor from the past? The Noisy Scrub-bird was first discovered in 1842 at Drakesbrook, south of Perth, by John Gilbert while on a collecting trip for the British ornithologist John Gould. Between that date and 1889 it was recorded at five other localities, being most common in the Albany district. From 1889 onwards there were no more records and the species was feared extinct until it was rediscovered in 1961 at Two Peoples Bay by a local teacher and ornithologist Harley Webster. Numerous searches have failed to find any other populations.

Clearly, the Noisy Scrub-bird was a rare bird, even when it was first discovered, with small populations in coastal areas from south of Perth to east of Albany. The cause of the Noisy Scrub-bird's rapid decline to near extinction, so soon after the arrival of Europeans, is unknown. However, it is likely that the change in fire environment was the main reason. Clearly, traditional Aboriginal burning practices, which were based on a rotational basis, were compatible with the species' survival. Within 50 years these practices had ceased and were replaced by European practices that were either too frequent or too intense. Studies at Two Peoples Bay suggest that if an area is burnt more than once every five to ten years then scrub-birds will not survive.

Following the rediscovery of the scrub-bird there was a long drawn out battle by conservationists to have the area declared a reserve for the species. There was considerable local opposition to making the area a nature reserve, for the Two Peoples Bay area had become a popular spot for fishermen. Over the years a small shanty settlement had developed and there were plans to develop a townsite on the site of the original rediscovery. Fortunately, the Government was persuaded to create a reserve of some 4,683 hectares which included, in addition to the site of rediscovery, a large area that had no scrub-birds. In retrospect, this was a wise decision as this area now has an expanding population of scrub-birds.

Noisy Scrub-birds are small birds (females 35 grams, males 50 grams), with long legs and tails, short wings, and cryptic brown plumage—ideal characteristics for ground-dwelling birds that live in dense vegetation. They are fast and agile, using their limited flying ability to move from shrub to shrub without having to go to ground. While difficult to see, they are inquisitive birds that will approach any disturbance (such as a human entering their territory), look and then move off.

Their preferred habitat is dense low forests, in gullies and around lake

View of Mt Gardner where population censuses of Noisy Scrub-birds have been carried out. Photo: G. Smith.

edges where there is a closed canopy and a dense understorey of shrubs and rushes and a thick layer of leaf litter. The extent of this habitat on the reserve is restricted. With the increasing population more birds are occupying heath and shrub vegetation, which is best considered only as survival habitat as breeding is probably a rare event in these habitats.

The only conspicuous activity of Noisy Scrub-birds is the male's territorial song which he sings throughout the year. The song is a variable and loud whistle of 10 to 15 notes that may be heard from up to 1.5 kilometres on a calm day. The females' and immature males' only vocalisations are two alarm notes. Territories range in size from four to nine hectares. Within the territory the male spends over 80 per cent of his time in a core area of one to two hectares, which are used throughout the year and in some areas have been occupied continuously for up to 20 years.

The breeding season extends from May to November. Males begin singing more frequently in April, maintaining a high but variable level of singing from May to October. The first nests are started in early May and a single egg is laid between late May and early October, with most eggs being laid in late June. The female builds the nest, incubates the egg and feeds the chick; only rarely does the male visit the area of the nest. The nest is globular (diameter about 18 centimetres) with a small side entrance and is made of rushes with some leaves and fine twigs. The bottom of the nest is lined with a papier mache-like substance made from decaying rushes and wood. The chick hatches 36 to 38 days after the egg is laid. At this stage it weighs four to five grams and is naked except for some dense fine down on its head and back. It leaves the nest when it is three to four weeks old and stays with its mother for some months, probably until it has finished its post-fledgling moult at about three months old.

The relationships between adults is poorly known, however there is some data to suggest that males are opportunistically polygamous. While only one breeding female has ever been located in a territory, a few males have been known to visit breeding females in adjacent areas without males, and may, in fact, mate with young females on the periphery of their territory. This conclusion is supported by the fact that a single male in captivity successfully mated with three females in consecutive years.

Scrub-birds feed at or near the ground, foraging in litter, the bases of rush clumps, decaying wood and in dense shrubs. The diet of adults is poorly known but appears to be mainly insects. The prey items fed to nestlings have been well documented. The most common items were spiders, crickets, cockroaches, worms and various larvae.

The loud directional song of adult males provides the only practical means of carrying out a census. Males begin to develop their territorial song in their second year, it being fully developed by their third year. Thus, all census data are given in terms of the number of singing males. The first census was carried out in 1970 and showed that there were 45 singing males on the headland around Mt Gardner. In 1971 the number was 44, but in the following years it gradually increased to 157 males in 1985. Incomplete counts in the period 1962 to 1966 suggest that there were 40 to 45 males during this period, while photo-interpretation of available habitat from aerial photography in 1946 suggests that only 20 to 30 males were present. The simplest explanation for the changes in population is the changing fire environment at Two Peoples Bay. The 1946 aerial photos indicate that the area had had numerous small fires; by 1960 the pattern had changed to fewer but larger fires. Since 1970 there have been no fires in scrub-bird habitat and the vegetation has been able to grow and provide more habitat.

Future of the Noisy Scrub-bird

What then is the future of the Noisy Scrub-bird? The bird probably survived at Two Peoples Bay because the rock outcrops on the hilly headland around Mt Gardner prevented the whole area from being burnt at one time. The present management policy of excluding fire has worked well. Part of the expanded population is now found around Lake Gardner and the area to the west, and forms a distinct sub-population. The two sub-populations are separated by a strategic fuel reduction zone, roads and firebreaks, and it is unlikely that both populations will be affected by wildfire at the one time. With adequate protection from fire and appropriate habitat management, the future of the population at Two Peoples Bay should be secure for the foreseeable future.

However, to provide added security for the species, the Western Australian Department of Conservation and Land Management began a translocation program in 1983. To date 18 males and 14 females have been moved to Mt Manypeaks, some 15 kilometres north-east of Two Peoples Bay, and eight females and eight males were translocated to an area on the south coast west of Walpole in 1986. At this stage it is too early to tell if the translocations have been successful. However, there is no reason to doubt that they will be. If further populations can be established and expand as the Two Peoples Bay population has, then we can truly say that the species has been pulled back from the brink of extinction.□

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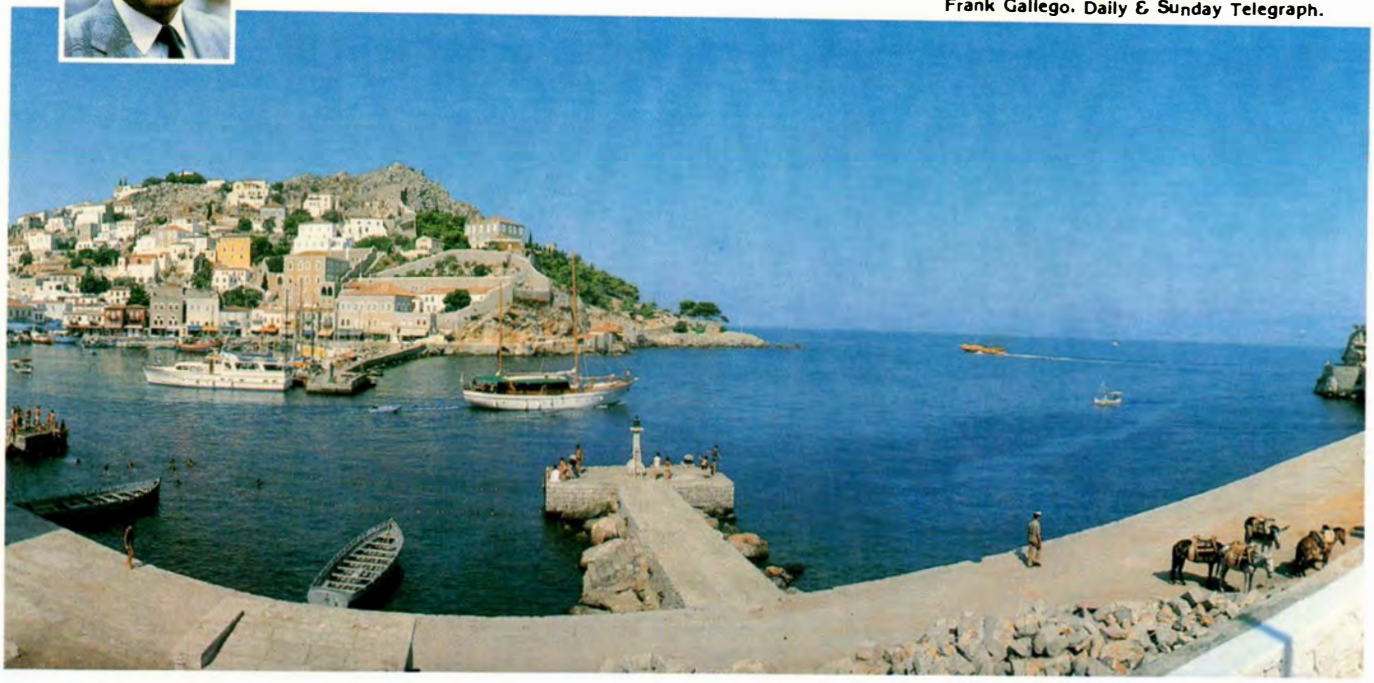

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