

# Australian Natural History

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## MAATSUYKER ISLAND

Australia's  
Most Southerly  
Light

BARN OWLS  
METEORITES  
INVADING  
ORNAMENTALS  
NATIVE BEES

AUTUMN 1988 VOL.22 NO.8  
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## Front Cover

Maatsuyker Island is part of a rugged, windswept island group off the southern coast of Tasmania. It is home to Australia's most southerly lighthouse—see the article on page 340. Photo by Gerry Whitmont.

# EDITORIAL On Ownership

Can we still call our fossils our own? Or our quality mineral specimens? Australia's past is written in its rocks and fossils, and the pieces that tell us the most about it are of the greatest scientific value. Like it or not, they also frequently attract a high financial value. Sometimes, through ignorance by the discoverers or a lack of interest by potential sponsors, many of our best specimens end up being sold overseas. This dilemma is discussed in Forum on page 368.

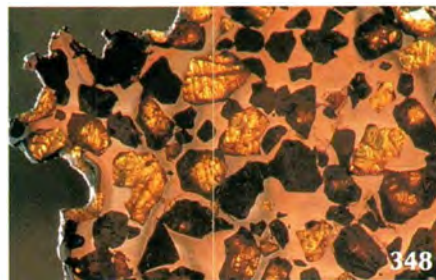
Can we still call our plants our own? Or can any country? While Australia is being invaded by overseas ornamentals like Asparagus Fern, Bitou Bush, Iceplant and Lantana, our wattles are doing a good job of infesting southern Europe and California. Florida's Everglades are being choked by our Paper-bark Tea-tree and nu-

merous Australian species are creating havoc in South Africa—all being shipped around for the sake of their intrinsic beauty. Tim Low looks at some of the consequences. See page 362.

If this isn't enough, objects come hurtling to Earth from outer space as well. Of course, they are valuable in that they can tell us a lot about the nature of the universe. Yet meteorites aren't always easy to locate after impact, as Glen Moore explains on page 348.

On a different note, I am delighted to announce that *Australian Natural History* has been awarded 'Best Periodical' in the esteemed Whitley Awards for 1987. These are made annually by The Royal Zoological Society of New South Wales for excellence in Australian natural history publishing.

—Fiona Doig, Editor



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### A Diver's Dilemma

In Robyn Williams' *Snorkel Sense* (ANH vol. 22, no. 6, p. 264), he refers to underwater breathing devices said to have been used in ancient times. The article is accompanied by a copy of a 16th-century drawing of a close-fitting diving suit with a flexible tube leading from the headpiece to a float at the surface.

I doubt whether any such apparatus was ever used. Even if water pressure had not constricted the tube, it would have pressed the headpiece against the diver's face. Without compensating air pressure from a pump at the surface, the diver's chest would have been compressed, making it difficult to breathe.

A snorkel works because the user breathes almost at the surface and therefore has no problems of water pressure. Had Aristotle's or Pliny's systems worked, we might expect them to have been continued (or re-invented) by sponge collectors in the Mediterranean and many other parts of the world. However, constrained by physics rather than pre-scientific imagination, such divers are limited—like



**A snorkeler is limited by the length of the tube.**

snorkelers who venture below the surface—to what can be done with one chestful of air.

—Ronald Strahan  
Australian Museum

In his column (ANH vol. 22, no. 6, p. 264), Robyn Williams noted that in the history of diving the snorkel was apparently preceded by similar systems in which a diver was supposed to have been able to breathe under water by means of a long tube extending to the atmosphere.

I would like to point out that for the depths apparently intended to be reached, these designs were overly optimistic. In practice they would have proven disastrous for the unfortunate diver. Physiological studies published in 1911 showed that with such an open or atmospheric system, humans in the prone position could only breathe comfortably to a depth of ten inches (about 25 centimetres). They were physically stopped from breathing at about three feet (just under a metre) and nasty things could happen at even modestly greater depths.

The relevance of such findings to arguments about the once-supposed aquatic habits of such sauropods as *Diplodocus* and *Brontosaurus* is discussed in A.J. Desmond's book *The Hot-blooded Dinosaurs*.

—Rodney C. Hayward  
Bundanoon, Vic.

### Mangrove Madness

I wish to draw your readers' attention to an amazing article (*Mangroves a 'Menace' to Harbour*) that appeared in the *Port Macquarie News* on 16 June 1987. This article quoted at length a local



**Mangroves.**

businessman, Bruce Jordan, who claimed that Pelican Island, basically a mangrove island, in the lower Hastings River, is detrimental to fish populations in the area because it reduces the amount of water available to fish in the river. The same person claimed that "mangroves were introduced by oyster farmers shortly after the turn of the century as a source of catching sticks for oysters" and that "conservationists wishing to conserve mangroves were attempting to preserve something that was not here when the white man arrived". He also believes that "mangroves are the largest single threat to people and property in the lower reaches of the Hastings River" and, for these reasons, that "the proposed canal estate development in the area would be beneficial to the area".

This article is to be deplored on several counts. The information in the article is inaccurate; mangrove areas function as important nursery grounds for juvenile fish and provide a source of nutrients for polychaete worms, crustaceans and molluscs, which in turn are eaten by

fish. Mangroves were *not* introduced by oyster farmers at the turn of the century; mangroves have been recognised in 24-million-year-old fossil deposits, and have been an integral part of our estuarine system long before humans evolved.

In no way can the destruction of mangroves, by canal estate development, be considered a beneficial activity; in fact the removal of mangrove and associated seagrass beds will damage the fishing in the area. It is ironic that people who buy a waterfront block of land in a canal estate development, in order to have easy access to the fishing in the area, are actually destroying the very resource that they intend to enjoy. Finally, it is deplorable that a newspaper would publish such information without checking its validity—especially since such incorrect statements only provide the developers with the ammunition they need to build more marinas and canal estate developments, to the detriment of our estuaries and coastal fisheries.

—Pat Hutchings  
Australian Museum



## Pigface

In a recent article on Australian succulent plants (ANH vol. 22, no. 6, p. 262), Tim Low suggested that pigfaces, *Carpobrotus* spp., are so named because of their resemblance to pigs. I should like to put forward an alternative hypothesis.

Early seafarers visiting Australia from the UK generally came via southern Africa, where pigface is equally abundant and is known as *big vys*. *Vys*, pronounced 'face', is the Afrikaans word for members of the plant family Mesembryanthemaceae, which includes *Carpobrotus*. *Big vys*; pigface.



TIM LOW

### Pig face or big vys?

If that sounds far-fetched, let me provide an analogous example as supporting evidence. Many of us are all too painfully familiar with the caltrop-like spiny fruit of three-cornered jacks, known colloquially—especially in Western Australia—as 'doublegees' or 'double Gs'. Now, why on earth should a plant be called Double Gs? Well, it was probably introduced from South Africa, where it is called *dubbeltjes* (little devils) in Afrikaans (a very appropriate name!). In this case, however, I believe that the South African pronunciation does not sound

at all like 'doublegees'. So I conclude that some early Western Australian saw the Afrikaans name written down, and mispronounced it to his mates next time he trod on one—and hence the name. I'm ready to stand corrected on either of these (and also on my spelling of the Afrikaans words!) but I've yet to hear a more convincing derivation.

—Ralf Buckley  
O'Connor, ACT

### Good on You, Gordon

I would like to congratulate Gordon Grigg on his article *Kangaroo Harvesting* (ANH vol. 22, no. 5, p. 204).

Having travelled a great deal in outback Australia, I am only too aware of the impact that the cloven-footed animal has had on our fragile environment. I believe the Australian artist Jack Absolom tries to point to this tragedy in all his paintings of central Australia, by including an area of salt pan.

Gordon Grigg has produced a well-researched document. He has forestalled many arguments that would be put against the proposal of farming 'roos, but restoration of habitat on a grand scale is by far the most important factor in his proposal. Imposing a European type of agriculture and animal husbandry on this continent has caused a disaster that the general public does not understand. With our bicentenary due next year, now would be the opportune time to ponder our folly, instead of celebrating achievements of doubtful merit to the exclusion of the basic problems that we have generated in the environment.

—C.W. Richardson  
Wingham, NSW

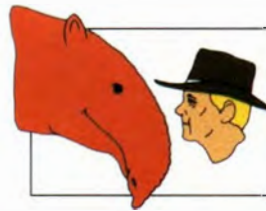
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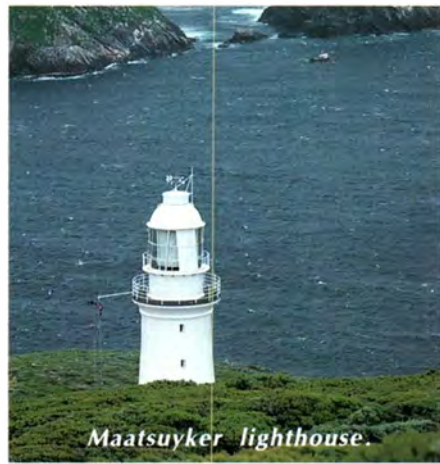
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*The wind sent horizontal spray whipping across the water.*





Maatsuyker lighthouse.

GERRY WHITMONT

# AUSTRALIA'S MOST SOUTHERLY LIGHT

By GERRY WHITMONT

**M**aatsuyker Island, situated ten kilometres off Tasmania's southern coast, is part of a group of six islands known as the Maatsuyker Group. The island is roughly triangular in shape, about three kilometres long and one-and-a-half kilometres at its widest point. Although often quoted as the most southern habitation site in Australia, this is not strictly correct—Macquarie Island (part of Tasmania) and the Australian Antarctic Territory lie further south.

We first saw the island from the decks of the brigantine *The Eye of the Wind*, in much the same way as passengers on earlier square-riggers would have done. The chill silent beauty of Maatsuyker in the pre-dawn light is an exhilarating experience never to be forgotten. Jagged cliffs rise steeply from the sea to a summit of 260 metres. The island would have been

the first land sighting for many a tall ship sailing east through the Roaring Forties of the Great Southern Ocean, headed for Hobart. Abel Tasman, during his voyage of discovery, first saw the island in November 1642. He probably named the island after Lieutenant Maatsuyker, the Governor of the Dutch East Indies at the time.

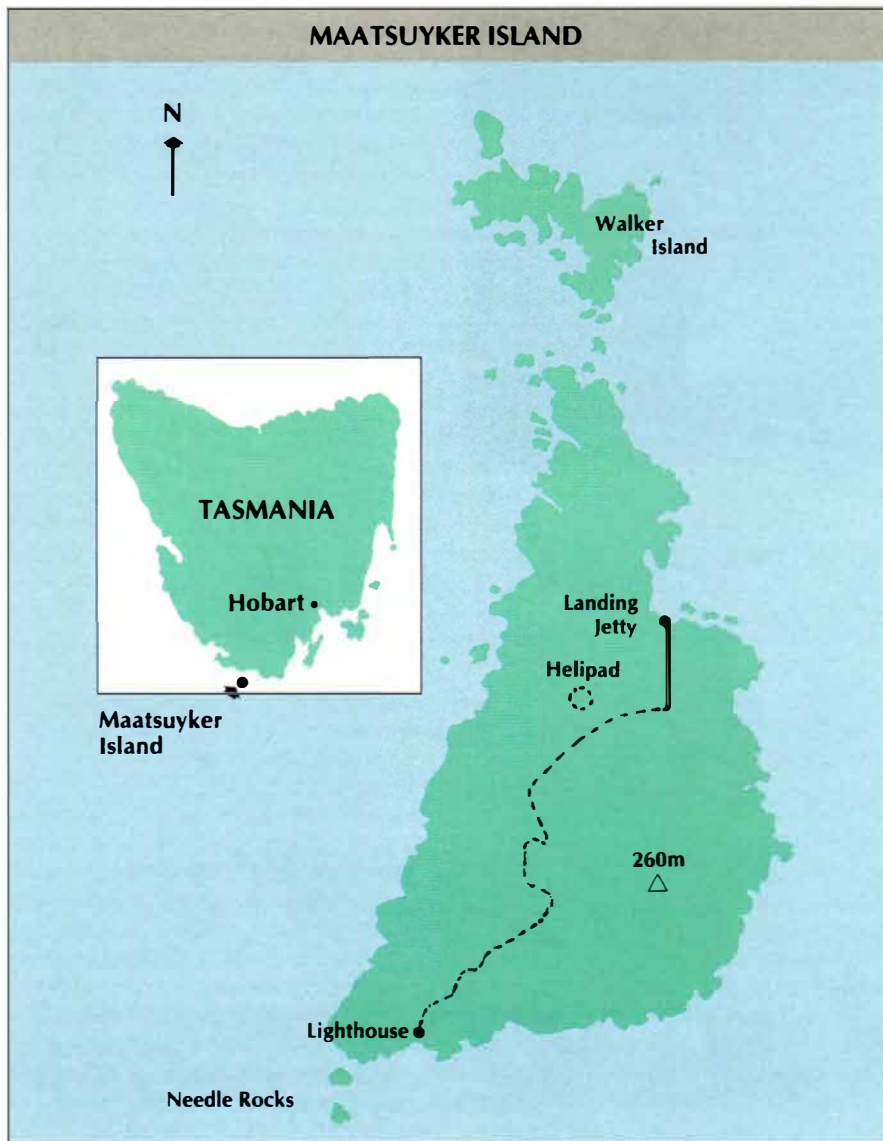
A continuously-staffed lighthouse has been operating on Maatsuyker since 1891. It provides Australia's most southerly light—a welcome and warning for ships' safe passage—and is one of the few remaining manned lighthouses in Australia. It is run by the Australian Department of Transport whose policy is to automate most lighthouses in an effort to reduce maintenance costs. Automation usually means the lighthouse is demanned and therefore the light, if in an isolated area, becomes less reliable. A considerable campaign was organised

by those individuals and groups who saw the need for lighthouse keepers on Maatsuyker. Fishermen's and yachtsmen's organisations put forward arguments about the need for reliability, and the Tasmanian Conservation Trust about conservation. In 1983 the House of Representatives Standing Committee on Expenditure (also known as the 'Razor Gang') finally recognised the importance and benefit of the presence of at least two lighthouse keepers on Maatsuyker Island. Because the lighthouse keepers' homes are the only habitation along the rugged, inhospitable Tasmanian coastline, stretching along the south and as far north as Temma in Tasmania's west, there was a special case for continued manning of the station.

Maatsuyker Island remains an extremely important 24-hour communications and weather base. In this most

GERRY WHITMONT





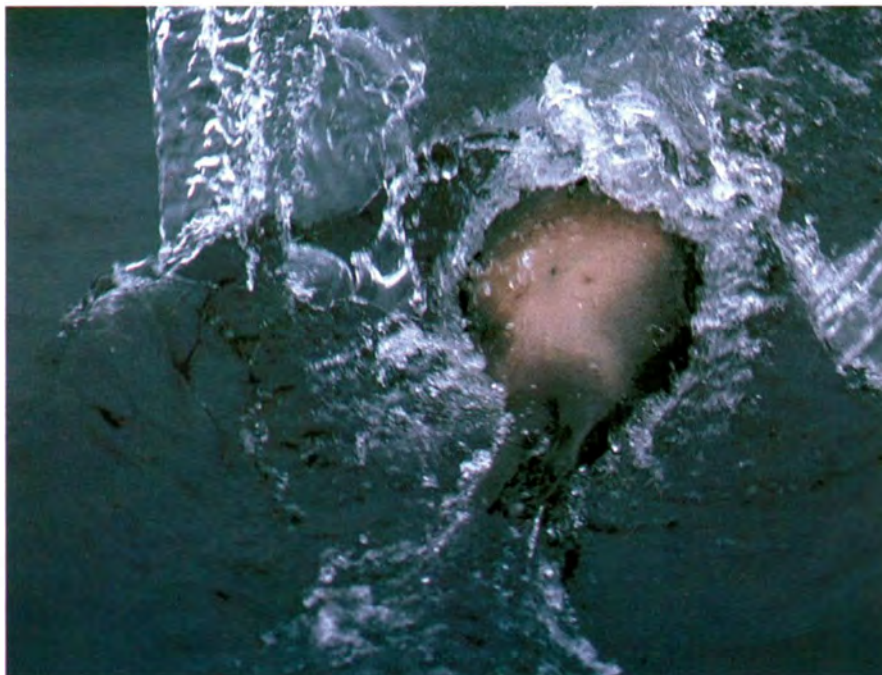
remote and isolated area of Tasmania, the proximity of large mountain ranges creates a 'dead radio area', that is, radio communication with other areas is extremely difficult. Maatsuyker Island, however, has a radio telephone link with Hobart. This is an invaluable means of relaying urgent communications from south-western wilderness areas of Tasmania, and is of extreme importance to fishermen, yachtsmen, fire fighters, search and rescue operators, bush-walkers and grounded aircraft. The island, being elevated and set off the coast, is also in a key position for coastal surveillance (shipping disasters and illegal activities), and its light warns ships travelling from the west to Australia's eastern seaboard or the Americas.

Lighthouse keepers also ensure the protection of the island's flora and fauna, which are of particular biological interest because of the lack of disturbance. There are no introduced pests, such as feral cats and rats that, on other islands, feed on the eggs and chicks of native ground-nesting birds. Settlement is restricted to two homes around the lighthouse, and fires have been few and confined to small areas.

Small, undisturbed islands such as Maatsuyker offer the opportunity to discover the minimum area of habitat able to support certain species. For example, Maatsuyker supports only one species of land animal, the endangered Swamp Antechinus (*Antechinus minimus*). This small marsupial has a body length of less than 15 centimetres and a tail about eight centimetres long. It feeds on insects and their larvae, worms and small lizards. Nearby De Witt Island, which is much larger by comparison, has two land mammals—the Tasmanian Pademelon (*Thylogale billardierii*) and the Eastern Swamp Rat (*Rattus lutreolus*).

In contrast to the few land animals on Maatsuyker, the island's rocky shores support a large colony of Australian Fur Seals (*Arctocephalus pusillus*). Indeed Maatsuyker and the adjacent Needle Rocks Islands support the largest breeding colony of Australian Fur Seals in southern Tasmania. The size of the colony was estimated at 900 in 1975, and in 1977 a further 150 seals were counted on nearby islands.

During the days of sealing, three species of seal including the Southern Elephant Seal (*Mirounga leonina*) were exterminated in Tasmania and the Australian Fur Seal population greatly reduced. This century numbers have begun to recover, and the growing col-



GERRY WHITMONT

**The Australian Fur Seal is a superb swimmer and can dive to at least 130 metres in search of food. Here a young seal shows off its antics and plays around the ship as we sail towards Maatsuyker Island.**





GERRY WHITMONT

*Like marooned sailors in days of old, a crew member shelters in the inlet waiting for the storm to abate.*

ony on Maatsuyker and the Needle Rocks is encouraging. Introduction of legislation that provides for prosecution of persons illegally shooting seals, and the presence of the lighthouse keepers who ensure the law is kept, are probably the two main reasons for the significant population growth.

Until 1975, access to Maatsuyker was exclusively by boat. A landing jetty is located in the only suitable inlet, on the eastern side of the island. Goods used to be carried on a haulage way, which climbs 140 metres above the sea, but they are now delivered by helicopter and the old jetty has become a convenient sleeping platform for seals. These trusting 'guardians' of Maatsuyker gazed curiously as we approached their new-found jetty. The younger seals swam up to investigate our rubber dinghy; their older counterparts merely yawned or slept on.

From a distance Maatsuyker appeared to be a barren place with a cover of low heath and grass. In fact there is a rich variety of plant species, more diverse than that found in similar habitats on the mainland.

The main island cover is Manuka or White Tea-tree, interspersed with many other trees and tall shrubs including paperbarks, banksias and Cheesewood or Banyalla (*Pittosporum bicolor*). They form a closed canopy that covers most of the high slopes of the island. Westringia is also abundant and amateur botanists have dis-



J. GRAY, NPIAW

*The Grey-breasted Silver-eye is a common land bird on the island.*

covered some different varieties that may prove to be new species. Smithton Peppermint (*Eucalyptus nitida*) is the only eucalypt species on the island. It grows in a small area near the summit.

The ground often has a thick covering of ferns and spleenworts. Turquoise Berry (*Drymophila cyanocarpa*) and Climbing Blueberry (*Billardiera longiflora*) are two of the more attractive flowering plants that occur with the ferns. Other flowering plants include trigger plants and Christmas bells. Seven species of orchid have been recorded on the island and tree ferns are found on the steep

slopes. These grow up to a height of four metres in the deeper gullies.

In some places there is virtually no undergrowth; frequent comings and goings of mutton-birds (the Short-tailed Shearwater, *Puffinus tenuirostris*) have exposed the grey sandy soil, which is pockmarked with their burrows. During the breeding season, from September to April, as many as one million mutton-birds return to their burrows. Many of the burrows have been tunnelled or dug beneath tea-trees and the adult birds have to crash through the closed canopy to get to them. Birds that have made clumsy landings have been found strangled in



the vegetation. Their bodies become food for the Forest Raven (*Corvus tasmanicus*), which also eats the eggs from the more accessible burrows.

Steep slopes close to the sea are covered with pigface, iceplants or native tussock grasses. These areas are often used as rookeries by seabirds. Large rookeries of Little Penguins (*Eudyptula minor*), Fairy Prions (*Pachyptila turtur*) and Common Diving Petrels (*Pelecanoides urinatrix*) are well established on the island. Other seabirds that nest on the island include the Silver Gull (*Larus novae-hollandiae*), Sooty Oystercatcher (*Haematopus fuliginosus*) and Black-faced Shag (*Leucocarbo fuscescens*); those that are found on the island but do not breed there include the Pacific Gull (*Larus pacificus*), White-bellied Sea Eagle (*Haliaeetus leucogaster*) and the White-faced Storm Petrel (*Pelagodroma marina*). Lighthouse keepers have also observed species far from their 'known range'. These include the Grey-backed Storm Petrel (*Oceanites nereis*), the Great Egret (*Egretta alba*) and the Great-winged Petrel (*Pterodroma macroptera*). The Shy Albatross (*Diomedea cauta*), which breeds on Mewstone Island, south-east of Maatsuyker, and the Australasian Gannet (*Morus serrator*) are also frequently seen soaring above the waves.

A total of 13 species of seabirds and 28 land birds have been recorded on Maatsuyker. That's quite a variety for



M. FAGG

**Christmas bells (*Blandfordia punicea*) are found on Maatsuyker Island.**



an island some 200 hectares in area.

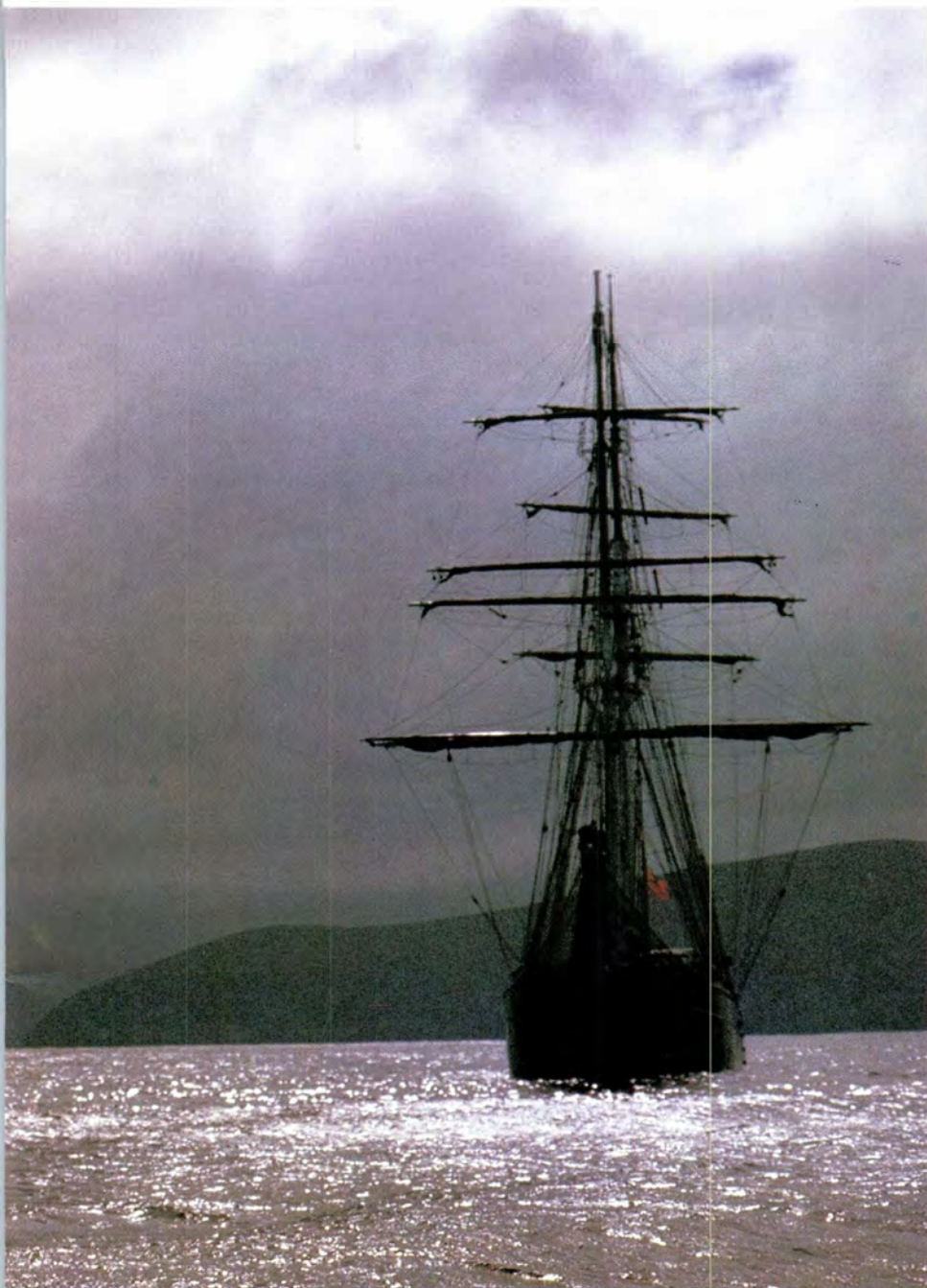
Land birds most common on the island are the Olive Whistler (*Pachycephala olivacea*), White-browed Scrub Wren (*Sericornis frontalis*), Crescent Honeyeater (*Phylidonyris pyrrhoptera*) and the Grey-breasted Silver-eye (*Zosterops lateralis*). It is surprising to find that Lewin's Water-rail (*Rallus pectoralis*) is quite common on Maatsuyker, because their habitat of ferns and cutting-grass under a canopy of scrub is very different to their typical lagoon and river habitat on the mainland. The rare migratory Orange-bellied Parrot (*Neophema chryso-gaster*) has also been sighted on Maatsuyker.

The land avifauna is probably similar to that which occurred when Maat-

suyker was first isolated from mainland Tasmania. Some expected species such as the thrushes, robins and fire-tails are missing. This suggests that they were simply not present in the Tasmanian south-west when the Maatsuyker Group was isolated.

Because water depths are unknown, it is unknown how long the Maatsuyker Group has been separated from mainland Tasmania. Once separated, however, Maatsuyker appears to have had a long history of Aboriginal occupation. Aborigines probably travelled to the island in summer from Louisa Bay—a journey of about 20 kilometres—in frail bark canoes. These canoes, which carried about seven or eight people, were not very seaworthy, and it seems that,





GERRY WHITMONT

once on Maatsuyker, the Aborigines were committed to an indefinite stay. Analysis of middens on the northern side of the island suggests that the Aborigines speared seals and ate mutton-birds and abalone. These middens have been identified by Dr R. Vanderwal as some of the more important archaeological sites in Tasmania, mainly because they show that the Tasmanian Aborigines made sea journeys. If the island was unmanned these important archaeological sites would be open to interference.

The whole of the Maatsuyker Island Group is renowned for its great storms, where winds can reach gale-force intensity within minutes. We experienced one such storm on Maatsuyker. From the lighthouse two

***Clouds surround the brigantine The Eye of the Wind, anchored in the calm before the storm.***

willy-willies were seen tearing across the water. We hurried back toward the ship but it was too late to leave the island.

Within what seemed like seconds, the wind had increased to 60 knots with gusts up to 80. The Roaring Forties proved their reputation. The wind howled as we sheltered as much as possible from the white squall. White caps on the water were whipped into a frenzy. There was sheer power and force in the elements. Horizontal spray surged across the waters to become vertical in an uplift that sent it over 300 metres up



G. CHEERS, ANT PHOTO LIBRARY

***Cheesewood or Banyalla is common on Maatsuyker.***

the rugged cliffs of the island. We sat and watched in awe as the ship was forced to weigh anchor.

Although the wind abated to 35 knots, it was more than two hours before it was safe enough for the jolly-boat to fetch us. Those two hours seemed another lifetime as we sheltered on the rocks of timeless Maatsuyker. The seals yawned and stretched just as they must have done when Aborigines braved these waters in their frail canoes.

We had been caught in an unexpected front that was not picked up in the weather forecast. It had come from the north-west and when it hit Tasmania it broke in two. One part intensified and struck Maatsuyker with a vengeance. The other, it was presumed, was headed for Hobart. The lighthouse keeper radio-telephoned Hobart to give a vital warning for the safety of coastal vessels, but he learned that Hobart's weather was fine and clear. It seemed that Maatsuyker Island stood a world apart; in the elements, the ecology and the peoples who frequented this isolated land. ■

*The author greatly acknowledges the Tasmanian Conservation Trust, publisher of Maatsuyker Island—Most Southerly Light by P. Blackwell, E. Banks and D. Brown (1979).*





**Common Sowthistle was eaten by Aborigines, and also by peasant communities in Europe, Asia and Africa. The raw leaves are bitter but when cooked taste bland and palatable.**

## Making Mistakes

**N**ever believe everything you read in books. I should know; my second book *Wild Food Plants of Australia* (Angus & Robertson, 1987) has just been published, and I am sure it is dotted with errors that others will delight in showing me.

Mistakes are inevitable. It's just too easy to misquote a source, to misidentify a plant, or to mix up a measurement. I only feel relieved—enormously relieved—for all the errors that did *not* get through. A misjudgment about kurrajong seeds was one of these.

Graziers in eastern Australia know the Kurrajong tree (*Brachychiton populneus*); its lopped leaves and stems provide valuable fodder during droughts, and it is often left standing when paddocks are cleared. A majestic tree of coastal ranges and inland slopes and plains, it has drooping, attenuated, often three-lobed leaves, a stout trunk, and clusters of bell-shaped flowers. Boat-shaped seed pods, five to seven centimetres long,

split to reveal rows of yellow seeds that Aborigines once cooked and ate. The seeds taste rich and nutty when roasted over a high heat.

In the first draft of my book I had surmised that Kurrajong seeds were “probably not very nutritious”. This judgment was based upon nutritional analyses of two closely-allied trees from northern Australia, Northern Kurrajong (*B. diversifolius*) and Red Kurrajong (*B. paradoxus*). According to one study, the seeds of these trees yield a meagre 1.2–5.9 per cent protein and 0.8–1.8 per cent fat. But just before I sent in my manuscript, a Sydney University team headed by Dr Jennie Brand published a paper revealing that seeds of the eastern Kurrajong actually contain a whopping 18 per cent protein and 24.7 per cent fat. I quickly amended my text to read “Kurrajong seeds are a remarkably nutritious bush food. . .” and this is the version that was published.

**The yellow seeds of the Kurrajong are housed in woody pods amid tufts of yellow hairs. These hairs are irritating and should not be touched; the seeds can be extracted safely with a knife. The roots of young trees were eaten by Aborigines, as well as the seeds.**



PHOTOS: TIM LOW



A mix-up over sowthistles almost led to another blunder. In 19th century books there are many references to Aborigines in southern Australia eating wild sowthistles or 'thistle' leaves. According to most modern plant texts the only native thistle in these parts is the Dune Thistle (*Sonchus megalocarpus*), and I dutifully prepared a photo and description of this sand-dune herb. However, every time I tried nibbling Dune Thistle leaves, either raw or cooked, I was repelled by their intense bitterness. They seemed an improbable source of food.



**The young white tubers of Sea Club-rush taste like coconut. The older black tubers, although still edible, taste like wood.**

Luckily, a botanist put me right by explaining that the textbooks are all wrong (never believe everything you read in books). Common Sowthistle (*S. oleraceus*), listed in all the books as an introduced weed, actually occurs naturally in Australia as a herb of creek banks. It was this much more palatable 'thistle' that the Aborigines used as food.

The confusion exists because Common Sowthistle is also native to Europe and Asia where it grows as a garden weed, and plants from these places found their way to Australia,

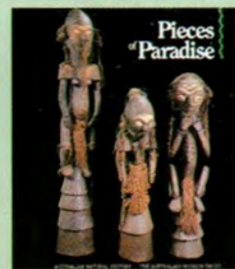
where they now thrive in gardens and farms. I reworked my text, substituting Common Sowthistle for the unpalatable Dune Thistle. It was a lesson in how difficult it can be to interpret old books when their descriptions of plant foods are vague. The old literature is baited with references to 'yams', 'berries', 'wild spinach' and the like, and it takes a degree of foolhardiness to attempt to identify these plants.

Sometimes mistakes work for the best. Early in my research I travelled hundreds of kilometres to western Victoria in search of plants to photograph. At Port Campbell I was delighted to find the Sea Club-rush (*Bolboschoenus caldwellii*, better known by its old name *Scirpus maritimus*) on the National Park plant list. The tubers of this sedge were possibly staple Aboriginal foods (although again the books are vague) and I had longed to see what this plant looked like. I waded into a stream on the edge of town and was thrilled to find that the dense sedges in the mud at my feet bore small edible tubers. Only a very few kinds of sedges produce tubers, so there could be no doubt that these were Sea Club-rushes. They were growing in such density that they could easily have served as staple foods. The new white tubers tasted like coconut, but the older black tubers were like wood. Although the weather was overcast, I shot off a large roll of film—I desperately wanted photos of these plants.

The photos turned out dismally but, as it turned out, it didn't matter. I returned home to find that Sea Club-rushes grow abundantly in my home city; they even sprout on a footpath two blocks from my house! In fact, Sea Club-rushes are common weeds of drains and ditches throughout south-eastern Australia. Now that I know what they look like they're as easy as mud to find.

That may seem ironical, but there is more. Sea Club-rush grows at Port Campbell but it is *not* actually mentioned on the National Park plant list. What I had read instead was a listing of the similar-sounding (but inedible) Sea Rush (*Juncus maritimus*, now known as *J. kraussii*). That was my mistake. Fortunately, mistakes sometimes turn out for the best.

Good eating! ■



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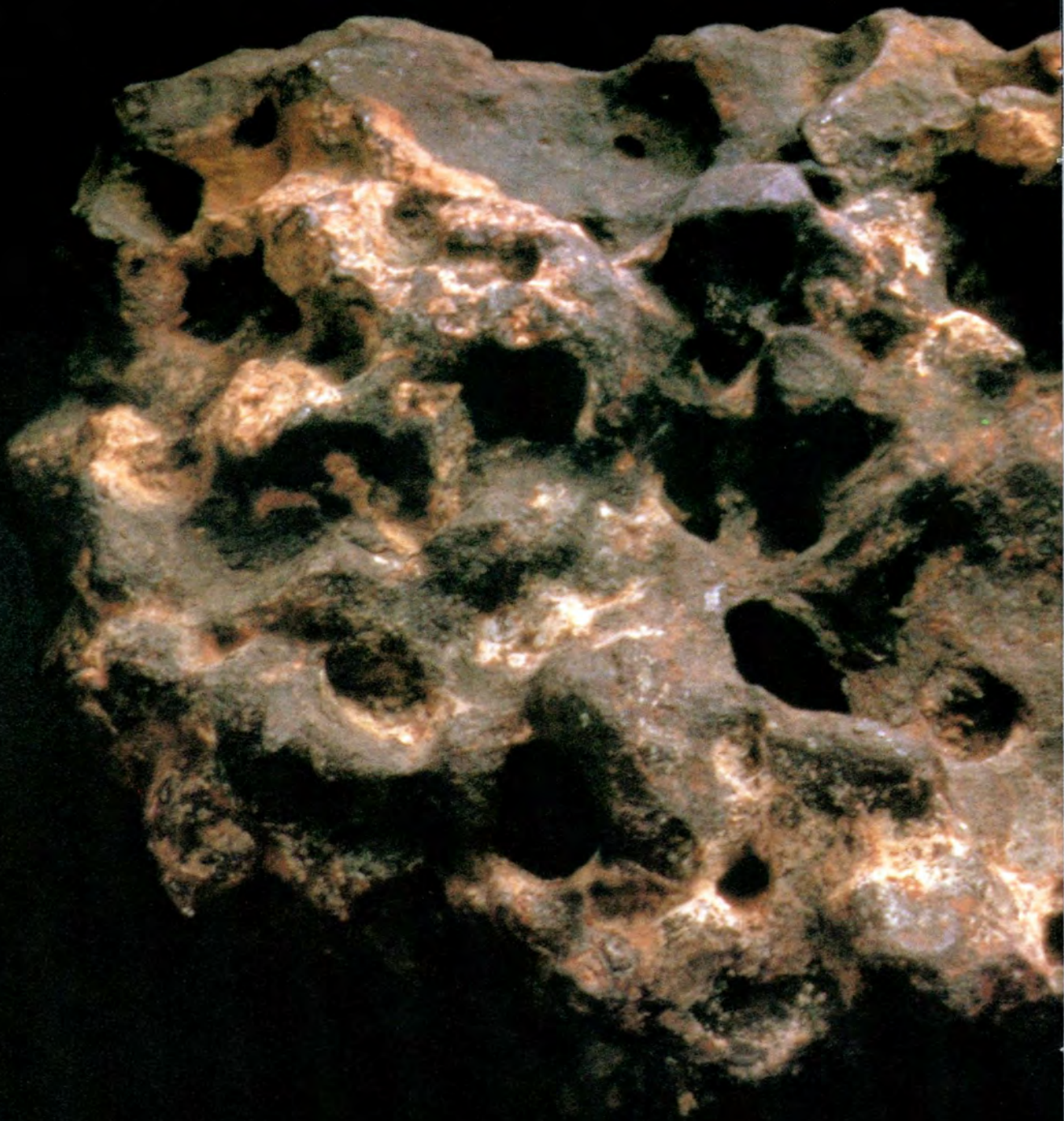
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T O ♦ C A T  
'FALLING





C H ◆ A  
**STAR'**

By **GLEN MOORE**  
UNIVERSITY OF WOLLONGONG

Only a few decades ago an understanding of the nature of the Universe was thought to be beyond mankind. Yet since then samples have been brought back from the moon, and robot spacecraft have landed on and sampled the surfaces of our nearest neighbours, Mars and

*A weathered iron meteorite, weighing 70 kilograms, found at Mudrabilla in Western Australia.*

GEOFF SMITH, ROBERT HAAG COLLECTION

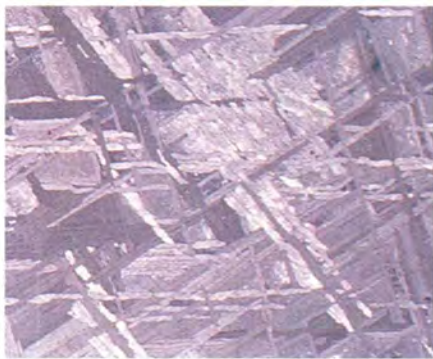
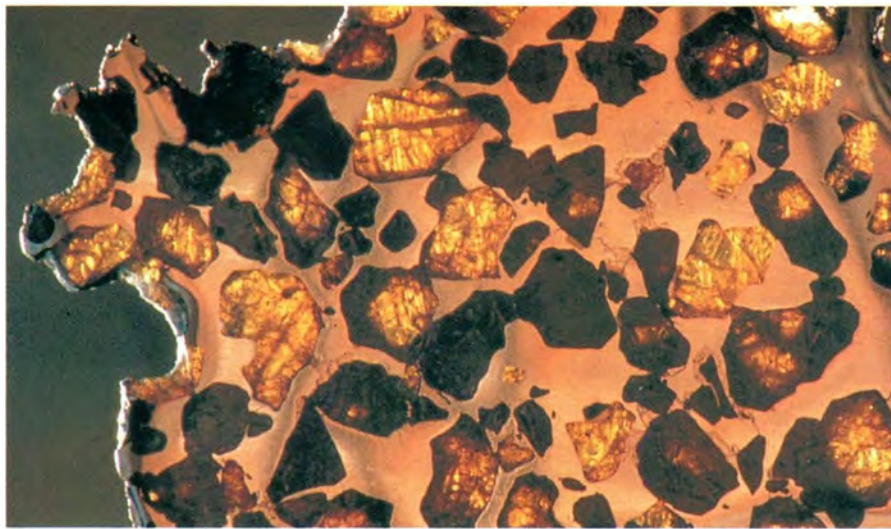


*A carbonaceous chondrite that fell on 28 September 1969 at Murchison, Victoria.*

*A slice of the stoney-iron pallasite that was discovered at Imilac, Chile. This meteorite exhibits olivine crystals in an iron-nickel matrix.*

*A cut, polished and etched slice of an iron meteorite found in Gibeon, Namibia, south-west Africa showing the well-defined Widmanstaetten pattern.*

*The polished interior of a stoney-iron meteorite, in which the rocks and metal have been mixed by collisions in the asteroid belt. This meteorite was found in Emery, South Dakota.*



*An iron meteorite of the Sikhote-Alin fall—the largest in recent history, dropping a total of 23 tonnes of material in 1947.*

Venus. We have even managed to sample the remnants of a few dying stars. If the astronomers of this decade had a wish, it would probably be to observe a nearby supernova, the violent death of a star. They had their opportunity last year when supernova 1987A blazed forth, being the first supernova event visible with the naked eye since the invention of the telescope. It may not have lived up to public expectations (after all it was so distant that the light we received had already left on its long journey before our ancestors had left their caves!), but the astronomers, eagerly awaiting such an event, were more than pleased. Almost simultaneous with its visual discovery, 19 ghostly, massless particles, called neutrinos, were detected at various laboratories around the world. So keen are scientists to study any material from beyond the Earth that these few particles resulted in the submission of over 100 scientific articles to one journal alone!

There is, however, one source of material from beyond the Earth that requires no telescope for its discovery or spacecraft for its recovery: the meteorites. Theoretically one has only to wait and this primitive material, left over from the formation of the solar system, some four-and-a-half billion years ago, will literally fall into our backyards. Unfortunately, falls of meteorites and their subsequent recovery are rare. Only when a meteorite is exceptionally large and falls near a centre of population, is it recovered. Most of the meteorites in museums have been found accidentally, many years, perhaps centuries, after their fall, and thus are called finds rather than falls. The most famous meteorite fall in Australia occurred at Murchison, Victoria, in September 1969. This meteorite broke into many small pieces that were subsequently found to contain organic materials, in particular amino acids, which are the building blocks of life. This one meteorite revolutionised scientific thinking on the possible existence of extraterrestrial life.

The world's most famous meteorite crater, Canyon Diablo, lies in the Arizona desert not far from Flagstaff. Almost two kilometres across, it is an awesome spectacle. It has been estimated to have been caused by a 35-metre-wide meteorite, between 25,000 and 50,000 years ago, the energy released on impact being equivalent to over ten million tonnes of TNT. An almost equally impressive crater (about 900 metres wide) is somewhat closer, but in a remote lo-





**A stony meteorite collected from Camel Donga in Western Australia, showing a shiny fusion crust.**

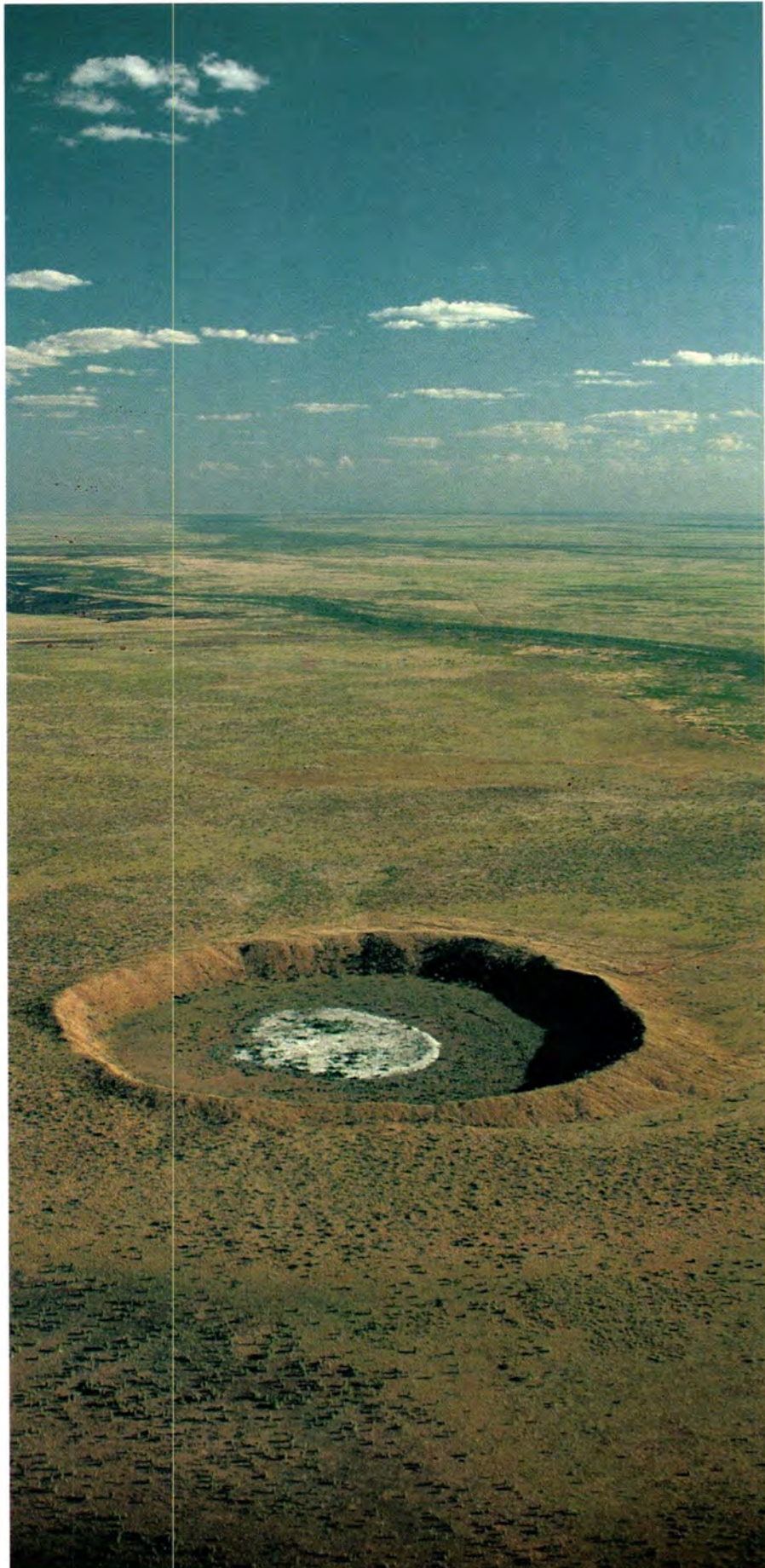
cation, at Wolf Creek in north-western Australia. Its difficult access has shielded it from public view. Another important but rather less impressive group of 13 craters lies at Henbury, not far from Alice Springs. The largest measures 200 metres across and together they occupy one square kilometre of ground.

Meteorites can take many forms. Some are rocks (the stony meteorites or chondrites), others metallic (the irons), and still others are a strange carbonaceous material similar to that which fell on Murchison. The most beautiful are loosely referred to as the stony-irons. Some of the rarest of these belong to a class called the pallasites, in which gem-quality olivine crystals reside in an iron–nickel matrix. Tiny diamonds can be found in others, a legacy of the immense forces produced on impact.

Although the stony meteorites are the most common to fall, they are not easily recognised, their only clue being a blackened crust formed during their fiery passage through the Earth's atmosphere. The iron meteorites are most easily recognised because of their striking metallic surface. When cut, polished and etched with a mild acid, they take on an entirely new appearance, often showing a pattern unique to meteorites—the Widmanstaetten structure. These patterns are the result of two iron–nickel alloys that show different resistance to acid etching and can only be formed by cooling at a rate as slow as a few degrees every million years. This slow cooling rate leaves no doubt as to the celestial nature of these materials.

The meteorites are to astronomers what fossils are to palaeontologists.

AUSTRALIAN NATURAL HISTORY



**Wolf Creek crater, north-western Australia, is about 900 metres wide by 50 metres deep. A total of 700 kilograms of meteorites have been recovered from the site, the largest weighing 150 kilograms.**





GLEN MOORE

**The nearly two-kilometre-wide Canyon Diablo crater in Arizona, USA. About 50,000 years ago a 300,000-tonne meteorite fell to create the world's best-preserved crater.**

Meteorites contain the original grains of the solar system and thus represent species that no longer exist. They are believed to originate in the asteroid belt between Mars and Jupiter, where the immense gravity of Jupiter suppressed the formation of a planet, leaving instead a ring of iron-nickel and stony debris. Although the pieces, some of which are up to 1,000 kilometres across, have been gradually grinding themselves down by mutual collisions, many large pieces less than 20 kilometres across still exist and are occasionally flung into orbits that approach Earth. These large fragments may represent our potential destruction, for, according to one popular theory, the extinction of the dinosaurs at the end of the Cretaceous (65 million years ago) occurred as a result of a collision of such a body with the Earth. Evidence has also been presented just a few months ago for a massive impact that occurred in the Pacific Ocean 2.3 million years ago, perhaps triggering the ice age of that time. Collisions as violent as 1,000 Hiroshimas are expected as often as once every 10,000 years.

When one handles a meteorite it is always with a great deal of awe, for these objects are older than any existing Earth rock (which formed after the formation of the Earth) and they contain the very materials from which our Earth was formed. It is clearly most important to investigate every meteorite fall and, if possible, recover material.

It was with great excitement that a copy of the *Sunday Telegraph*, on 21 December 1986, was received with the headline "Mystery UFO Crash Rocks Town!". All the signs of a great meteorite were contained in the story:



GEOFF SMITH, ROBERT HAAG COLLECTION

**An unusual graphite nodule found near the Canyon Diablo crater in Arizona. The specimen has been etched to show a fine network of metal within the graphite. Many small diamonds have been found in this meteorite, a result of the tremendous pressure exerted on such nodules during impact.**

shaking buildings, loud explosions and several flaming remnants falling to Earth. Only a few months earlier I was in Arizona, standing on the rim of that great, awe-inspiring Canyon Diablo crater, and shortly afterwards discussing with Robert Haag—one of the world's greatest meteorite hunters and collectors—what action should be taken the next time a major meteorite fall occurred in Australia. Here was an opportunity to put these ideas into practice.

Investigators from both amateur and professional organisations converged on Victoria's Strathbogie Ranges, coincidentally not far from Murchison, and conducted face-to-face interviews with the eye witnesses mentioned in newspaper reports, and then from house to house. It was vital that eye witnesses were contacted as

soon as possible in order to establish directions of their sightings and the appearance and sounds of the meteorite's fall. Reports were also collected over the telephone by both myself and Rob McNaught of the Earth Satellite Tracking Station at Siding Spring Observatory, but this was a slow process and it was soon obvious that no-one had witnessed an actual impact with the ground. To speed up the investigation, an article by reporter Geoff Adams was published in the main regional newspaper, the *Shepparton News*, rightly presenting the story as one of great importance and urging witnesses to come forward. Reports flooded in.

The area of the fall was narrowed down to the Mansfield district, much further to the east than anyone, including the Mansfield residents, ever suspected. The meteorite's line of flight was determined as roughly west to east, passing over the town of Euroa. Observers to the north of this line saw it move from right to left and observers to the south from left to right. Several witnesses in Euroa saw it apparently fall straight down in the east and a group on Mt Bulla saw it fall as it approached them from the west. A large proportion of the Mansfield residents were interviewed in an intensive survey lasting over a week. It became apparent that the meteorite broke into three pieces over Mt Samaria, shortly after flying over the rugged Strathbogie Ranges. There are, unfortunately, no inhabitants under the probable breakup point, and the fall would almost certainly have occurred in rugged country.

By this stage we were sure that it was a very large meteorite. The sound effects surprised everyone in a predominantly-farming community familiar with the sound of explosives, and were heard over 100 kilometres away. The fall was seen by an air-traffic controller in Tullarmarine, Melbourne, and as far north as the New South Wales border. In addition, both animals and humans reacted to that strange, poorly-understood phenomenon called electrophonics, whereby sounds appear to be transmitted as fast as light and strange 'hisses' and 'whistles' are heard.

Electro-phonetic sounds are presumed to be transmitted by electro-



magnetic means rather than by conventional sound waves. It was interesting to note that the only electrophonic phenomena noticed were close to the flight path and that, in the most striking case, the observer was building a large metal garage. His attention was first drawn by a 'hiss', and then to the sight of the meteorite. The possible role of the metal garage in creating the electrophonics may be of interest to researchers in this field. In other potential cases unusual animal behaviour was recorded in dogs and a horse, each showing a high level of agitation before the meteorite was noticed.

Meteorites usually enter the Earth's atmosphere at speeds of between 40,000 and 250,000 kilometres per hour, much faster than the speed of sound. This supersonic motion causes rumblings and then sharp detonations. The skin of the meteorite melts due to frictional heating and this material is blown off and forms a visible dust trail behind the meteorite. Only at a height of about 15 kilometres does the enormous air pressure slow the meteorite to below the speed of sound, at which point it usually breaks into several pieces. These pieces, which are often irregular in shape, then fall to the ground, whistling as they rotate. Observers close to the impact site will then hear a thump as the pieces finally reach the ground.

Most people who saw the Mansfield meteorite described it as a bright object—as bright as the moon or sun—that broke up into three pieces, continuing in the same direction. Everyone within 100 kilometres of the fall heard the detonations first, followed by the thunder-like rumblings. The sequence of sounds was reversed because the sound, created high in the atmosphere, was approaching Earth slower than the meteorite itself. This is why many of the observers heard the sound, looked up and only saw the dust trail. Only those near to the presumed impact site heard noises that could have been due to falling pieces, and in only one case was a whistle, followed by a thump, reported.

At the end of our week we had run out of witnesses. We knew the general area in which to look for the meteorite pieces but had no efficient means of looking. Information was given to the press and local authorities on what to look for, but success was limited on foot and eventually the searchers were forced to go home. Just when we had given up hope, television station

Channel 10 in Melbourne offered us a helicopter for a day.

A small group assembled at the foot of Mt Samaria a week later, including postgraduate astronomy student Mark Suters and myself. Geoff Adams was there, as were the local park rangers and, of course, a news team from Channel 10. Our main chance was to find substantial tree damage. As with the Sikhote-Alin meteorite, which fell in a forest in the Soviet Union in 1947, aerial searchers took three days to find the site. The trees near the Sikhote-Alin craters had been extensively damaged by airshocks and, therefore, our mission was to find similar effects. Such damage was found almost immediately and a ground inspection quickly established that several trees in a well-defined area had fallen in roughly the direction of the meteorite entry and at approximately the correct date (Friday 19 December 1986). However, no craters were found. One of the most intriguing effects was the suggestion of a glancing impact high on a tree trunk.

Our time at the site was limited and there was always the lingering doubt that the damage could have been caused by a windstorm. Yet I believe we were close to the fall. Perhaps we had walked right past it? Or perhaps

we were only 20 metres away from it? I doubt we shall ever know. And was the effort worth it? I believe so. To bring a rock from the moon costs billions of dollars, whereas a meteorite, if found quickly, will be less damaged and contaminated than any moon rock, and of course would be considerably cheaper!

What are the lessons to be learnt? If any meteorite is to be found from a fall there either has to be an eyewitness account of an actual impact (an unlikely event), or a crater in a well-frequented area. Alternatively, greater public awareness of the phenomenon of meteorite falls, and public co-operation in providing useful sightings, could help increase the number of recoveries. This is where the press can play a part, as with the Mansfield fall, where a newspaper took up the cause in a responsible way. This time we did not 'catch a falling star' but we are better prepared for the next. ■

*Anyone who has information on probable meteorites, or phenomena likely to be associated with meteorite falls, should contact the Australian Museum. The Australian Museum has one of the largest collections of meteorites in Australia. Why not visit the Museum's meteorite display?*



**Meteorite craters at Henbury, Northern Territory.**

WILDON TRANNIES



## RARE & ENDANGERED Matchstick Banksia

**B**anksias are a group of plants familiar to most Australians. These shrubs and trees, with their conspicuous flowering cones, are found from the coast to the mountains, in forests, wetlands and heaths, along rivers, near the snow and in many people's gardens. All of the 74 species currently known to science are found in Australia, with one species extending to New Guinea and adjacent islands. By far the richest area for banksias is south-western Australia where 58 species occur. It is here that one of the rarest, the Matchstick Banksia (*Banksia cuneata*) is found.

Identified as recently as 1981, the Matchstick Banksia is confined to remnant vegetation in the wheatbelt area of Western Australia, within a 50-kilometre radius of the town of Quairading. It is a gazetted rare species and has been accorded a conservation status of '2EC' ('2' meaning a species with a natural geographic range of less than 100 kilometres; 'E', an endangered species that may disappear from the wild within one or two decades if present land use and other causal factors continue; and 'C', a species known to occur within a national park or proclaimed reserve).

Four very restricted populations of the Matchstick Banksia are known: three on roadside verges and one in a small nature reserve. A recent survey found fewer than 300 plants in the

wild, with individual populations ranging in size from one to 100 plants. The population in the nature reserve is the most perplexing. In 1982 its size was estimated at more than 300 plants; but a survey in April 1987 located fewer than 50 plants. The reasons for this startling decline are not clear; there is no evidence of recent disturbance such as fire, and no dead plants were found!

The Matchstick Banksia is a large shrub with smooth, grey bark and serrated, wedge-shaped leaves. Together with the Holly Leaf Banksia (*B. ilicifolia*), it is placed in a separate subgenus (*Isostylis*) from all the other species. The two species produce inflorescences, or flowering heads, which, unlike most banksias, are not elongated but are rather short and tufted. In the Matchstick Banksia these inflorescences are borne at the

tops of the branches during spring and early summer.

Each inflorescence may contain up to 100 individual flowers. These are long and narrow, initially pink with a green apex, later becoming creamy yellow. Unfertilised flowers fall from the inflorescence axis, which then resembles a bright orange button. The two-centimetre-long fruits (follicles) are woody with soft downy hairs. They are bivalved with each valve containing a single winged seed. Follicles remain closed on the branches for a number of years until either the branch dies or a bush fire kills the entire plant. They are held closed by a resin that breaks down with time or can be melted during a fire.

This fire-related seed release is found in a number of *Banksia* species, many of them common, and in plants from other genera. It has possibly contributed to the decline of the Matchstick Banksia because of changes in fire regimes occurring in the wheatbelt since settlement. Fires that occur too frequently will prevent re-establishment of the populations, as the young plants will not have developed a large seed store (plants take four to five years to flower).



PHOTOS: BABS & BERT WELLS

*This plant is growing on a roadside verge near Quairading, Western Australia.*





Alternatively, long periods between successive fires result in plant death before seeds are released.

Since settlement, 90 per cent of what is now the wheatbelt area has been cleared. Native vegetation is now confined to rocky outcrops, roadside verges, small pockets on farms, and the occasional small nature reserve. Degradation of this remnant vegetation through land salinisation, rabbit infestation, weed invasion and altered fire regimes may have contributed to the current vulnerability of the Matchstick Banksia. Because the Matchstick Banksia has only recently been identified, little is known of its past distribution. One wonders how many other species are in a similar predicament and how many have disappeared or will soon go, perhaps before we are even aware of them.

We are currently studying the effects that fire, weed control, rabbit and insect exclusion, direct hand-sowing and seedling transplantation have on the Matchstick Banksia. The aim of the study is to explore ways of maintaining present populations and

*The short, tufted flowering heads of the Matchstick Banksia.*



*Each bivalved, woody fruit (follicle) encloses a single winged seed.*

establishing new populations by manipulation of the environment. Realistically, however, the species may have no future in the wild; its only chance for survival being through its release as a horticultural plant. Such a decision may soon have to be made. ■

—**Stephen Connell, Byron Lamont and Stephen Bergl**  
Curtin University of  
Technology, WA



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# QUIPS, QUOTES & CURIOS

## Alice, the Dodo and the Tambalacoque Tree

If you were asked to name the most famous bird on Earth, if not *Archaeopteryx* your answer would most likely be the Dodo (*Raphus cucullatus*). After all, many of us were introduced to it at an early age in *Alice in Wonderland*. Despite the fact that the Dodo is perhaps better known for its extinction than as a living species (it was one of the first animals in our recent history to become extinct), most of us can conjure up an image of the Dodo. Basically just an over-sized, flightless pigeon, with a large head and heavy, hooked bill, it was a most extraordinary bird—one that had evolved its many peculiar features during its isolation on the remote island of Mauritius,

about 800 kilometres east of Madagascar.

The Dodo's story most probably began about two million years ago, when its ancestors flew from Africa or Madagascar to Mauritius—a land teeming with fallen fruits and seeds, and devoid of predators and competition. It was under these idyllic conditions that the Dodo became plump and lost its power of flight; its wings were mere shadows of their former selves, the body feathers soft and downy, and the once-aerodynamic tail reduced to an absurd tuft of curly feathers.

All was well until Portuguese sailors arrived in 1507, followed soon after by the Dutch, the French and the English.

With a lack of readily available meat, the early Mauritian settlers took to slaughtering the birds. This

was found to be an easy task, for the birds, naive to any form of danger, offered little resistance and practically walked into their cooking pots. The birds' lack of fear, together with their ungainly waddle, gave these early settlers the impression that they were stupid (hence 'dumb as a Dodo').

However, it was not so much the sailors' deliberate destruction that led to the birds' demise, but the indirect effect in the form of domestic animals they brought with them: pigs habitually root up the forest floor, disturbing ground-nesting birds, and macaque monkeys are notoriously fond of eggs and young. These animals, which also found conditions on the island idyllic, quickly multiplied. And since the Dodos were supposed to have laid only one large, white egg that both parents incubated, it is not surprising that, within 200 years of the bird's discovery, the expression 'dead as a Dodo' had become a tragic reality.

In preparation of the birds for eating, the early settlers reported single, large stones the size of hens' eggs in the gizzard, which no doubt would have helped grind up hard seeds. It is with this piece of information that I introduce an intriguing but hotly-debated issue concerning plant-animal mutualism.

Stanley A. Temple reported that the Tambalacoque tree (*Sideroxylon grandiflorum*), once common in the upland forests of Mauritius, was today only represented by a handful of trees, all older than 300 years. The trees produce fertile seeds surrounded by a thick endocarp (stone or pit), which, according to Temple, can be 15 millimetres thick and

"mechanically resists the expansion of the embryo within" (*Science* 197: 885–86, 1977). For the seeds to germinate, then, it seemed that the thick pit would have to be abraded and thinned down, a task that could well have been accomplished by passage through a Dodo's gizzard. Matching the age of the surviving trees with that of the Dodo's demise, Temple concluded that the present near-extinction of the Tambalacoque tree is due to want of a Dodo. A thick pit that evolved to resist damage in a Dodo's gizzard is a pit too thick to germinate without the Dodo's intervention.

Temple 'empirically' backed up his theory by extrapolating a curve that plotted size of modern birds against the force generated by their gizzards. For a bird the size of a Dodo he estimates that the Tambalacoque pits were strong enough to resist destruction. He also force-fed Turkeys (the closest modern analogue to the Dodo) with 17 pits and, from the ten that weren't crushed, managed to germinate three. These, he claims, may well have been the first Tambalacoque seeds to germinate in 300 years.

Temple's 'just-so' story received immediate publicity. And the fact that it is an example of a *plant* that declined after the extinction of its associated *animal* (especially the infamous Dodo), rather than the other, more usual way round, made the story even more attractive and has led to its treatment as textbook dogma.

Yet serious doubts have been expressed about the Dodo's role (or at least lack of one) in the declining numbers of Tambalacoque trees. Principal among these



KAREN HANDLEY

Painting of the Dodo, said to have been drawn from nature.



comes from A. Wahab Owadally of the Mauritian Forestry Service (*Science* 203: 1363–64, 1979) and Anthony S. Cheke *et al.* (*Animal Kingdom* Feb./Mar. '84: 4–6; 51). They claim that the seeds do not require animal intervention to germinate, or any other form of mechanical abrasion. In fact the first seeds ever to germinate in the Forestry Service received no treatment. They were sown in December 1971 and germinated in April 1972, which incidentally was *before* Temple germinated his 'Turkey' seeds, thus falsifying his claim to have germinated the first Tambalacoque seeds in 300 years! The Forestry Service used to treat seeds to induce germination, but later abandoned the technique when the difference in germination rates for untreated and treated Tambalacoque seeds was found to be insignificant.

There is also a well-defined, asymmetrical fracture zone in the Tambalacoque's hard pit (similar to that in a walnut). Its very reason for existence is that when the pit can no longer accommodate the swollen embryo, it splits along this line of weakness. The smaller portion, which breaks away much like a skullcap, is only five millimetres thick—not the uniform 15 millimetres all the way round as implied by Temple.

Another major doubt revolves around the age of the surviving Tambalacoque trees. A survey conducted in 1941 by R.E. Vaughan and P.O. Wiehe indicated a significant stand of trees that were less than 100 years old. And, if this is the case, the Dodo, which became extinct about 300 years ago, cannot have been instrumental in their germination.



Temple bounced back by announcing that the trees are difficult to age (they have no rings; age estimates are based on relative girths and heights) and that Wiehe was also involved in the age estimates for *his* trees. As both Vaughan and Wiehe are now dead, we might have to wait 84 years before we know just what 100-year-old Tambalacoque trees look like (a 16-year-old tree is growing in the campus of the University of Mauritius, planted from one of the seedlings germinated in the Forestry Service) and how they compare to so-called 300-year-old trees.

How then do these debunkers explain the tree's rarity and apparent standstill in germination? Firstly, the trees have never been as common as Temple implied and, by the same token, are not as rare today as he claims. Secondly, just as the Dodo was disturbed by the introduction of exotic animals and plants, so too was the Tambalacoque tree and the whole of the ecology of the forest. In addition to the pigs that root up and disturb

### **Many of us were introduced to the Dodo through Alice in Wonderland.**

the forest soil, and the monkeys that are fond of unripe fruit including that of the Tambalacoque tree, the sailors also introduced browsers (deer and goats), grazers (cattle) and seed and seedling-eaters (rats). If a seedling manages to escape the attentions of these animals, it then has to battle with the fast-growing, gregarious, exotic trees and shrubs. Given these negative influences, and the fact that the seeds have proved to germinate spontaneously, Tambalacoque trees would still be in a sorry state today, with or without the Dodo.

So why does the Tambalacoque have such a tough pit if it did not arise out of mutualism with the Dodo? Temple's suggestion that it evolved to resist damage from animals is probably correct. But not just that which was brought about by the Dodo's gizzard. There were also strong-beaked giant tortoises and a large-billed parrot (all now extinct) that could have damaged a

large, edible seed.

In summary, Temple's hypothesis is an astute example of scientific logic, but one that can't be proved, just as much as it can't be disproved. His case, as does his anti-case, rests on a lot of circumstantial evidence, much of which is not included here. Owadally and others in no way dispute the fact that the Dodo may have eaten and abraded the Tambalacoque pits, and passed them out intact to subsequently germinate; what they do debate is simply the idea that these seeds had become *dependent* on the Dodo (or any other animal) for their germination.

One final point. In Alice's fantasy world, she and her curious bunch of acquaintances were sopping wet and were seeking a method to dry out. The Mouse told a 'dry' story without success; so the Dodo suggested a 'Caucus-Race'. He mapped out a racecourse on which he placed the contestants; and at their own time, whenever each was ready, they started running. After about half an hour, when all were dry, the Dodo announced the race was over. When asked who won, the Dodo, after much deliberation, said "Everybody".

Just as nobody loses in the Caucus-Race, there are no losers in the Dodo's real-life story. Temple *versus* Owadally is not a case of who wins and who loses; nor should the Dodo be thought of as having 'lost' through its extinction. Every creature, whether living or extinct, and every healthily-debated scientific issue, contributes to a much greater, complex whole. In this respect, Temple, Owadally, the Dodo and the Tambalacoque tree are all winners.

—G.H.





## Toxic Plants and Animals: A Guide for Australia

Ed. by J. Covacevich, P. Davie and J. Pearn. Queensland Museum, South Brisbane, 1987, 504 pp. \$28.00.

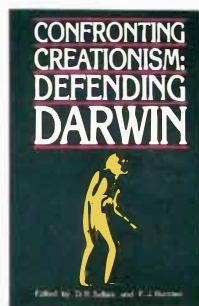
We have long frightened our English cousins with tales of our venomous animals, and boasted to our Texan friends that their rattlesnakes are gnats compared with our Taipans, but it has not always been easy to quote chapter and verse. This is now possible with the publication by the Queensland Museum of a guide to Australian toxic plants and animals. The book is overwhelmingly about animals; only about 13 per cent is devoted to toxic plants and these have a distinctly Queensland flavour. The animal section is, however, comprehensive. It contains, of course, excellent chapters on the expected: snakes (nine chapters including an excellent pictorial key to use while you wait for the doctor), spiders, seawasps, blue-ringed octopuses and so on, but there are also some unexpected and usually unsuspected 'villains': rove beetles, poisonous sea turtles, frogs and crabs, and 'nettle-rash' moths. There are three timely chapters on ciguatera (food poisoning from reef fish).

Among the wealth of tables there is one that will

delight primary school children: in a survey at a Queensland University Open Day, doctors and medical students together correctly identified 25 per cent of a sample of venomous snakes; school children achieved 24 per cent, and biology graduates only 16 per cent.

I found only one error. Mike Gray gives the correct distribution of the Sydney Funnelweb, but in the next chapter, written by an editor, it is said to be confined to a small area around Sydney Harbour. My apologies to the producers of an excellent survey for this little sting in the tail.

—Arthur Woods



## Confronting Creationism: Defending Darwin

Ed. by D.R. Selkirk and F.J. Burrows. New South Wales University Press, Kensington, 1987, 158 pp. \$14.95.

Have you ever opened the door to be confronted by Paul Keating look-alikes professing the secret of life eternal and all in the name of the Church of Jesus Christ or the Latter Day Saints or some even more outlandish organisation? If so, this book is a *must* for you. For not only will it enable you to turn such moments of horror into hours of joy as you point out the idiocy of their beliefs but, as they flee abjectly from

your door, you may find that you will never have to endure such visitations again.

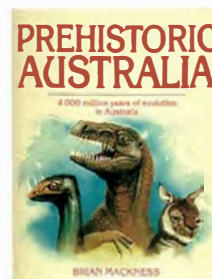
On a more serious note, however, I can recommend this book as one of the most outstanding contributions to our science and society that I have read. On the one hand it exposes 'Creation science' for the debauched and dangerous perversion that it is, and also the cynical way it is sugar-coated for the consumption of educators and students. On the other it presents, in an easily-understandable and masterfully-written way, the scientific basis for evolution.

Perhaps the best thing about the book is its accessibility. Facts are easily found, and unnecessary scientific terminology is avoided. It is ideal reading for upper high school or undergraduate university students. Indeed, I feel that this book should be essential reading for all high school students, for not only does it set out the basis for the theory of evolution, it also explains the basis of the scientific methodology. An understanding of scientific methodology is sadly lacking, in my experience, in many first-year university science students. This leaves them floundering in many science classes, and vulnerable to the nonsensical but seductive doctrines of fringe religious groups.

Finally, the authors must be congratulated for spending the time and effort in putting together such a fine and useful volume. With the growing pressure to be productive in their own narrow fields, scientists all too rarely get the credit that they deserve for more popular works. Special note must be made

of Associate Professor Michael Archer, who took time out of his busy schedule to contribute almost half the papers in this book.

—Tim Flannery



## Prehistoric Australia

Brian Mackness. Golden Press, Sydney, 1987, 191 pp. \$39.95.

With *Prehistoric Australia* Brian Mackness realises his dream, kindled at an early age, to find an easy-to-read, popular account of the fossil history of Australia. Tired of waiting, he decided he should write it himself. But instead of launching into it on his own he took the time to thoroughly research the subject (no mean feat on its own) and consult with the scientific specialists in the various branches of palaeontology. As can be seen from the acknowledgements, this entailed 'picking the brains' of many well-known palaeontologists who themselves realised the need for such a book. They would have been only too pleased to give assistance and advice to someone with the persistence to gather together the widely-disseminated knowledge and information, and bring them together in this commendable work.

Mackness sets out to document the history of life on our continent from 4,000 million years ago to the arrival of humans. This he does chronologically, as



would be expected. He deals with groups of animals and plants, and emphasises some for each geological period.

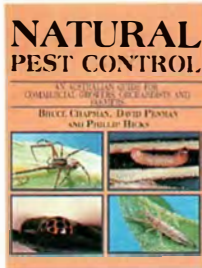
The title may not be all that original—quite a few books lately have appeared with similar ones—but at least it gives you a good idea of the contents. The illustrations are numerous and generally of a high standard. However, too many different artists have been used, which gives the work a lack of uniformity of artistic style. A couple of the black and white drawings are of poor quality and I feel it would have been best to stick to the better artists. The quality of production is generally good. It's a pity it could not have been full colour but I expect that would have greatly increased the price.

Occasional typographical errors and spelling inconsistencies ('Palaeozoic' also spelt 'Paleozoic') were noticed; and a few production hiccups stood out. But as for the scientific content, the way in which the book was researched and checked before publication means that its accuracy cannot often be faulted. It is as up-to-date as possible within the constraints of publishing.

The inclusion of a bibliography is a pleasing attribute—one that should be well used by those wishing to delve deeper into Australia's past. Another plus is its comprehensive index, a must for all books of this type.

In brief, *Prehistoric Australia* is easy to read and would be suitable for an audience from early high school onwards. It fills a niche that has too long been vacant in Australian publishing. The book also won the 1987 Whitley Award for the category 'Best Prehistory'.

—Robert Jones



**Natural Pest Control: An Australian Guide for Commercial Growers, Orchardists and Farmers**

*B. Chapman, D. Penman and P. Hicks. Nelson, Melbourne, 1986, 115 pp. \$19.95.*

This is an excellent little book with an unfortunate title. It suggested to me an offering from what was once, rather impolitely, called the 'muck and magic school' (organic farming), whereas it is, in fact, a competent introduction to integrated pest control and management.

The concept behind integrated pest control is that pests (or, rather, their damage) are best controlled by applying several methods together in a way that causes as little environmental disruption as possible. Any severe, one-pronged attack will lead to problems and, in particular, to the development of a resistance in the pest population. The book outlines the various modes of attack, and then closes with a guide to their integration.

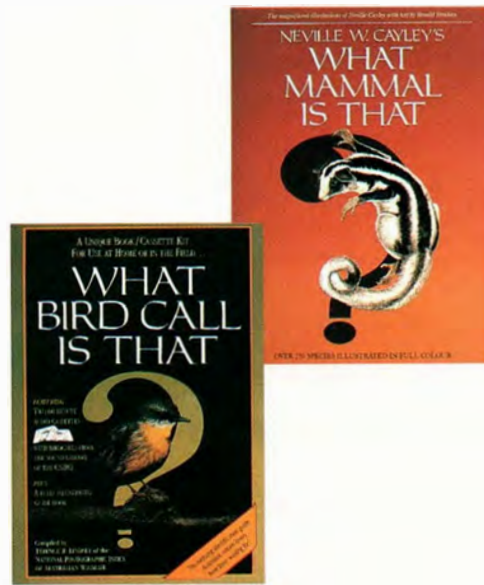
Unfortunately the book originated in New Zealand and has not been thoroughly 'ockerised'. The principles are the same there, but the pests are often different.

Finally, the emphasis is on pest control for small holders, not farmers. The publishers should keep the text but change its title.

—Arthur Woods

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## ROBYN WILLIAMS

### A Soviet Encounter

One afternoon in the Soviet far east, nearly ten years ago, I received a very odd 'phone call. "Is that Dr Williams from the hydrology section?" asked the voice. "No," I replied, "not doctor, nor from the hydrology section [of the Pacific Science Congress]. But my name is Williams." The man grunted and hung up. Ten minutes later, the same happened. I vouchsafed that I was a journalist, not a hydrologist, and would he care to call another hotel—mine was but one of several being used to house delegates from over 70 countries.

Ten minutes later, there he was again. Perhaps he expected me to say "The pink owl flies over the Volga at midnight!", at which point he would reply "Ah, but the green goose layed 18 eggs last Tuesday," whereupon we would exchange microfiche and US dollars.

But no more calls that day. However, at 6.30 the next morning, there he was again. "Dr Williams? I would like to show you my book about the man who invented space travel, deep-sea diving and the modern theories of respiration more than 100 years ago!" This must be the password, I thought, the coded message giving me the cue to respond. "I would like to come now," he added.

Ten minutes later someone tapped on my door. It opened and in came a smiling fellow in his mid-fifties waving a string bag. "Feldmann," he announced. "Gabriel Feldmann, and here is my volume. You must look. This is Paul Bert who made space flight possible."

"D'you mind if I get dressed?" It was no more than quarter to seven in the morning. Gabriel Feldmann sat next to me, smiling, indeed beaming like Mo, the Australian comedian. He wore a white beret and flourished his books. One was about Paul Bert, statesman, scientist, visionary, whom I'd never heard of. The other was on J.B.S. Haldane, geneticist, mathematician, Scottish bomb-thrower and eccentric, who I knew very well.

Feldmann turned out not to be a spy. He was a lowly researcher at the

Soviet Academy of Sciences in Moscow, unstoppable enthusiast about Bert, and president of his local Robert Burns Society. I persuaded him to leave me to my ablutions and come back in the afternoon to be interviewed. When he returned I had a little 'duty-free' prepared (for the benefit of us both). The recording did not go well. Feldmann was fine in the build-up about the extraordinary Bert, but he'd somehow forgotten how it came to be that Bert had invented deep-sea diving and space flight so long ago. "Never mind," I said, "have another drink"; after which Feldmann put on his beret and went off, swinging his string bag, waving cheerfully as he spotted friends in the street.

A week later I was in Moscow. I had ten days in front of me to see leading scientists. The trip had been organised from Sydney where we had received no replies from the Soviet end of things, despite countless telexes, letters and calls. I was at the gigantic Rossia Hotel, just off Red Square. There were three prime contacts on whom I depended totally for help during my stay: the Soviet Academy, the Australian scientific attaché and our correspondent, David Willis, a reporter for the Christian Science Monitor who was 'stringing' for the ABC.

I called David. He said "Look I'm sorry, but I can't see you for a week. By the way, the Soviet Academy won't talk to you, and the scientific attaché has gone to Mongolia for a two-week emergency visit. Good luck!" Click.

All my arrangements had collapsed. I couldn't leave the hotel in case someone 'phoned, and I couldn't call anyone myself because there were no telephone books in Moscow. Our embassy was sympathetic but powerless. The British scientific attaché was pleasant, bought me a meal and said it often took months for anyone to see journalists in Moscow. It seemed that ten days was not enough. I sat in my room. Waiting. Looking at the walls. Reading my tenth book borrowed from the Australian Embassy.

Three days passed. Then I remembered the extraordinary Feldmann. Was he simply a dear eccentric? He'd

given me his number. I called. He was typically effusive: "I'll come, all will be organised."

I doubted it. This was more than a dotty fan of Rabbie Burns could fix. However in half an hour or so I stood outside the Rossia and saw him approach, still with white beret and string bag. Once in my room Gabriel Feldmann picked up the 'phone and began to use it as David Oistrakh once used the violin. Never have I witnessed such creative dialling. Clues were chased, bureaucrats circumvented, contacts exploited. He waved his hands, threatened the ceiling, caressed the handpiece. "We make progress," he smiled after an hour. "This next fellow I went to pioneer camp with in 1937." More dialling. Another hour.

Finally, Feldmann got up, presented me with the telephone and said "This is Ivanov, talk to him. He will organise anything you want." And so it turned out. Within 30 minutes a car was outside to take me to my first academician. The rest of my stay in Moscow turned into a triumph of productivity.

I last saw Gabriel Feldmann disappearing into the crowds of Red Square, his trusty string bag still full of books about Bert. He'd given me one, written in Russian of course. So I still don't know how the old chap had ushered in space travel so long ago. There is no doubt that my stay in Moscow would have been a disaster without the remarkable Gabriel Feldmann. He sent me a few letters to Australia in later years. They bore no stamps or postmarks, having been hand-delivered by some Australian traveller unknown to me. He wrote of Burns and Haldane and curious things. I still have that aborted interview we recorded in the Soviet far east. Perhaps one day I'll play it on air. ■

*PAUL BERT (1833–1886) was a French physiologist, statesman and lawyer, also trained in engineering. He studied the effects of compressed air on the body. His research helped the many workers building tunnels under rivers and laying the foundations for bridges, whose use of compressed air gave them the bends. He was a member of the French Chamber of Deputies from 1874–1886 and latterly a Cabinet minister in charge of public instruction. His research laid the basis for the study of aviation medicine from the 1940s.*



## POSTER Northern Spiny-tailed Gecko



FORD KRISTO

The Northern Spiny-tailed Gecko (*Diplodactylus ciliaris*) is the largest member of a group of at least 11 closely-related gecko species that share a defence mechanism unique amongst terrestrial vertebrates: an ability to squirt from the tail a thick liquid that dries into a sticky web of threads on contact with air. Although the secretion is apparently non-toxic, the combination of shock and discomfort probably wards off many potential predators.

The glands that produce the sticky secretion are located deep within the tail. These are 'fired' when muscles surrounding the glands contract and force the secretion through specialised 'rupture zones' in the muscle and overlying skin of the tail. In some cases, the secretion has been reported to squirt up to 50 centimetres.

Should this defence mechanism prove unsuccessful, the Northern Spiny-tailed Gecko has two other alternatives. Like almost all other geckos, it can voluntarily shed (autotomise) its own tail, either par-

tially or completely, leaving the squirming tail to distract the predator while the gecko makes its escape. The gecko can also suddenly swing its head and open its mouth wide, revealing a mouth and tongue colour that contrasts strongly with the otherwise well-camouflaged body. In most populations, the mouth is a bright orange-yellow, although in some north-eastern populations, and in other species of spiny-tailed geckos, the mouth is blue.

The species name (*ciliaris*) refers to the long, soft spines that overhang the eye (supraocular spines). Together with a paired row of russet, orange or black spines on the tail, and a daylight colour pattern of russet or brown patches on a grey or brown background, the supraocular spines provide camouflage, breaking up the body outline, obscuring the eye, and matching the colour of the branches on which the geckos perch by day.

The Northern Spiny-tailed Gecko grows to over 12 centimetres in total length, and occurs over much of arid and tropical Australia. Spiny-tailed

geckos are arboreal and nocturnal, most active in the first few hours following sunset while the substrate is still warm, and feed on spiders and insects, especially beetles, crickets and insect larvae. When active, or when exposed to high temperatures by day, the spiny-tailed geckos pale to a uniform silvery grey colour, reducing the rate of heat gain by day and colour-matching moonlit objects by night. The pupil of the eye is vertically elliptical, closing to a narrow slit joining a series of pinprick-like holes by day, and opening wide when active at night to receive the maximum available light.

Like all Australian geckos, spiny-tailed geckos lack moveable eyelids, and the large eye is protected from drying out by a thin clear spectacle. The outer layer of this spectacle is shed with the rest of the skin. Should the spectacle become dusty, the gecko can clean it by licking it with the broad fleshy tongue.

—Glenn Shea  
University of Sydney





FORD KRISTO





Ornamental plants are invading the Australian bush; meanwhile, Australian natives are becoming pests overseas.

# Invading Ornamentals

By TIM LOW

The Iceplant (*Mesembryanthemum crystallinum*) has looks that kill. Crowded along its leaves and stems are glistening cells of intensely salty water. When an Iceplant dies this salt leaches onto the soil surface, forming a miniature salt desert in which nothing can grow. It may take years before rains remove enough salt for new plants to survive. But the first seedlings to sprout in the subsaline soil are inevitably more Iceplants, and the cycle continues.

A native of South Africa, Iceplant has become a serious weed of pastures in southern Australia. Its habit of accumulating and concentrating salt from the soil is having devastating effects. How tragic that Iceplant was introduced to Australia deliberately—because its invidious salt cells look ornamental. The whole plant sparkles alluringly as though coated in crystals of sugar.

The Iceplant is but one of thousands of plants spread around the world for the sake of its ornamental appeal. Like Lantana (*Lantana camara*), Gorse (*Ulex europaeus*) and hundreds of other shrubs and trees, it readily runs wild to the detriment of native plants and natural ecosystems. Indeed, ornamental plants are be-

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*The South African Bitou Bush, introduced to Australia as a garden plant, has become one of Australia's worst bushland weeds, especially around Adelaide, Melbourne and along the coast of New South Wales and Victoria.*





***Iceplant is an eerie ornamental plant turned weed. Its leaves and stems are covered in sparkling cells of salty water. Up to 12 per cent of its dry weight is salt (sodium chloride).***

coming so widespread and ubiquitous in the wild that their dispersal by people has become a significant factor in world plant distribution.

In Australia, many garden plants displayed a dispensity for weediness soon after they were introduced. Soursob (*Oxalis pes-caprae*), Gorse and Iceplant had become weeds by the turn of the century. Of more current concern are those garden plants, cultivated in Australia for decades, that are only now going feral.

Bushwalkers in Sydney heathlands may have noticed the rise of dense thickets of the garden plant called Asparagus Fern (*Protasparagus densiflorus*), an import from South Africa. In southern Queensland this plant does not yet form thickets, but Brisbane biologists are concerned, for it is becoming common in the wild. Single plants are appearing in coastal heaths and along rainforest margins, the seeds carried by birds. In another 20 years or so there may be spiky Asparagus Fern thickets throughout southern Queensland, just as in Sydney.

The Camphor Laurel (*Cinnamomum camphora*) of China and Japan is another tree on the move. In hills east of Lismore it has formed dense forests in place of rainforests cleared for grazing. Camphor Laurel



saplings are now common along Sydney streams, and within 15 years are likely to choke out native trees.

On Moreton and Bribie Islands near Brisbane, dense thickets of Umbrella Trees (*Schefflera actinophylla*) have sprouted within eucalypt forests near the small townships. An Umbrella Tree thicket has also appeared in a forest in western Brisbane. But the Umbrella Tree is a curious case, for unlike most of our ornamental plants it is a native tree. It grows naturally in damp forests in northern Queensland, and is rapidly becoming a feral species 1,300 kilometres south of its normal range, its seeds spread by birds.

The Umbrella Tree is far from

***Lantana was introduced to Australia as an ornamental plant and now infests an estimated four million hectares of bushland and pasture.***

unique. Thanks to the efforts of native plant-growers, growing numbers of ornamental Australian plants are spreading into forests outside their natural range.

In Belair Recreation Park near Adelaide the dainty Bluebell Creeper (*Sollya heterophylla*) from Western Australia has become one of the most common forest vines. First recorded there in 1952, it is now considered by Peter Kloot of the South Australian Department of Agriculture to be a potentially serious weed. It flourishes



alongside two other misplaced natives, Sweet Pittosporum (*Pittosporum undulatum*) and Silky Hakea (*Hakea sericea*), both from eastern Australia.

Other travelling 'natives' include the Common Kangaroo Apple (*Solanum aviculare*) of eastern Australia, which now grows wild near Perth in Western Australia and Port Lincoln in South Australia. Coast Tea-tree (*Leptospermum laevigatum*) was transported from Victoria to South Australia, and Cadaga (*Eucalyptus torelliana*) from Cairns to Brisbane. Western Australia's Golden Wattle (*Acacia saligna*) can now be seen growing wild along the coasts of New South Wales, South Australia and southern Queensland.

These plants challenge the very concept of a 'native' plant. Australia is a continent in one country. Had Australia been carved into a number of European-sized republics, we would not have the absurd notion of a plant from Perth being considered a 'native' in Sydney. (Perth is further from Sydney than Istanbul from Amsterdam, and a Turkish plant grown in Holland would hardly be considered a native.) This broad definition of 'native' plants has exacerbated the spread of ornamental plants, as more and more 'natives' go walkabout, altering the balance of native ecosystems, and even changing canopy structures and ground-cover densities.

The success of Australian natives elsewhere in Australia has its parallel overseas. Ornamental plants from Australia now run wild in many regions of the world. In southern Europe, seven Australian wattles grow wild along the coasts and plains between Portugal and Romania. California's wild roadside vegetation includes five Australian wattles and three eucalypts. Hawaiian rainforests are being invaded by Queensland Silky Oaks (*Grevillea robusta*), and the Silky Hakea of eastern Australia has become a weed in Europe and New Zealand.

None of these infestations can be regarded as serious, but there are two regions of the world, Florida and South Africa, where Australian shrubs and trees are bringing devastating effects.

In Florida, the Paperbark Tea-tree (*Melaleuca quinquenervia*) and the Coast She-oak (*Casuarina equisetifolia*, known locally as Australian Pine) are displacing native vegetation in swamps and along shores in the



TIM LOW

**The South African Asparagus Fern (not a true fern) is rapidly becoming a weed of heaths, coastal dunes and rainforest margins in coastal New South Wales and southern Queensland.**



TIM LOW

**Gorse was introduced to Australia from Europe as a hedge plant and ornamental. It had become a weed in Victoria by the 1880s and was declared noxious in 1908. An acre of Gorse plants can produce 15 million seeds, some of which stay dormant for up to 25 years.**





**Native Poplar, a small tree of rainforest edges in eastern Australia, has become a significant forest weed in South Africa.**



**Western Australia's Bluebell Creeper is becoming a common bushland weed in the southern Lofty Ranges near Adelaide, where this plant was photographed. Its sausage-shaped berries are edible to people and birds, and the latter are no doubt spreading the seeds.**

Everglades. Frank Craighead, writing in *The Trees of South Florida* (University of Miami Press, 1971) derided the she-oak as "a most serious problem in the preservation of native vegetation in South Florida". She-oak also runs wild in Mexico, the West Indies and South America.

In South Africa, three Australian hakeas (especially Silky Hakea), eight wattles and the Coast Tea-tree are choking out the native fynbos, one of the world's richest plant associations.

The destruction posed by Australian hakeas was first recognised 60 years ago, when prickly hakea thickets sprang up along the streambeds of the South African Cape Mountains. The problem became so acute that a Hakea Conference was held in 1961, and programs of burning, culling and biological control were begun. An aerial survey in 1977 found that 40 per cent of an area of 960,000 hectares was infested. The hakeas, which are proclaimed noxious weeds, continue to spread.

Eight species of Australian wattle are also causing heartache. Introduced to South Africa as ornamentals, dune-stabilisers or as sources of timber, tannins or firewood, they have become invidious invaders of fynbos areas disturbed by grazing and burning. By fixing soil nitrogen they enrich the soil, creating habitat unsuited to native plants. South African weed ex-

perts A.V. Hall and C. Boucher contend that Australian wattles "have polluted our vegetation and our landscapes. We may draw a parallel to air pollution. . .". One of South Africa's rarest plants, *Homoglossum aureum*, is actually threatened with extinction by choking thickets of the Golden Wreath Wattle, known there as Port Jackson Willow.

A curious phenomenon prevails along South Africa's coasts, where Australian wattles are replacing the native Bitou Bush (*Chrysanthemoides moniliferum*). This process is proceeding in reverse in Australia, where thickets of Bitou Bush, a declared noxious weed in Victoria, are choking out stands of Golden Wattle (*Acacia longifolia*) along beaches in Victoria and New South Wales. It appears that the success of each plant in a foreign land is due to the absence of its predators and parasites.

Hall and Boucher, in discussing a list of South Africa's worst weeds—including hakeas, wattles, Coast Tea-tree and the Australian Native Poplar (*Omalanthus populifolius*)—conclude grimly: "They replace the Flora with monotonous growths that depress the scientific interest, diversity and beauty of the landscape. Their wall-like thickets shut out our finest views from visitors, and with spine and branch they bar the way to the pleasures of walking through the veld."

Clearly, the world's flora is becoming increasingly mixed, and action is needed now. We should heed the advice of Frank Craighead, who witnessed the devastation to Florida's wetlands caused by Australian trees, and concluded: "The indiscriminate introduction of exotic plants needs federal regulation. None should be propagated and distributed until their propensity to reproduce naturally and invade our native environment is determined."

Recently I telephoned the Australian Quarantine Inspection Service in Canberra to ask if Australia has regulations like these. I was dismayed by the response.

Rodney Turner, the Nursery Stock Inspector, informed me that Australian Government policy was to allow in anything not known to be a weed, or closely related to a weed. No field of nursery tests was required. Unknown plants were merely checked against Commonwealth and State weed lists. Plants were considered innocent until proven guilty.

When I protested that this policy



only guarded against weeds that were already here, Turner replied by saying that some overseas weed books were also consulted. To see how useful this might be, I checked 20 overseas weed texts held by a State herbarium library. The books covered regions as disparate as Egypt, Java, The Solomons, Canada and the world. I could find no mention in their pages of many of Australia's worst ornamental bushland weeds. There was no listing for Asparagus Fern, and no mention whatever of Bitou Bush, one of Australia's worst forest invaders. Nor were Tiger Lily (*Lilium formosanum*) and the garden asparagus *Protasparagus plumosus* cited, although both are serious rainforest weeds on Lord Howe Island.

Conversely, there was no mention outside South Africa of the pest potential of hakeas, wattles and other Australian natives. Of course these plants are not mentioned in Australian weed books: they do not behave here as weeds.

Clearly, the Australian quarantine system is not adequate. It cannot guard us against future ecological disasters of the kind caused in the past by Bitou Bush, Lantana and Gorse. We need a new system that places the onus upon the importer to show that the plant will not spread. Enough ornamental plants are available in Australia already without placing the environment at further risk.

The Society for Growing Australian Plants should play a part, by educating the public about the ecological risks posed by native plants out of place. They should actively discourage the growing of certain risk species such as Sweet Pittosporum, Silky Hakea, kangaroo apples and certain wattles. The emphasis should be upon growing native plants within their natural range.

Home gardeners should also take more care. Garden clippings should never be dumped near the bush. Many infestations of Asparagus Fern, and of succulents such as cacti, agaves and live-leaf (*Bryophyllum* species) have begun in this way. Gardeners living close to natural bush should remove any plants, whether introduced or native, that show a tendency to spread.

It is too late to undo the damage already done. It is not too late to accept responsibility for the future. We urgently need strategies for containing the spread of ornamental plants, or more ecological disasters await us. ■

# Perspectives of the Earth

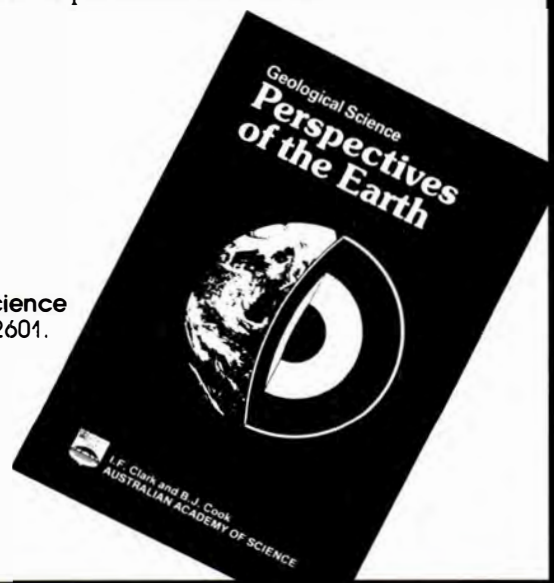
**Perspectives of the Earth** is a geology book that has mostly sold to high school and university students. But we think that the book is more than a text. The illustrations and attractive writing in the book make it a good way to introduce geology to anyone who is interested in the state of the Earth. The publication, edited by two of Australia's leading geology educators also offers geologists a reference for unpractised or long-forgotten areas of science and a chance to revise learning that may have become out-of-date.

**Perspectives of the Earth** is a comprehensive account of the formation of the universe, and the solar system, the rise and weathering of mountains, the drift of the continents, the accumulation of mineral deposits, the eruption of volcanoes, the origins of earthquakes and the laying down of fossils. Aspects of exploration, mining and the use of Earth materials is also described.

**Perspectives of the earth** is available from good bookshops or direct from the Academy.



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# Who Should Pay for Australia's Past?

In our society certain activities and institutions are widely perceived as having major cultural value. Individuals and organisations that support them attract considerable kudos. Activities such as music, drama, painting and sculpture attract wealthy or influential sponsors. Their support enables art galleries to purchase rare and expensive items, and the performing arts to mount exciting programs.

For some strange reason natural history museums, which provide equally valuable services to the community, are widely, albeit incorrectly, perceived as being more 'educational' than 'cultural'. They find it difficult to obtain private sponsorship for their exhibition programs, specimen acquisition and research activities.

The arts attract sponsorship in millions of dollars, our natural heritage—plants, animals, minerals and fossils—receives only a fraction of that. This is not due to lack of public interest because natural history museums attract millions of local and overseas visitors every year and their travelling displays reach many more.

In Australia, sponsorship of natural history museums lags far behind the United States, where most major museums are wholly or largely dependent on private funding. Sponsorship and

philanthropy have greatly enriched their collections and public displays, and these contain not only the finest items from North America but also from around the world, including Australia. With little tradition of private or corporate sponsorship, Australian State museums still rely heavily on limited State funding. Although things have improved in recent years, they still fall far short of what is required.

The main function of Australia's major natural history museums is to investigate, record, preserve and display our natural heritage. Most of us are aware of threats to our living heritage, which has been grossly modified by 200 years of European settlement. But few realise that other parts of Australia's heritage are also under threat, for different reasons.

The story of Australia's distant past is written in its rocks. During exploration and mapping of Australia by prospectors and geologists, while clearing for agriculture, and quarrying and mining for economic resources, many remarkable mineral and fossil finds have come to light. Many are in national collections, where they belong. But many more are in private collections where they are often effectively lost to science. Others are permanently in overseas collections

and thus are virtually inaccessible to Australian researchers.

There is no excuse for such items leaving Australia by default. This country has many young scientists willing and able to explore its geological past, as well as the wealth to fund them and keep its treasures where they belong—in Australia. Export controls exist that attempt to regulate and prevent the loss of rare and unique fossils and minerals, but if the nation is not prepared to fund such acquisitions for State and national museums, these regulations seem somewhat pointless.

Let me give a couple of examples.

## The Chapman Collection

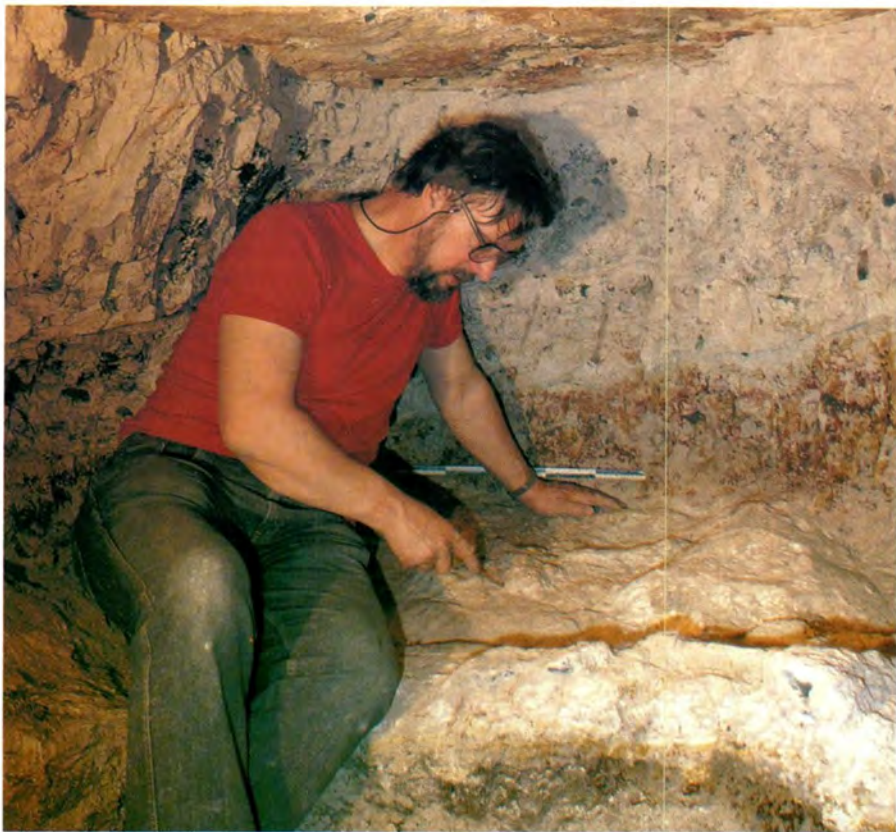
Australia is famous for the variety and quality of its mineral treasures. Although some State museums have good collections, many of Australia's rarest and finest mineral specimens are in private hands. The best private mineral collection in Australia is probably that owned by Albert Chapman of Sydney.

Albert Chapman, now in his 70s, has collected minerals since he was a boy. Many of his rarest items come from world-famous Australian mineral sites that have been worked out or are no longer accessible. Such material is literally irreplaceable. For quality, beauty and rarity, many mineral specimens in the Chapman collection far surpass those held in State museums, some being the finest examples of their kind in the world.

Three years ago Chapman approached the Australian Museum with a remarkably generous offer. He had decided to sell his collection but wanted it to stay in Australia and, if possible, intact. He offered it to the Museum for one million dollars. At that time the Chapman collection was valued at over two million dollars, and since then international prices for world-class mineral specimens have risen further as major sources are worked out. Despite this, the original offer to the Museum still stands—but time is running out.

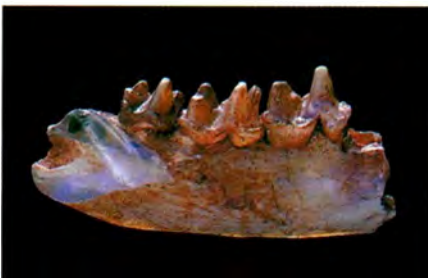
Since 1985 the Australian Museum has tried to find a sponsor for this world-class Australian mineral collection. Yet, despite the attraction of handsome tax deductions and excellent publicity, all efforts have proved fruitless. If no sponsor is found by early





ROBERT JONES

**Alex Ritchie digging for opalised dinosaurs in the 'Sheepyard' near Lightning Ridge.**



JOHN FIELDS

**Steropodon, opalised mammal jaw.**

1988 Chapman will reluctantly send his collection to the United States for sale at the world's largest mineral fair in Tucson, Arizona. Perhaps only when the Chapman collection has been sold and split up, and its treasures dispersed abroad, will Australians belatedly realise what they have lost.

### Sea Monsters in Opal

The same may apply to Australian fossils. In 1971 an opal miner found a fine opalised skeleton of a plesiosaur, an extinct marine reptile, at Andamooka, South Australia, and sought my advice on how to excavate it. I suggested it should be in the South

Australian Museum. If they could not buy it I would try to raise the money, but I stressed that it should not leave the country. After several attempts to contact the miner I heard nothing until three years later when an American businessman informed me that he had bought the specimen and donated it to the Science Museum in his home town, St Paul, Minnesota, as a tax-deductible donation. The price—a mere \$US2,500!

Several years later, in 1976, Ken Harris, an opal miner at White Cliffs, in far western New South Wales, uncovered another opalised plesiosaur skeleton. My assistant and I drove to White Cliffs to excavate the skeleton, which was more complete than the Andamooka specimen. The fragile, fractured skeleton was brought to Sydney for cleaning. When the Museum was unable to make Ken Harris what he considered a reasonable offer, he took the unfinished specimen back to White Cliffs where it went on display as a tourist attraction (see ANH vol. 19, no. 12, p. 408).

This specimen, the finest example ever found in New South Wales, would undoubtedly be a highlight of the displays in any public museum and



ANTHONY FARR

**A few pieces from the Chapman mineral collection.**

a major tourist attraction. Instead this treasure from Australia's distant past remains in a walk-in tourist mine at White Cliffs, seen only by a few thousand visitors each year. Because of our role in its safe recovery, the Australian Museum has been given first option on this specimen if Ken Harris decides to sell it. But whether we could ever find sufficient funds to pay a fair market price is another question!

### The Appeal of Dinosaurs

While plesiosaurs swam in ancient Australian seas, dinosaurs roamed the land; but until very recently fossils of Australian dinosaurs have been as scarce as the proverbial hen's teeth!

Dinosaurs, everyone's favourite monsters, undoubtedly form one of the best drawcards for any natural history museum. When I arrived in Sydney 20 years ago, not one museum in Australia had a complete dinosaur skeleton (real or replica) on display! Aware of the public fascination with dinosaurs I decided to remedy this. I knew where I could get a fine replica of a flesh-eating dinosaur from California for \$US3,000 and naively thought it would be easy to find someone to sponsor it for the people of New South Wales. I tried three large Sydney department stores, a glass company (fibreglass is used in casts), a prominent mining millionaire, and a local



Leagues club. All were sympathetic but declined to help and I gave up, frustrated.

Several years later I devised a scheme to ask the young people of New South Wales to buy their own dinosaurs. TNT and the Bank of NSW (now Westpac) liked the scheme and supported it. Our 1975 Dinosaur Appeal was a great success, raised \$12,500 in \$1 donations and paid for replicas of *Stegosaurus* and *Dilophosaurus*. Twelve years later our 'shareholders' are now bringing their children to see the skeletons they helped to buy. The pulling power of dinosaurs was dramatically illustrated again in 1983 when our spectacular 'Dinosaurs from China' exhibition drew 246,000 visitors in 12 weeks, an attendance rivalling any of the visiting block-buster art exhibitions to Australia.

So, we *know* that we have a huge number of dinosaur enthusiasts; all we need now are *Australian* dinosaurs to put on public display. Well, we have just found them, right here in New South Wales, but we need money and support to enable us to recover them.

Lightning Ridge, in New South Wales, is Australia's best-known opal field, world-famous for its black opal. It also produces many opalised fossils, most of which are cut up, polished and destroyed. Some end up in private collections or are sold to tourists as interesting curios. A few find their way into State museums.

Discoveries of this kind form a unique part of our cultural heritage. Only in Australia are such fossils preserved in opal—gem or potch. This makes them collectors' items. Unfortunately it also places them beyond the reach of State museums with limited funds—and we are all poorer for it.

Visitors to Australia expect to see its treasures on display in its museums. Instead, our finest opalised fossils are tucked away in private collections, unseen except by fortunate owners and their friends. When such specimens disappear overseas the loss is doubly tragic, especially when the only reason is lack of funds. Australians should not have to travel abroad to see the treasures of their own country.

In 1984, assisted by a generous donation from Esso Australia, the Aus-

tralian Museum purchased a large collection of fossils from Lightning Ridge. It included one of the most important fossils ever found in Australia, the opalised jaw of a mammal. It pushed the known fossil record of mammals in Australia back from 25 million to around 120 million years in

## Australians should not have to travel abroad to see the treasures of their own country.

one hit (see ANH vol. 21, no. 9, p. 396). *Steropodon* (meaning 'flash-of-lightning-tooth') is a relative (and possible ancestor) of the Platypus. It lived with, and almost certainly scurried around under the feet of, dinosaurs.

The same collection included some dinosaur bones so we decided to search for dinosaurs, hoping also to find more mammals near them. In July 1986 we carried out a joint Museum-Army dig for dinosaurs on the 'Boneyard', near Lightning Ridge, but with limited success. Then reports began to come in that sounded more promising. Opalised bones were turning up in some quantity on a claim owned by Bob Foster, a miner on the 'Sheepyard', a small opal field 80 kilometres west of Lightning Ridge. I visited the site to check, and the reports were true. There had once been dinosaurs in the Sheepyard.

In September 1987 we returned to the area with another team of Army volunteers. What we found there confirms beyond doubt that the Sheepyard field is the richest source of dinosaurs in New South Wales and one of the best in Australia. In the short time we were there, we recovered more than 20 opalised dinosaur

bones, several of them complete. Most belonged to small, two-legged plant-eating dinosaurs like *Hypsilophodon*, which reached three to five metres in length. There are almost certainly many more bones awaiting discovery on Foster's claim, and encouraging reports are coming in of similar finds from other claims on the Sheepyard field. However, many fine opalised fossils have been, and are still being, destroyed in the opal fields, through ignorance of their unique scientific importance.

Having now confirmed the potential of the Sheepyard, we want to mount a long-term program to search for dinosaurs using volunteers (Army, Earthwatch, university students etc.). Such a project would probably lead to major scientific discoveries. It would also have considerable educational, tourist and publicity value.

But we cannot do it alone. We need sponsors for an excavation program, funds to buy rare or important fossils, and volunteers to dig dinosaurs.

We know where the dinosaurs are and we know how to get them out. But to find, prepare and reconstruct them we need money, equipment, logistic support, skilled preparators and lots of time.

We need your help to do it! Donations to the Australian Museum for scientific research and purchase of specimens are tax-deductible.

And why should you help us? No-one has expressed it better than one of America's greatest palaeontologists, Professor G.G. Simpson, in his book *Attending Marvels—A Patagonian Journey* (1934):

*"Fossil hunting is far the most fascinating of all sports. . . It has some danger. . . uncertainty and excitement and all the thrills of gambling with none of its vicious features. The hunter never knows what his bag may be, perhaps nothing, perhaps a creature never seen before by human eyes. It requires knowledge, skill and some degree of hardihood. And its results are so much more important, more worthwhile, and more enduring than those of any other sport!"*

*"The fossil hunter does not kill; he resurrects. And the results of his sport. . . add to the sum of human pleasure and to the treasures of human knowledge."* ■



# photoart

PHOTOGRAPHY  
BY FORD KRISTO

## Lunacy

**T**raditional Australian Aborigines, unavailed of photographic technology, used Dreamtime myths to preserve images and the significance of the silver orb. In one such myth, the wax and wane of the moon is explained by the moon's reluctance to die, like his sister the Dugong, and never come back. Instead, whenever he got sick and died he would return three days later to gain strength and grow.

Today's truly cunning moonfiend will take photos of the ancient satellite, which can then be enjoyed later in the privacy of his or her home. The accompanying photography was made using sunlight, moonlight, single flash, twin flash, double, triple and quadruple exposures, and even painting with flash; or combinations of these techniques and illuminations. The camera was a Nikon FE2. A tripod and a variety of lenses were needed to focus on subjects of diverse size and varying distances. The film was Kodachrome 64, Ektachrome 100 and Fujichrome 100.

The only real art involved is explaining to suspicious passers-by what it is that you're actually up to!

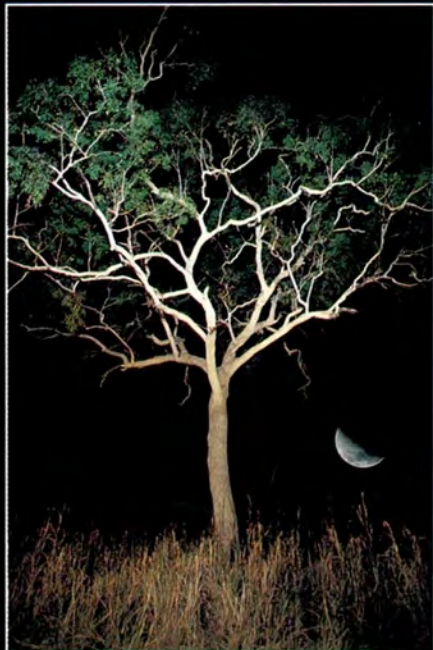
—Ford Kristo



*Peron's Tree Frog,  
Litoria peroni.*



# photoart



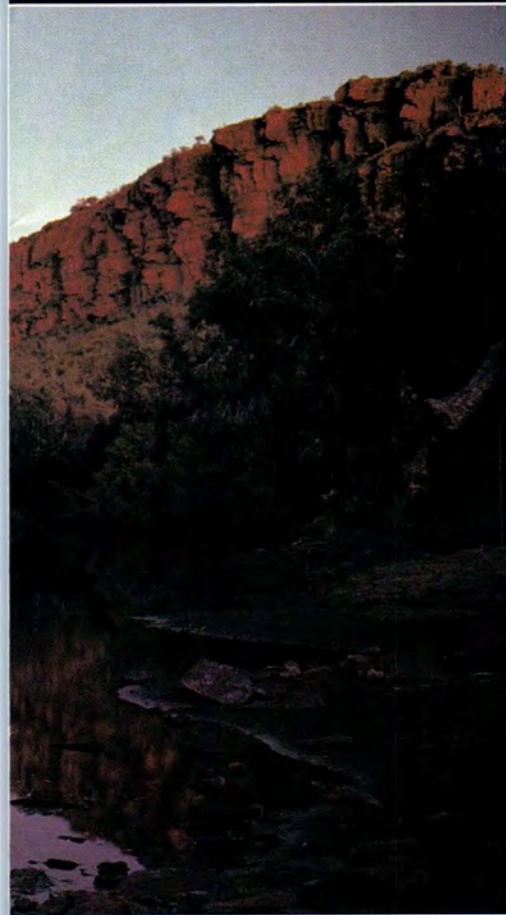
1,2 *Moonrise over Victoria River, NT.*

3 *Moonrise at Jervis Bay, NSW.*

4 *Squirrel Glider,  
*Petaurus norfolcensis.**

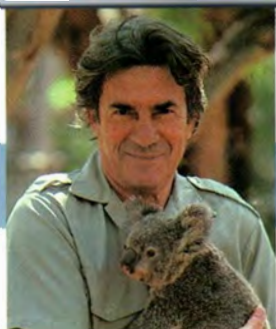
5 *Vombatus ursinus,  
*Tidbinbilla, ACT.**





3





## With TAMS at Kakadu

**F**ire! is said to be the most compelling exclamation in the English language and will bring instant help from anyone nearby. In Australia a survey has shown that 'shark!' is the most frightening word. But 'crocodile!' is a cry that must be outstripping both 'fire' and 'shark', at least in northern Australia.

Everywhere we went in the Darwin region, and also in Kakadu National Park, we found warnings on the dangers of crocodiles. There is reason for this concern: while in the last 100 years there have only been 55 recorded attacks by these huge reptiles, 30 of them fatal, the last 20 attacks took place during the previous six years and eight of these were fatal.

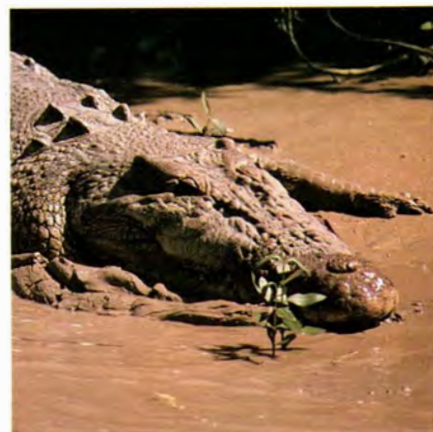
While leading a TAMS (The Australian Museum Society) group on a tour that was to include Kakadu National Park, Coburg Peninsula, the Gulf country, Lawn Hill National Park and Katherine Gorge, questions about this formidable creature came thick and fast.

I reassured all members of the party by quoting anthropologist Baldwin Spencer. He wrote of how the Australian Aborigines, who had a deep respect for this reptile, always "put an old woman in the rear" when crossing a dangerous river "because, so they believed, the crocodile always seized the last person, and the loss of an old woman does not matter much".

With humility, I told the group that I would accept the rear position; but I also assured them that we would not be crossing any dangerous streams.

I knew from my reading that there was no completely satisfactory evidence of a crocodile coming out of the water onto the land to select a victim. Attacks usually take place in the water or on the water's edge. However, despite this lack of evidence, when camping on a creek bank I would always sleep nearest to the water.

In the Darwin Museum we saw a chilling exhibit, 'Sweetheart', a famous Saltwater Crocodile (*Crocodylus porosus*) caught in the Finniss River south of Darwin in 1979. It was 5.1 metres long with a



*A four-metre-long Saltwater Crocodile.*

girth of 2.3 metres and weighed 780 kilograms!

'Saltwater Crocodile' is not the most perfect of common names as the reptiles can also be found in estuaries and freshwater lagoons. Similarly, 'Estuarine Crocodile', another common name, is not wholly appropriate as they may also be found far out to sea and in fresh water. However, Saltwater Crocodile

*A Lotusbird strides across the water using the floating plants as 'stepping stones'.*



PHOTOS: VINCENT SERVENTY



is probably the best name as it helps to distinguish it from the smaller Freshwater Crocodile (*C. johnstoni*).

I find the hysteria about the Saltwater Crocodile unpleasant. We can satisfy most people by encouraging them to treat the creatures with the same 'dreaded respect' that we give to snakes and other potential dangers; that is, keep a respectful distance from them and they should do you no harm. In a national park, under no circumstances should we interfere with any wildlife: all are part of the web of life that visitors come to see and enjoy, and we must simply accept any risks involved. However, at popular swimming or fishing spots outside such reserves, it is sensible to capture troublesome animals and transfer them to safer places, or to crocodile farms.

In terms of natural history interest, there's more to Kakadu and the Northern Territory than its crocodiles. When the Australian Government nominated Kakadu National Park for the World Heritage List, the official statement, in addition to the more than two pages identifying its natural features, contained another two pages on its cultural heritage.

Although unusual for places on this prestigious international list, this dual aspect of the park ensures that a visitor gets the best of both worlds: of nature, and of the world of people, for here are some of the finest examples of human artistic efforts.

There are paintings of Tasmanian Tigers (*Thylacinus cynocephalus*), long extinct in the region. There are also many X-ray paintings that, although found in other parts of the world, reach their finest development here. In these paintings some of the internal organs, as well as the outer shape, are drawn, indicating an intellectual as well as artistic interest in the work. The 'Mimi' human figures show a truly artistic quality; they have a dynamism, a fluid quality, strongly reminiscent of the work of famous modern European artists.

One small painting, usually overlooked, is of an archer fish shooting drops of water at a Saint Andrew's

Cross Spider (*Argiope aetherea*). The archers are a group of fish that have a deep groove running lengthways in the palate. When the tongue is raised the groove is converted into a tube and, if the gill covers are snapped shut, water is forced out along this firing 'barrel'. By using the tongue to interrupt the flow, the fish can control this stream, converting it into bullet-like droplets, which are directed towards an unsuspecting victim (an insect or other small creature) on a branch overhanging the water. It is knocked off its perch and quickly devoured by the fish.

An aquarium at San Francisco makes this a feature of their display by feeding the fish at one particular time and fastening a grasshopper or other food item to an archery-type target. Drops can be shot to a distance of 1.5 metres and, in one case, a fish that was misled by the glowing tip of a cigarette shot out enough water to douse the burning tip!

In Kakadu such small species would play only a small part in food-gathering of the Aborigines. What this charming picture does show is that the Aborigines took as keen an interest as any European naturalist in the world of nature that surrounded them.

The two major sites available for tourist inspection are Obiri Rock, now known as Ubirr, and Nourlangie Rock, known to the original owners as Burrunguy. Guides are available at certain times each day but visitors who arrive too early or too late must wander through these magnificent galleries in some mystification. Few, for example, would appreciate that here is an artistic tradition covering more than 20,000 years. A simple nature trail, with leaflets referring to unobtrusive numbers in appropriate places, might solve this problem. It is a common practice in many of the national parks of the world.

The natural history of Kakadu was a constant delight. One of our camps was at Sandy Billabong, where we slept among giant paperbarks on a soft grassy ground. We wandered along the edges of the water meeting

the Blue-winged Kookaburras (*Dacelo leachii*) that woke us each morning. Instead of the jovial chuckle of the Laughing Kookaburra (*D. novaeguineae*) from southern and eastern Australia, the Blue-winged Kookaburra has a more fiendish call.

While on a boat trip along one of the billabongs we saw the occasional Jabiru (*Xenorhynchus asiaticus*), Australia's only stork, as well as that delightful creature variously known as the Lotusbird, Jacana, Lily Trotter or Christ Bird (*Irediparra gallinacea*).

This last name is due to the fact that it literally seems to walk on water. This miraculous feat is accomplished partly from the lightness of the bird but mainly because the toes



**An archer fish shooting drops of water at a Saint Andrew's Cross Spider.**

and claws are longer than the legs and, in proportion to size, the longest of any Australian species. With these it is able to take advantage of any floating scrap of vegetation such as a lily leaf to bear its weight as it skitters over the water surface.

The memory of this attractive bird lingers most in my own mind, but discussions around the campfire at night showed how diverse were all our memories—as diverse as the natural and cultural wonders of Kakadu National Park. ■





*A Barn Owl,  
milliseconds before striking  
its prey. The nictitating  
membranes protect  
the bird's eyes.*



A Barn Owl is perched on a branch, looking towards the camera. The owl's face is the central focus, with its large, light-colored eyes and dark beak. The background is dark, making the owl stand out. The owl's feathers are a mix of light and dark brown, with some white on its chest.

# Night Stalker!

## The Remarkable Barn Owl

By PENNY OLSEN

CSIRO DIVISION OF WILDLIFE  
& RANGELANDS RESEARCH

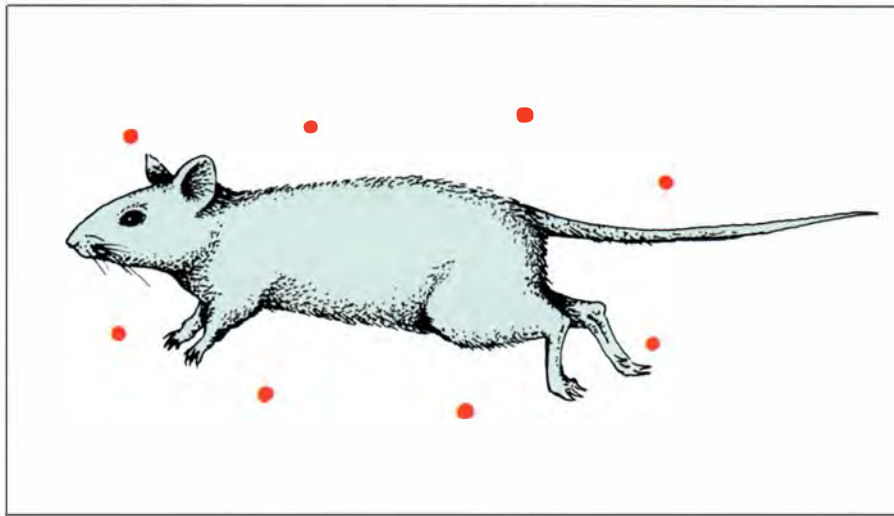
Nicholas Birks of Keith, South Australia, was puzzled when mice, stranded in a 200-litre drum that was used to hold bird feed, began disappearing overnight. By quietly watching one evening, he soon discovered that a Barn Owl was jumping in, catching the mice and carrying them away.

A keen amateur wildlife photographer, Nicholas seized the opportunity. He painted the inside of the drum black and set a small burglar-alarm beam across the opening. As the owl entered, it broke the beam, triggering the camera and flash lying in the bottom of the drum. Later, he hung black cloth near the exit and reset the beam, camera and flash to photograph the owl as it flew off. The results, as you can see, are dramatic.

By making use of the entrapped mice, the owl was, like Nicholas, being opportunistic. Such adaptability is one of the reasons why Barn Owls are so successful. Indeed, they

N. N. BIRKS





**Area covered by Barn Owl's talons at the moment of striking the prey.**

are one of the most widely-distributed land birds in the world. With over 30 recognisable geographic forms, they are found in the drier, warmer parts of all continents, usually within 45° latitude from the equator. The subspecies found in Australia, *Tyto alba deliculata*, occurs throughout the mainland and on some offshore islands, but is rare in Tasmania. Preferring the open country of grasslands, farms and scattered woodland, it is probably most common in semi-arid Australia.

The Barn Owl's plumage is exquisite: soft grey tinged orange-buff and delicately mottled with black and white above, and white below. If

**A sequence of photographs showing a Barn Owl entering a drum to feed on mice, and then leaving.**

their whiteness is caught momentarily in the beam of car headlights they seemingly float, ghost-like, before melting into the night. By night they appear remote, even sinister, their otherworldly scream chilling the darkness; by day, they become the endearing, wise bird of many children's storybooks. Roosting in the foliage of trees, in tree hollows, buildings or holes in cliffs, they seem to watch the world knowingly, with small, dark eyes set in a buff-outlined, white, heart-shaped facial mask.

In Australia they seldom venture out during the day; if disturbed and flushed, they are often mobbed by frenzied magpies or other birds. Contrary to one popular belief, they can see by day, possibly even better than they can at night, by closing their pu-

pils right down. After nightfall, they take over from the diurnal birds of prey, and their specialised nighttime vision comes into use.

Like many nocturnal birds, they have eyes with high visual sensitivity, that is, a high ability to detect low light levels. This differs from visual acuity, which is the ability to distinguish fine detail. The Barn Owl's eyeball is shaped to let in as much light as possible to brighten the image reaching the retina, and they have a predominance of rods (light-sensitive elements) in their retina. Their front-facing eyes, which give them their appealing, human-like appearance, may also help brighten the image, by binocular summation—the additive effect of viewing much of their world through both eyes simultaneously.

Seventy per cent of their field of vision can be seen by both eyes at once, but their total field of vision is only a relatively narrow 110°. This is good for judging distance but not so useful for spotting predators, such as Peregrine Falcons (*Falco peregrinus*), if these approach and attack from the rear. Most other birds have a much wider field of vision. The pigeon, for example, has a field of 340° because of its more laterally-placed eyes, but only 20° is covered by both eyes at the same time. A person's total visual field covers 180°, with 140° overlap. Owls partly compensate for their loss of vision to the rear by their remarkable ability to turn their heads through 180° or more in either direction.



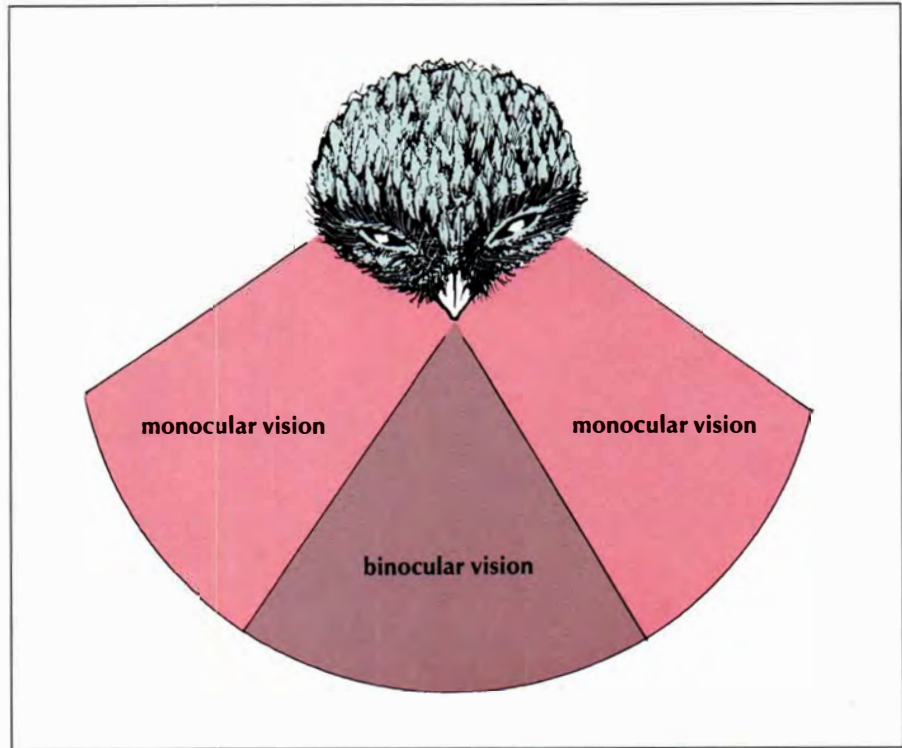
N.N. BIRKS



Barn Owls eat nocturnally-active animals, mostly small mammals such as mice and rats. Even though Barn Owls can detect prey at low light levels, they cannot see in absolute darkness. They can, however, catch prey by sound alone. The owls can hear faint sounds below the range of human hearing; when hunting they will dive into long grass alerted and guided only by the rustle of leaves, the high-frequency calls made by their prey, or the sounds of the chewing of grass.

The owls have a number of extraordinary physical adaptations to maximise their powers of hearing. The inner ear is very large. A ruff of special feathers frames the face and acts like a sound reflector to channel sound to their ears. They also have asymmetrical ear openings so that sound reaches one ear at a slightly different time to the other. By putting microphones into the ears of a dead owl, it was found that, when the owl's head was turned so that the sound reaching each ear was equalised, the head was facing the sound source.

However, Barn Owls' prey also have good ears, and are agile and can hide when startled. To help overcome this, the owl's light wing-loading and soft-edged, velvet-surfaced flight feathers allow silent, buoyant flight, so not only can the owl avoid being heard by potential prey but it can itself hear any sound made by the prey. Slow-motion film has shown how Barn Owls may combine both auditory



**Head of Barn Owl illustrating field of vision and extent of binocular vision.**

and visual powers to catch small mammals. The owl first detects prey by sound, turning its head towards the animal, then launches itself from its perch, visually aligning itself for an attack. It attacks head-first and, on close approach, flings its feet forward and head back (with eyes closed) so that its feet travel in the former path of the head, directly towards the prey. A good grasp is achieved with the help of the owl's reversible fourth toe and the strong and curved talons with their serrated undersurfaces.

The talons form two four-cornered vices that together cover an area of roughly 60 square centimetres and rapidly close around the body of their victim.

Barn Owls prefer to eat with their eyes closed, the bristles around their bill and their feet sensing the prey, which is often swallowed whole. Unlike many other birds of prey, such as hawks, they have no crop to hold food so they must regularly eat small amounts. About once a day, they regurgitate a black, glossy pellet made







N.N. BIRKS

*A double exposure of a Barn Owl with a Starling.*

up of the indigestible portion of their prey. Pellets, usually made up of bone, fur, feathers and the casings of insects, often accumulate under daytime roosts. Inspecting them is a convenient way to learn about the owl's

food and to survey small, nocturnal mammals in the area.

***Barn Owls regurgitate the indigestible portion of their meals. This pellet contains a rodent's skull and hair.***

Like other birds the owls have a third, usually transparent eyelid (nictitating membrane) that protects and cleans the eyes. In the Barn Owls, however, the nictitating membrane is opaque and robust. The Barn Owls also have an upper eyelid that closes downwards in a slow blink to add to the human-like quality of the owl's face. In most other birds, the upper and lower lids close by meeting in the middle.

Barn Owls have a boom-or-bust breeding strategy, tied to the vagaries of their prey. When rodents are abundant the owls thrive and raise several large broods of young a year. When food becomes scarce, breeding declines and many owls gather where prey is more easily caught, swooping from roadside fenceposts to catch mice or insects picked up in headlight beams. At such times they are often hit by cars, their sad bodies lining some inland roads.

Many farmers recognise the Barn Owls' value in pest control and often build little doors into their barns to encourage the owls to roost and nest there. Like photographer Nicholas Birks and the Barn Owls themselves, these farmers are also being opportunistic, making good use of a transient resource. ■



J.M. LABAT, AUSCAPE



Deep in the ground or packed neatly into hollow twigs, or in tiny earthen or resin domiciles of their own making, lie millions of Australia's most interesting and beneficial insects—native bees. Seven families of bees (out of a world total of nine) occur in Australia, and most Australian species are endemic. Recent tallies put the number of described Australian species at over 2,000 although many more remain to be discovered and described.

Australian beekeepers and naturalists, including Aborigines, have long admired the industrious members of the genus *Trigona*, the tiny, colony-forming, social bees of our warmer regions. These are the honey-making cousins of the imported European Honey Bee (*Apis mellifera*). Various species of *Trigona* are usually the recipients of the term 'native bee', but their teeming and relatively conspicuous 'cities' are at the end of the evolutionary spectrum of Australian bees. Most native bees are 'solitary' (that is, 'unsocial') and cryptic. Each female constructs one or more isolated nests in which her offspring develop in individual cells, never to know their siblings or parents. Between the species of *Trigona* and the masses of solitary species occurs a fascinating group of 'primitively' social species. Referred to as 'allodapines', these bees figure prominently in the quest for man's understanding of the evolution of social biology. However, their quiet and simple societies have remained a secret to most people. Chief among them in Australia is the genus *Exoneura*.

*Exoneura* adults occur in a size range similar to that of *Trigona*: the smaller species may reach only four millimetres in length, while the larger ones are about eight millimetres. A few species are completely black except for white facial marks, but the majority have a dark red abdomen. Although *Exoneura* females possess a sting, it is not used defensively. Males are more hairy and look some-

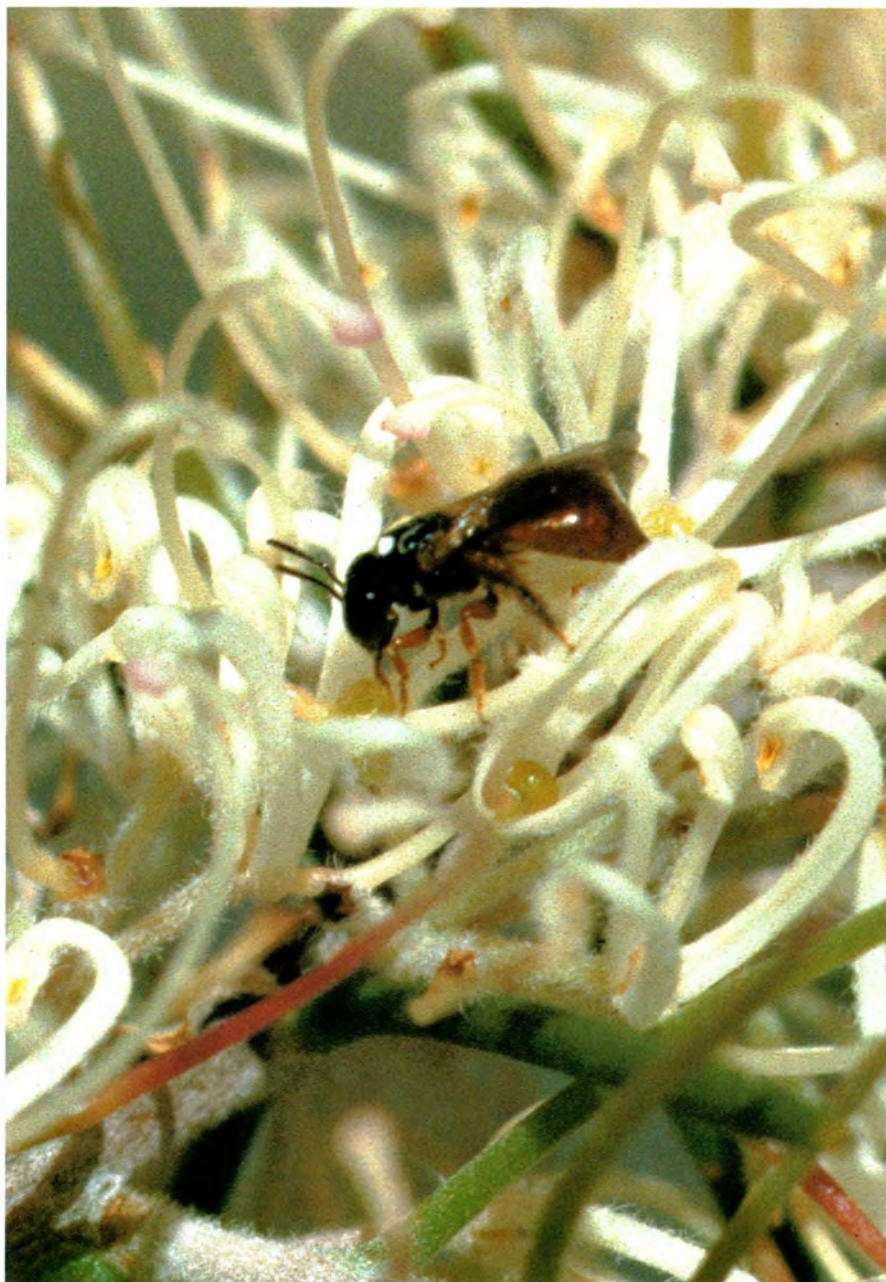


Food exchange between members of *Exoneura bicolor*.

# Inside the (Secret) Societies of Native Bees

By **EVAN SUGDEN**  
VISITING SCIENTIST,  
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(UNIVERSITY OF  
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EVAN SUGDEN

*Exoneura* sp. foraging for nectar on *Hakea teretifolia*.

what like miniature drone European Honey Bees. The genus is typified by the subject of most of my studies, *E. asimillima*.

An *Exoneura* colony begins as a solitary venture. A single, impregnated female leaves the nest of her birth to search for a suitable site in which to rear her own family. The nest site is typically a pithy plant stem, such as a dried flower stalk of a grasstree or the fallen frond of a tree fern. The selection of a nest site is influenced by the thickness, length, and angle of the stem relative to the ground, cover from direct sunlight and wind, and proximity to other *Exoneura* nests and to the flowering plants that will sustain the colony members.

Once a stem is chosen, the female begins to chew methodically into the soft pith and does not quit her task until the burrow is deep enough to allow her to block it from inside with her abdomen. This guarding behaviour protects the bees from marauding ants. Black house ants, for example, are tiny but voracious predators that can rout an unguarded bee nest in a few hours, dismembering the adults and carrying away the larvae to provision their own young. However, the ants find an impregnable barrier in the bristly abdominal 'shield' that female *Exoneura* bear. This plate-like flattening of the abdomen fits snugly into an entrance-narrowing collar made of excavated pith fragments.



EVAN SUGDEN

**A female *Exoneura* guard bee blocks the nest entrance from marauding ants with her red abdominal shield.**

The guard bee can block the intrusion of most predators by so stopping the nest with her own body.

As the female continues to excavate her burrow, she may be visited by other young females that often burst into the new nest. Usually they are ungraciously pushed out again but, in at least some species, these visitors are allowed to remain as 'cofoundresses'. In most cases, they are full-sisters of the original female, a condition that was predicted by sociobiology theory before its verification through detailed genetic analysis by Dr Michael Schwarz, formerly from Monash University. Recognition of full-sisters is probably achieved through chemical means. Two or three sisters then share responsibilities of burrowing and guarding.

Eventually, a fertilised female begins to lay eggs. This sets her apart from the others and forms the basis for caste differentiation. The differ-





TERRY HOUSTON

An egg series of an *Exoneura* sp.

ences are primarily behavioural but morphological differences between 'queen' and 'worker', as are found in the European Honey Bee and *Trigona* species, have been found in *E. tridentata* by Dr Terry Houston of the Western Australian Museum. There are normally only one or two egg-layers in each colony, regardless of the number of females or whether they are mated. The egg-layers are apparently capable of inhibiting ovarian development in their nestmates.

Egg placement is often characteristic within some species of *Exoneura*. Some deposit them in a graceful spiral around the lower wall of the burrow, while other species, such as *E. bicolor*, merely accumulate them in a relatively haphazard jumble. Arrangement of the developing larvae within the communal chamber, on the other hand, is characteristic behaviour for all adult females of the genus *Exoneura*. The older larvae are positioned toward the nest entrance while younger ones are kept below them in descending order by age, with eggs at the bottom. Despite considerable commotion and tumbling about, this order is maintained most of the time. The reason for it is obscure; it seems impractical that returning foragers must stumble over non-feeding pupae to reach the hungry younger stages. Perhaps the arrangement ensures maximum contact of 'nurse' bees with all the brood.

The larvae of *Exoneura* are unique among bees. In advanced stages they possess branched

'pseudo' appendages—tiny hydraulic arms that protrude from the midportion of the body. Most bee larvae are, in contrast, soft grubs, indistinguishable except by minute characteristics familiar only to the specialist in insect larvae. The function of the delicate ornamentation of *Exoneura* larvae is unclear. The pseudoarms may help hold onto the tiny pollen masses that each larva is fed, or they may serve to maintain the larva's position in the nest burrow, which may be steeply inclined.

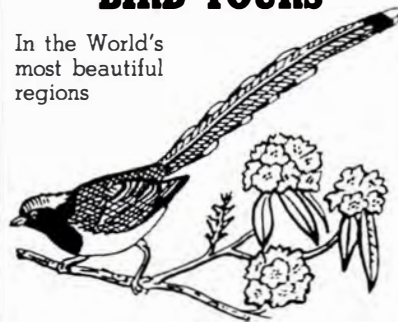
*Exoneura* larvae have the longest feeding period of any bees and are capable of withstanding long fasts of many weeks. They are fed progressively by foraging adults as long as pollen and nectar are available. If a dearth period ensues, the larvae patiently await their next meal. This adaptation may reflect the bees' unpredictable Australian habitats in which drought or fire may remove food resources or cold, windy weather may prevent adult flight. Through this slow development strategy, some young are assured survival. By comparison, solitary bees begin their life on a mound of food that sustains them throughout their continuous feeding and growth. The reproductive strategy here is for the adult bee to build and provide as many larval cells as possible and for the larvae to develop rapidly. If adult foraging is interrupted for a long period, food accumulation and egg laying are delayed and fewer offspring may result.

The foragers of the *Exoneura* colonies tend to be older females and there may be only a few or even just one of these. They must work hard to satisfy the appetites of the larvae and the other adults. A forager may spend several hours a day shuttling between a favoured resource plant and the nest. She crawls among the small clustered flowers of native peas, heaths or hakeas, or the cup-like flowers of native gums or bottle brushes. The flower-host range of *Exoneura* must be wide to sustain the long-lived colony throughout most of the year.

Nectar is the forager's principal goal. *Exoneura asimillima* can imbibe seven microlitres (a small drop) at one gulp. By comparison, the nectar crop of the relatively giant European Honey Bee can hold up to 50 microlitres. While foraging, pollen is packed into the special hairs that frock the hind legs. Back in the nest, nectar is offered by regurgitation to

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**Mature larvae of *Exoneura asimillima*. Although not obvious in this picture the developing larvae are arranged in ascending age order with the oldest nearest the nest entrance.**

other adults, which eagerly extend their mouthparts for a drink. When the nectar has been shared, the female proceeds down the line of brood, squeezing past the older individuals and rearranging the smaller ones to make room. Arriving at a hungry one, she stops, turns around and then combs the pollen out of her leg hairs by rubbing them together. Again turning, she regurgitates a droplet of liquid onto the pollen pile and kneads it with her mouthparts into a sticky 'pudding'. When finished, the mass is broken up into small crumbs, which are placed on the bellies of the waiting larvae.

All *Exoneura* colonies that successfully produce new bees are 'sub-social', as opposed to solitary, because brood survival requires adult care throughout larval development. A single reproductive may live to be 'helped' by her own offspring at the expense of their chance to reproduce. If the 'workers' assume most of the non-reproductive duties (nest cleaning, foraging, guarding, larval provisioning etc.) then the colony is 'eusocial', or fully social. More often, the original reproductive dies before many of her offspring become adults. One or more daughters may then begin to lay eggs and the colony becomes 'quasisocial' as the last of the original reproductive's brood mature. If certain sisters of the same generation become egg-layers and others function as workers, the colony is 'semisocial'. If sisters or less closely related individuals cofound a nest, the resultant colony becomes difficult to describe. A single colony

may pass through several of these states as it matures or it may die out at an early stage of social development.

The social condition of a colony at any moment is difficult to predict as so many possibilities exist. No particular arrangement is obligatory and even the simplest arrangements may lead to successful production of a new generation. For this reason, bees of the genus *Exoneura* are considered 'primitively' social. Despite this, *E. asimillima* may have up to 66 individuals in a single nest. The nest cavity may be occupied for several consecutive years, being lengthened each season to a cumulative total of up to 740 millimetres. Males may comprise a large proportion of the bees in such situations. They often leave their home nests to find mates and take shelter in neighbouring colonies, where they are readily accepted. Mating may take place in a nest, although males of some species wait outside to encounter females. They either hover in front of nests or 'patrol' a series of nest stems.

The life of an *Exoneura* colony is not without intrigue. Whole nests may succumb to ant predation and individual larvae may suffer mite attacks. However, the most stealthy enemy is another allodapine, belonging to the genus *Inquilina*. These *Exoneura* look-alikes behave like cuckoo birds and, in fact, are often referred to as 'cuckoo bees' or social parasites. For obscure reasons, *Exoneura* host bees accept these intruders into the nest and either ignore them or accept them as their own sisters. *Inquilina* adults have in-

effective pollen-collecting hairs and probably do not forage for pollen. The parasites lay their eggs among the *Exoneura* brood and may eat the host eggs. The new generation may then be composed largely or entirely of *Inquilina* bees, which leave the colony in search of new host nests.

*Exoneura* species are marvelously adapted to a changing environment. Such flexibility makes them excellent study subjects. Their nests can be moved to new localities and, like European Honey Bees, the free-flying occupants will take bearings on the new surroundings and carry on their work. Their successful adaptation to artificial nests allows detailed observation and manipulation for scientific purposes. Most importantly, however, their 'primitive' yet varying sociality may lend insight into mechanisms of social evolution.

*Exoneura* can be found in scrubby habitat near undisturbed bushland rich in spring wildflowers. The nests make interesting additions to the naturalist's garden. They may already be present in yours, inhabiting tree ferns, grasstree stems or dry twigs of common shrubs such as *Abelia* (*Abelia grandiflora*) or mock orange (*Philadelphus* spp.). Look for round holes (two to three millimetres in diameter) at the broken ends of pith stems or twigs, with reddish abdominal shields, or even tiny bee faces, blocking them. The bees can be seen hovering around these nest entrances or among sweet-smelling flowers such as tea-tree blossoms on warm days. ■



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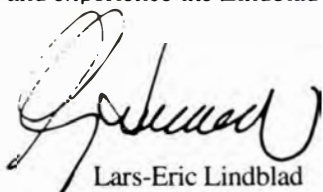
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