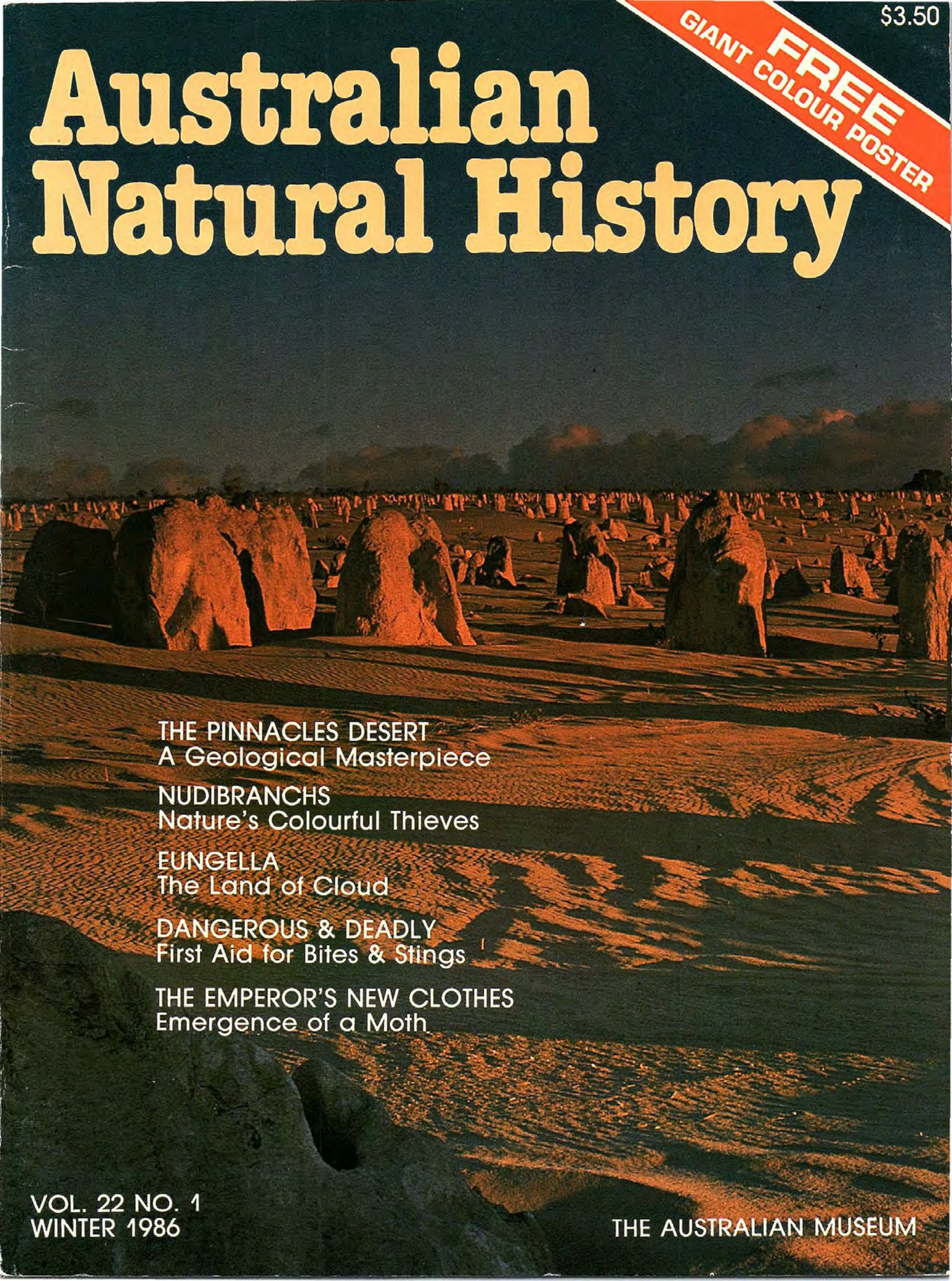
$3.50

FREE GIANT COLOUR POSTER

Australian Natural History



THE PINNACLES DESERT
A Geological Masterpiece

NUDIBRANCHS
Nature's Colourful Thieves

EUNGELLA
The Land of Cloud

DANGEROUS & DEADLY
First Aid for Bites & Stings

THE EMPEROR'S NEW CLOTHES
Emergence of a Moth

VOL. 22 NO. 1
WINTER 1986

THE AUSTRALIAN MUSEUM

Australian Natural History

Published by
The Australian Museum Trust
6-8 College Street,
Sydney, N.S.W. 2000
Phone: (02) 339 8111
Trust President: Robyn Williams
Museum Director: Desmond Griffin
EDITOR
Fiona Doig
SCIENTIFIC EDITOR
Georgina Hickey, B.Sc.
CIRCULATION
John McIntosh
ART DIRECTOR
Sue Oakes
TYPESETTING
Rochester Communications Group Pty Ltd
FILM WORK
F.M.F. Colour Creations Pty Ltd
PRINTING
RodenPrint Pty Ltd
ADVERTISING
Jean Barnet
(02) 939 6263
(02) 339 8234
SUBSCRIPTIONS
Annual subscription (4 issues)
Within Australia $A13.00
Other countries $A15.00
Two-year subscription (8 issues)
Within Australia $A25.00
Other countries $A30.00
For renewal or new subscription please forward credit card authority or cheque made payable to:
The Australian Museum
P.O. Box A285 Sydney South
N.S.W. 2000, Australia
Subscribers from other countries please note that money must be paid in Australian currency.

The Editor welcomes articles or photographs in any field of Australian natural history.

Published 1986.

ISSN-0004-9840

Front Cover

Amidst the shifting sands, the Pinnacles Desert in Western Australia is a remarkable geological feature. It is the topic of an article in this issue which explains the formation processes and discusses the desert's transient nature. Photo: W.A. Photo Index.

EDITORIAL

A question I am often asked as Editor of A.N.H. is 'what is natural history?'. At these times I falter because to my mind the subject is limitless: from unusual geological structures like those in the Pinnacles Desert (see page 12) to the colourful nudibranchs (p. 2), intricate insects (p. 36) and pathology research (p. 27). These subjects all come under the natural history umbrella. However, most people want a simple, concise, dictionary-style definition such as 'the study of nature'. Rather dry. Such simplicity can't grasp the intricacies, beauty and changing moods of natural history—to properly define it would fill a book. Yet the problem is not one of explaining what natural history *is*—instead it lies in defining the boundaries of this diverse subject. I wonder how *you* perceive natural history? Why not write and let us know!

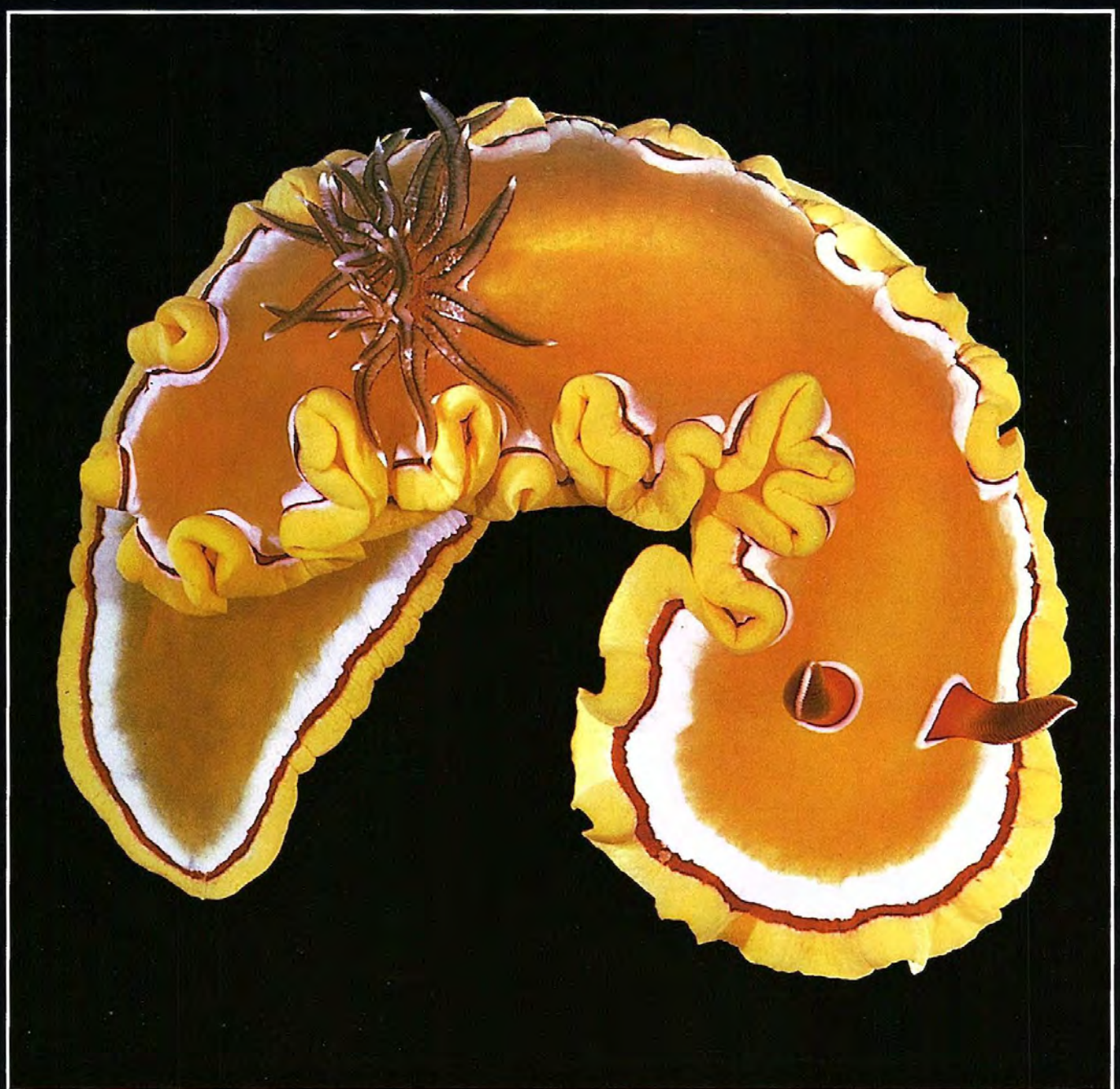
Fiona Doig, Editor

Contents

NUDIBRANCHS: NATURE'S THIEVES

Text and Photographs by Bill Rudman

Some steal stings and poisons from other creatures for their own defence and some are solar-powered, cultivating plants inside their bodies. Any way you look at them, nudibranchs, or sea-slugs, are among the most beautiful of marine animals, offering a virtually endless array of bizarre shapes and spectacular colour patterns. The diversity and adaptations that these seemingly defenceless, shell-less molluscs have evolved for survival in the sea have long held the fascination of biologists, as Bill Rudman from the Australian Museum explains.



This spectacular chromodorid *(Glossodoris rubroannulata)* was officially named in March 1986. Like most marine invertebrate groups there are still many unnamed nudibranch species, both rare and common, which await further research.

Among the gastropods, or snails, there have been many evolutionary experiments in both reducing the size of the shell and losing it altogether. Land slugs illustrate well the greatest disadvantage of being shell-less—drying out. They solve this problem by staying in shady places and by exuding copious quantities of sticky, slimy mucus when crawling. This essential protective coating, however, ensures that the word 'slug' engenders a feeling of repugnance in all but the most dedicated naturalist.

Despite this unfortunate drawback, no common name other than sea-slug is available for the beautiful nudibranchs. They are only distantly related to land slugs and have evolved from a group of marine snails that, many millions of years ago, embarked on an independent—and highly successful—evolutionary experiment in becoming slugs.

The order Opisthobranchia encompasses not only the nudibranchs, in which all trace of the shell is lost in adults, but also the bubble-shells, sea-hares and sacoglossans. The opisthobranchs include species showing all stages in the evolution of slugs from snails. They have successfully populated an enormous variety of marine environments, with species thriving from the deep sea to the intertidal zone and from the tropics to the poles. They range in size from microscopic, worm-like animals that live in the gaps between sand grains to giant sea-hares half a metre long.

A great diversity in diet is exhibited, with sacoglossans and sea-hares feeding on seaweeds, while most bubble-shells and all nudibranchs are carnivores. Individual species are usually very specific in their dietary habits, eating only one, or perhaps a few, different foods. An economical way to look for nudibranchs under water is to locate their food source as most species rarely venture far from their next meal.

The common but seldom seen aeolid *Fiona pinnata* feeding on goose barnacles. A careful search of freshly beached barnacle-encrusted logs or fishermen's floats will often uncover large colonies of these specialised nudibranchs.

The loss of a protective shell in nudibranchs incurs several disadvantages. It restricts them to marine environments where they won't dry out and it has forced them to evolve more subtle means of defence against predators. However, there are advantages in becoming shell-less and the ingenious nudibranchs have fully exploited them. For a start, they don't need to use the enormous amounts of energy that are required to build and continually enlarge the shell as the animal grows. Also, *having* a shell restricts the size and the shape of the animal and the elimination of this encumbrance in nudibranchs has been accompanied by the evolution of a great diversity of shapes.

Within this vast diversity there are two basic body plans, well-illustrated by the dorids and the aeolids. All nudibranchs have a pair of anterior chemosensory tentacles called rhinophores which detect or 'smell' chemicals in the water. The dorid body plan is quite simple. It consists of a long body with a pair of anterior rhinophores and a circle of gills on the back in the posterior midline. The back can be smooth, rough, ridged or covered in tubercules and species may be dull or brightly coloured. Some may have short or long processes on the back but a circle of gills is a sure sign of a dorid nudibranch. Molluscs in general have an all-purpose 'digestive gland'

Found around southern Australia from Western Australia to New South Wales, *Ceratosoma brevicaudatum* is a typical dorid nudibranch with a pair of chemosensory head tentacles (rhinophores) and a ring of bushy gills. It has poisonous mantle glands which are concentrated in the bright red lump just behind the gills.

that produces digestive enzymes and absorbs digested food before being passed into the blood. In dorids, this digestive gland constitutes one large mass in the body cavity.

In the second major group of nudibranchs—the aeolids—the pair of anterior rhinophores is retained but the circle of gills has been replaced by groups or rows of blood-filled tubular processes down each side of the body called cerata. These cerata act as gills and each ceras has a branch of the digestive gland inside it. The development of these gut branches into cerata has been an important step in the evolution of defence mechanisms in aeolids.

Aeolids feed mainly on coelenterates: sea-anemones, hydroids, soft-corals and hard reef corals. One interesting exception, however, is *Fiona pinnata*. This species feeds only on goose barnacles and is found throughout the world on barnacle-covered driftwood and old floats.

Other exceptions are species of *Favorinus* which feed almost exclusively on the egg masses of other opisthobranchs. These egg masses occur in a wide variety of colours and, when eaten by *Favorinus,* give colour to the aeolids' cerata. This is one of the rare cases where the colour of the nudibranch results directly from the colour of its last meal!

Nudibranchs have developed an amazing diversity of defence mechanisms. Among the aeolids we find one of the most fascinating and intricate examples of theft in the animal world. Coelenterates, the main food of aeolids, have evolved special stinging

The white, granular band inside the red and yellow border of *Chromodoris daphne* contains a range of noxious chemicals which it obtains from the sponge it eats. These are used to deter attack by predators because, like many related chromodorids, the bright colours probably warn fish that this juicy slug is poisonous.

structures called nematocysts. These occur in a variety of different shapes and sizes. Some are used for poisoning and killing, and others are used to entangle their prey so that it may be drawn to the mouth. The agonising sting of the Portuguese Man-o-war, or Blue Bottle, and the often fatal sting of the northern Queensland Box Jellyfish are two well-known examples of the power of coelenterate nematocysts. At the end of last century, some European biologists realised there was a special sac at the tip of most aeolids' cerata containing stinging cells remarkably similar to those of coelenterates. It soon became clear that the aeolids, on eating their coelenterate food, were removing undamaged nematocysts and storing them in the tips of their cerata for future use. When attacked, the aeolid discharges these stinging cells through a pore at the tip of each ceras. Today, almost 100 years since this fascinating form of theft was discovered, it is still not clear exactly how the aeolid is able to remove the nematocysts from the coelenterate and maintain them in working order.

One aeolid, *Glaucus atlanticus,* feeds exclusively on the Portuguese Man-o-war and often remains unnoticed on the sand alongside them when they are washed up on surf beaches. But beware! Its sting can be worse than that of its food, for it stores only the most virulent and poisonous of the nematocysts. There have been cases reported in New South Wales of children being severely affected by Portuguese Man-o-war stings—not from the Man-o-wars themselves, but from inadvertent handling of the aeolid *Glaucus.*

In the last five years we have discovered that some groups of aeolids are involved in another type of theft from coelenterates—one that can literally feed them for life. In tropical waters, most reef-forming coral and soft-coral colonies contain in their tissues microscopic, unicellular, plant-like organisms called dinoflagellates. Some dinoflagellates, known generally as zooxanthellae, have adapted to life in animal tissues where not only are they living in a safe environment but they also have all the necessary requirements for growth and reproduction. As long as they maintain contact with sunlight, they are able to photosynthesise and produce excess sugars and oils which are removed by the animal host

The pink veins in the cerata of this Tasmanian aeolid (*Phyllodesmium* sp.) are branches of its gut. Its colour results directly from the colour of the food it is eating.

for its own nutrition. This process of two organisms living together for apparently mutual benefit is loosely termed 'symbiosis'. Coral reef scientists also believe that without these symbiotic dinoflagellates, most tropical corals would not have sufficient energy to produce the calcium carbonate skeletons that form the building blocks of coral reefs.

Some aeolids actually take the living zooxanthellae from the coelenterates they feed on and move them to special 'gardens' inside their bodies. Here the plants have sufficient sunlight, oxygen and nutrients to grow, reproduce and photosynthesise. In some species, the farming of these kidnapped zooxanthellae is so efficient that the nudibranchs never or seldom need to feed again. They obtain all their nutritional requirements from the sugars and oils produced by the symbiotic zooxanthellae. Therefore, it is no exaggeration to describe these self-sufficient organisms as 'solar-powered' nudibranchs.

Dorid nudibranchs have not been as adventurous in trying out new shapes as the aeolids, but many display spectacular colour patterns and are protected from predators by distasteful and noxious chemicals stored in glands in their skin. One of the simplest defence strategies used by dorid nudibranchs is camouflage. Most dorids feed exclusively on encrusting colonial organisms such as sponges, bryozoans or ascidians. Being either of similar colour to their food or translucent offers these dorids a simple method of hiding in the open. More elaborate camouflages have also evolved, such as developing bristles or tubercules on the back to mimic the texture of their sponge or other prey colony.

In colour, texture and shape, the chromodorid *Verconia verconis* camouflages itself on its food, the pink sponge *Aplysilla rosea*. As an added defence, it stores poisons from the sponge in the tips of the papillae around the edge of its body.

***Chromodoris tasmaniensis* is a common intertidal nudibranch in Tasmania but is normally only found by scuba divers in New South Wales. The bold colour pattern probably serves to warn fish of its poisonous nature.**

However, the appropriately named chromodorids, a group of brilliantly coloured dorids, are an exception to the rule. Their colours are so bright and spectacular that—at least to the human eye—they not only make no attempt to hide but appear to positively advertise their presence.

Although this mystery has yet to be completely unravelled, in recent years

The three colour forms of this 'solar-powered' aeolid *(Pteraeolidia ianthina)* illustrate its life history. As a juvenile, it is white and devoid of unicellular symbiotic plants. The brown specks in the middle animal are recently acquired plants which it can now cultivate. As the plants grow and reproduce, the animal will eventually turn a dark blue-brown. At this stage, most of its nutritional requirements will be provided by these symbiotic plants.

we have discovered several clues as to why these brightly coloured chromodorids can be so brazen and yet remain uneaten! One explanation appears to fit the bill. Chromodorids feed on a group of sponges that, for their own protection, produce distasteful chemicals, some of which are extremely toxic to fish. Fish learn quickly not to eat certain sponges. By using a technique that mirrors the aeolids' tricks with coelenterate nematocysts and zooxanthellae, the chromodorids are able to isolate these noxious chemicals without ill effects and then place them in special 'mantle glands' on their backs. Different chromodorid genera arrange their mantle glands in different ways; some form a band around the body, others are concentrated in a single, conspicuous spot. When disturbed, the chromodorids discharge the chemicals as a white, sticky substance that deters potential predators.

But why advertise your presence with such bright colours if you are trying to deter predators? Probably for the same reason that butterflies are often brightly coloured and apparently open to attack by birds. Like chromodorids, many butterflies build up a supply of noxious chemicals from the plants they feed on during their larval stage. When the caterpillars metamorphose into butterflies, these chemicals are usually concentrated into those parts of the wings and body that are most vulnerable to bird attack. In simple terms, the predatory birds quickly learn to avoid these noxious butterflies by avoiding their associated colour patterns. Although a few butterflies may die as each new generation of birds learns to avoid the same patterns, a bright and distinctive colouring clearly protects the species at the population level. A number of different species of noxious butterfly may evolve similar colour patterns and, in doing so, spread their small–but inevitable–burden of loss.

This mimicry has been studied intensively in the insect world but little information is available on chromodorid predation. However, because their situation is so similar to that of butterfly mimicry, we can be reasonably sure that these nudibranchs are advertising their noxious mantle glands to potential predators.

Australian waters abound with seaslugs, but we still have little more than a superficial knowledge of their biology and ecology. Some species are unique to Australia while others have a wider distribution in the tropical Pacific and Indian oceans. With a possible 2,000 species to be found in Australia, many fascinating discoveries are yet to be made. □

This typical aeolid of the genus *Flabellina* is wrapped around the stalk of a colony of hydroids on which it feeds. From these tiny sea-anemone-like animals, the aeolid removes the stinging nematocysts which it stores in the orange sacs at the tip of each ceras. When attacked it can fire these stolen weapons in its own defence.

THE EMPEROR'S NEW CLOTHES

TEXT AND PHOTOGRAPHS BY PAMELA AND DAVID MAITLAND

From egg to caterpillar, caterpillar to pupa and pupa to adult moth, the dramatic metamorphosis of the Emperor Gum Moth is marked by complete changes in form — the Emperor's 'new clothes'. The long-spined, colourful caterpillar eats leaves, storing the food as fat. Within its body it carries a great potential for change which is realised at pupation. During this outwardly quiet period, great metabolic activity takes place and, from a simple, lumbering caterpillar, a majestic moth emerges.

1 *The eggs of the Emperor Gum Moth* (Antherea eucalypti) *are about two millimetres round and are laid on the underside of gum leaves. They are a common sight throughout Australia in January and February. Within a week, small, dark caterpillars, about five millimetres in length, emerge and immediately begin feeding, first on the egg-shell and then on the leaf. The caterpillar is the relatively unspecialised, grub-like feeding stage during which reserves of tissue are built up for the eventual transformation into the highly specialised structures of the adult moth.* ▶

2 *Caterpillars go through several growth stages called instars. Belying its softness, the skin of a caterpillar is not very elastic. At the end of each instar the caterpillar forms a new, larger skin and sheds the old one which it may then eat. The new skin unfolds like a concertina as the caterpillar grows. Because caterpillars are slow, soft and fat, they are ideal food for many animals, particularly birds. The Emperor Gum Moth caterpillar is not defenceless, though, for along its back and sides are rows of conspicuously-coloured stubs bearing spines that deter birds. These spines, although they discourage some animals, offer no defence against microscopic predators such as viruses.*

3

3 *The Emperor Gum Moth caterpillar eats vast quantities of vegetable matter and produces commensurate amounts of hard, hexamerous droppings which are fragrant with gum oils. Their unusual shape reflects the invaginations (hence the increased surface area) of the posterior gut wall where water is absorbed. Although considered a nuisance because they stain patios and pools, if swept up they make wonderful fertilizer!*

4 *The two large, vertical hemispheres of the head, which look like enormous eyes, are in fact regions of strengthened cuticle. They form a firm base to which the muscles powering the strong jaws are anchored. The caterpillar has tiny, black, simple eyes just above the jaws that detect only light from dark. Caterpillars have two kinds of legs: the dark tapering ones at the front of the body, which correspond to the six legs in the adult moth, and the 'prolegs' that include the larger, fleshier ones along the bulk of the body and the broad clasping pair at the tail end. The prolegs are armed with a ring of small hooks designed to help grip the smooth surfaces of leaves and stems.*

4

6

5 *Having attained its maximum size after a few weeks of eating and growing, the caterpillar becomes restless, stops feeding and is ready to pupate. Its colour changes to a purple-brown for camouflage because it usually moves from the green leaves onto the red-brown trunk to spin its cocoon.* ▶

6 *Before pupation, the Emperor Gum Moth caterpillar makes itself a hairy cocoon woven from silk spun from glands near its mouthparts. The cocoon dries as hard as a rock and provides some protection from ants, wasps and other predators. Inside the cocoon the caterpillar sheds its last skin to reveal a soft, white pupa, the outside of which soon hardens into a brown shell.*

7

7 *An enormous amount of development occurs within the pupa's hard exterior. Much of the caterpillar tissue is liquefied except for the vital organs and a few clumps of special, dormant cells. These are the imaginal discs–the formative adult tissues that grow into specialised adult features. The pupal shell effectively acts as a mould for the body, and the head, antennae, wings and legs can be seen sculptured on its surface. The head capsule and shrivelled-up skin of the last moult lie in the bottom of the cocoon.* ▶

5

8

8 *After about a month, the Emperor Gum Moth is ready to emerge. The pupal case splits open and the moth must now contend with its cocoon. First it wets a patch of the cocoon with special fluid from its mouth, thus dissolving it. Then, with special teeth at the base of its fore-wings, it makes a hole in the cocoon. The damp and crumpled adult moth can now push its way out of the cocoon. After clambering up the nearest twig or just hanging onto its cocoon, it pumps blood into its wings before they harden. When dry, the moth vibrates its wings to warm the flight muscles, which must reach a certain temperature before the moth can fly. The male moth flutters away in search of a mate while females often remain close to where they emerged and use special chemicals – pheromones – from scent glands to attract males.* ▲

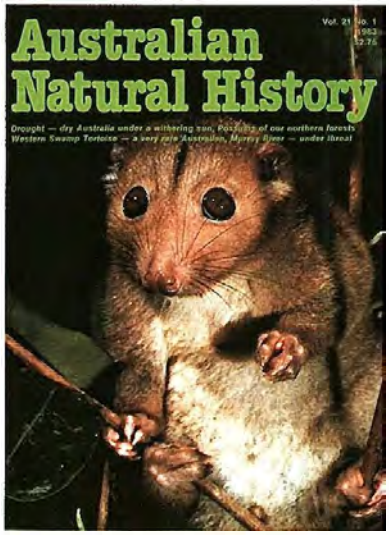
9

9 *A nocturnal creature, the adult Emperor Gum Moth usually rests camouflaged on the bark of a tree during the day. If disturbed, however, it displays the eyespots on the hind wings, fooling predators into thinking big eyes mean big mouths so they'd better keep away.*

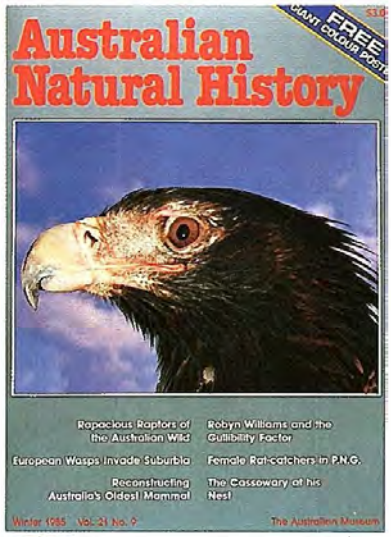
10

10 *In contrast to the head of the caterpillar being predominantly jaws, the adult moth's head is mostly eyes and antennae. Although adult moths do not have jaws, they are usually equipped with a long tongue to feed on nectar. But not the Emperor Gum Moth. All its energies are directed towards finding a mate. The male bears enormous feathered antennae that are covered with extremely sensitive chemoreceptive organs. These can detect female pheromones over long distances downwind. The male flies towards the source of the scent, mates with the female who then flies off to lay her eggs on the leaves of a suitable gum tree . . . And the tale of the Emperor's new clothes begins again.* □

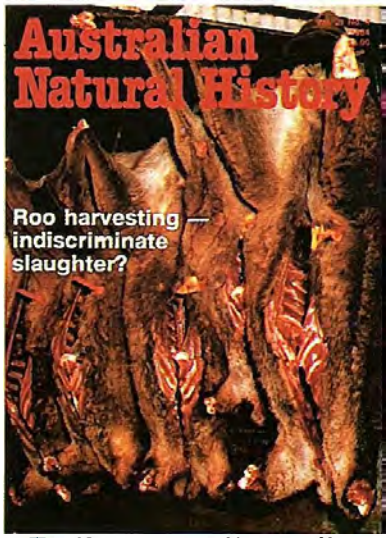
BACK ISSUES
...of the Natural Authority



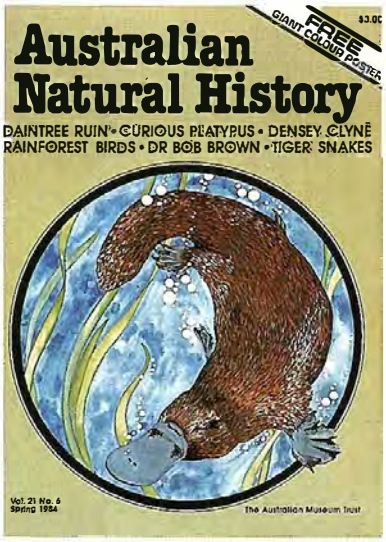
1 Drought • Possums • Rare Tortoise • Death of the Murray



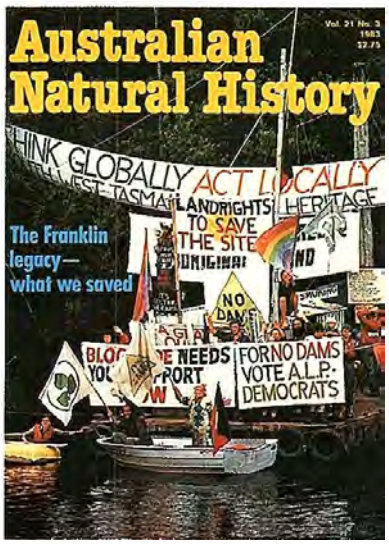
2 Raptors • Rat-catching • Wasp Invasion • Opal Fossils • Bullants



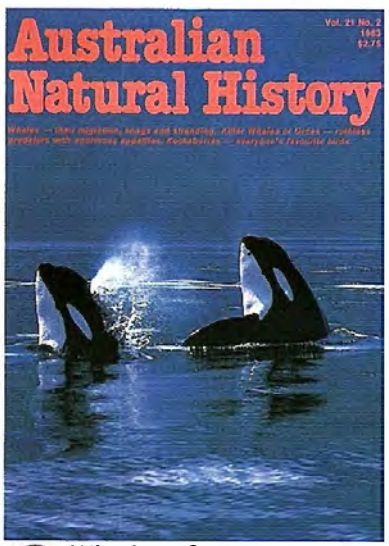
3 Kangaroo Harvesting • Mantids • Simpson Desert • Forestry



4 Platypus • Daintree • Rainforest Birds • Tiger Snakes



5 The Franklin • Tasmanian Devils • Magpies



6 Whales: Song • Stranding • Migration • Killer Whales • Atoll Animals

Australian Natural History

The above A.N.H. back issues can be ordered by completing this coupon (or a copy) and returning with payment, post-free, to:

FREEPOST 10
Australian Museum
P.O. Box A285
Sydney South NSW 2000

BACK ISSUES ORDER FORM

Back issues are available for $4 each or $20 for six, including postage and handling.

Please send me: ☐ copies of No. 1 ☐ copies of No. 2 ☐ copies of No. 3 ☐ copies of No. 4 ☐ copies of No. 5 ☐ copies of No. 6

Total number of magazines: ☐

Cheque or card authorisation must accompany order. Make cheques payable to 'Australian Museum'.

NAME ..... ADDRESS .....

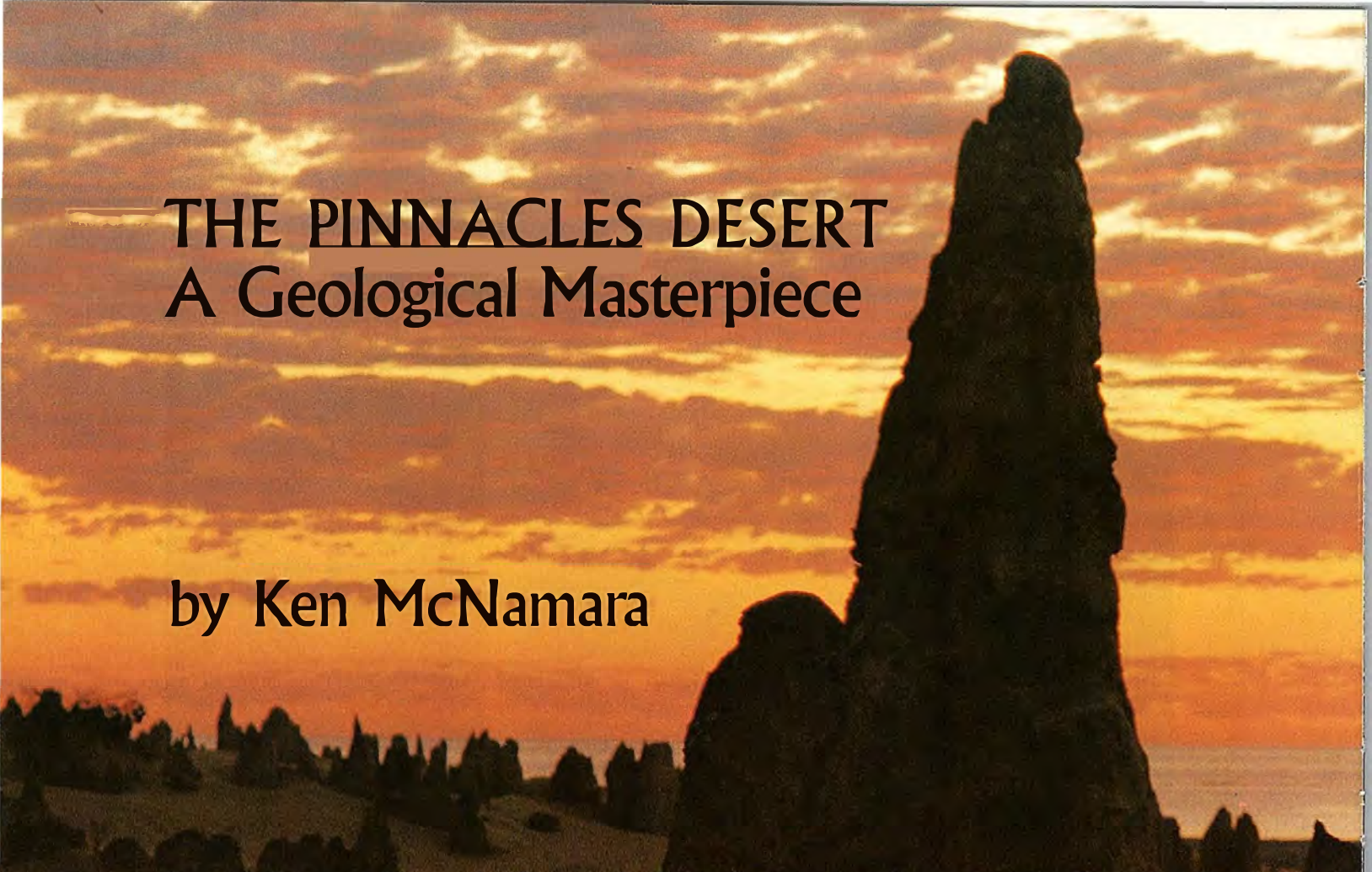
..... SUBURB ..... P/CODE .....

Please debit my ☐ Bankcard ☐ American Express ☐ Visa

☐☐☐ ☐☐☐☐☐☐☐☐☐☐☐☐

Signed ..... Expiry Date .....

Cheque/card authority enclosed for $ .....



THE PINNACLES DESERT
A Geological Masterpiece

by Ken McNamara

One of the most bizarre landscapes in Australia is an area known as the Pinnacles Desert in Western Australia. Situated close to the sea near the township of Cervantes, about 180 kilometres north of Perth, the Pinnacles Desert is a stark area of shifting, yellow sand studded with thousands upon thousands of large, limestone pillars. Ken McNamara, of the Western Australian Museum, enlightens us on these natural wonders.

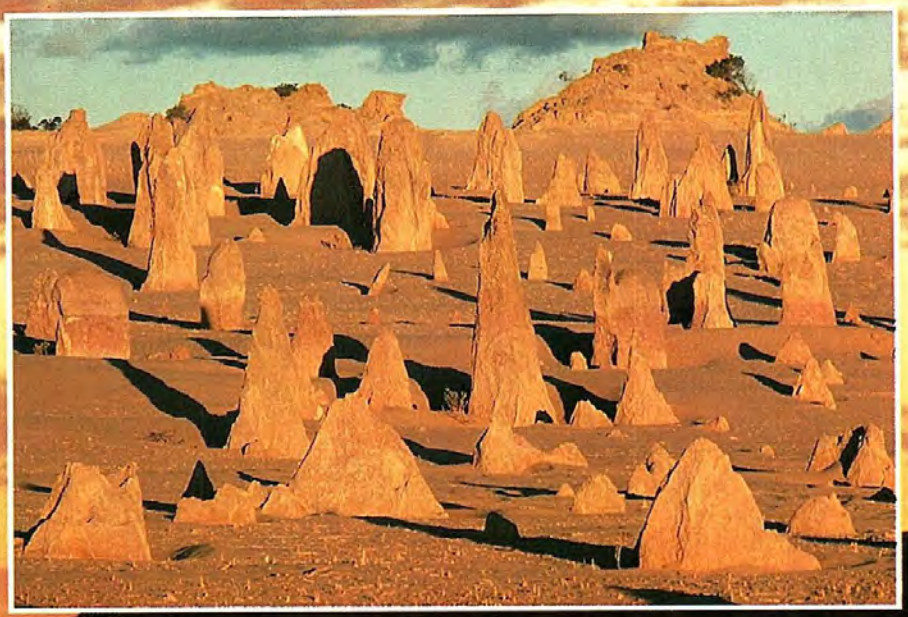
Situated in the Nambung National Park, these limestone monoliths tower up to five metres in height and display a fascinating variety of shapes. The most distinctive of these are the regular, parallel-sided columns which wouldn't look out of place in a megalithic site such as Stonehenge. These columns often terminate in a hard cap, giving an overtly phallic shape. Some form jagged, sharp-edged structures that rise to a finely pointed apex; many resemble petrified termite mounds; and others have been sandblasted to a smooth finish or have a honeycombed surface—the latter a result of wind erosion picking out the softer parts of the structure.

To understand how these pinnacles were formed, we must go back to the interglacial periods during the Middle Pleistocene—700,000–120,000 years ago. During these relatively warm periods, a rich marine life flourished. Invertebrate shells of molluscs and forams would have provided the basic raw material for the lime sand that constitutes the pinnacles. These sands, over thousands of years, hardened into the Tamala Limestone, which occurs along the coast of much of south-western Australia. The limestone is an aeolian calcarenite. That is, it was formed from wind-transported, calcareous sand grains. Developed first as offshore sands, then brought ashore by wave action, these lime sands were blown by the wind into large dunes, up to tens of metres in height. Evidence that the Tamala Limestone was once a series of mobile sand dunes is displayed by the presence of cross-bedding or dune bedding in sections through the limestone, reflecting the changing slope of the advancing dune front. Such bedding is visible in many pinnacles.

The first stage in the formation of pinnacles begins with the stabilisation of dunes by an extensive vegetation growing under the influence of a Mediterranean-type climate. The alternation of cool, wet winters with hot, dry summers is an important factor in the cementation of the dunes and their transformation into compact limestone. After winter rains, sand grains are dissolved by the action of slightly acidic water percolating between them. During summer, as the dunes dry, dissolved calcium carbonate precipitates as a cement around sand grains at low levels of the dunes, thus stabilising them from below. At the same time, vegetation stabilises the surface of the dunes by developing a humic soil, which in turn increases the acidity of groundwater, thereby accelerating the leaching process.

A thin upper humic layer develops on the dune surface, beneath which is a layer of residual quartz sand—the insoluble remnants of the dissolved sand. Dissolution and cementation concentrate at the base of this soil horizon and result in the formation of a hard layer of calcrete. It is this calcrete that caps many pinnacles and protects the softer limestone underneath from wind erosion.

The formation of pinnacles from lithified dune sands commences with the development of cracks in the hard subsoil calcrete layer. Plant roots exploit these cracks, penetrating the



softer sediments beneath, and water, preferentially running down these channels, leaches the limestone. These channels widen into solution pipes after the roots rot away. As the limestone undergoes continual leaching and the solution pipes deepen and widen with prolonged weathering, a quartz-sand soil cover progressively deepens. This steadily works its way into the solution pipes and fissures within the limestone. As the leaching process continues over thousands of years, the subsurface limestone gradually dissolves away until only a few, more resistant columns remain—the pinnacles. At this stage they are still buried in the sand.

Other theories on the formation of the pinnacles suggest they represent remnant plugs of limestone. The idea is that the solution pipes become filled with harder, secondary deposits of limestone and that these plugs then survive the severe subterranean weathering of, in this case, the Tamala Limestone, and persist as the pinnacles in the Pinnacles Desert. A small number of pinnacles may have possibly formed this way. Some of the pinnacles have a superficial veneer of secondary limestone, but the presence of dune bedding and the absence of concentric banding in fallen pinnacles suggest that most of the pinnacles are not secondary limestone plugs. Another popular theory claims the pinnacles are the fossilised remains of giant Tuart trees. However, there is no evidence to substantiate this view.

Many of the pinnacles in the Pinnacles Desert may, however, represent the original sites of long plant tap roots which extended deep into the limestone in search of the water table. Dissolution of the calcium carbonate during wet winters would have been most active in the root zone, an area of higher acidity. As the limestone dried out during hot, dry summers, reprecipitation of the calcium carbonate between sand grains would have been concentrated around the root zone. On weathering of the limestone these areas would be more resistant and persist as pinnacles.

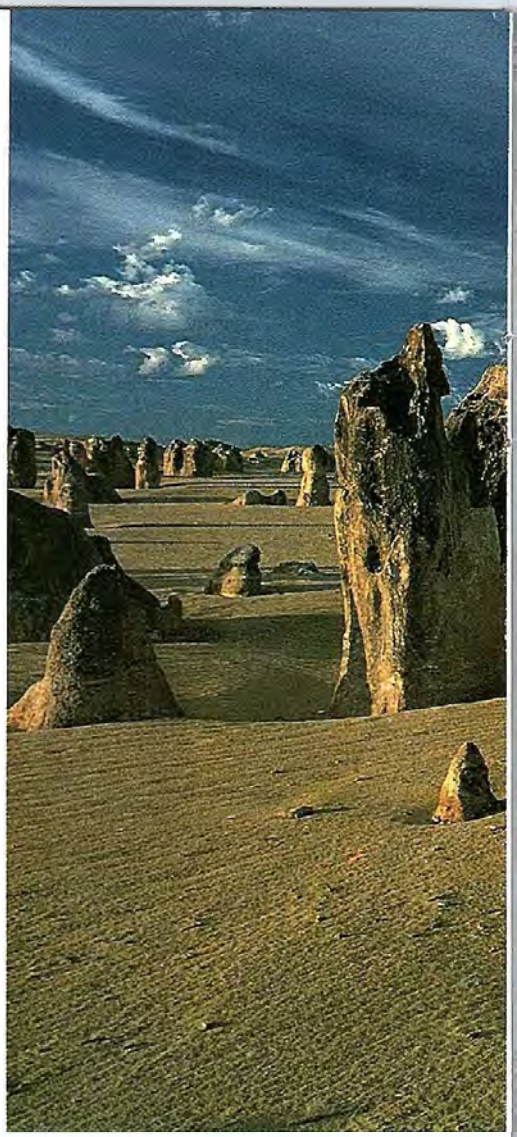
The formation process of pinnacles is an entirely subterranean phenomenon. Their exposure occurs by removal of the overlying quartz sand by wind, a process known as deflation. Dry conditions during the last 25,000 years, as the last glacial period reached its maximum intensity, resulted in extensive wind erosion. Much of the quartz sand that originally covered the pinnacles was blown inland. Once exposed, the pinnacles themselves were subjected to wind erosion.

One of the most puzzling and intriguing questions about the pinnacles in the Pinnacles Desert concerns the time that they were first exposed. There is evidence to suggest that they may have been exposed more than once in recent times. Archaeologists have found a number of chert artefacts and associated limpet and turbo shells around some of the pinnacles. Because they are made of Eocene (about 45 million years old) chert, which is not found in the area today, it is thought that they may have been derived from quarries submerged by the post-glacial sea-level rise more than 6,000 years ago. Radiocarbon dates on limpet shells from a nearby site gave an age of 5,090 years before present.

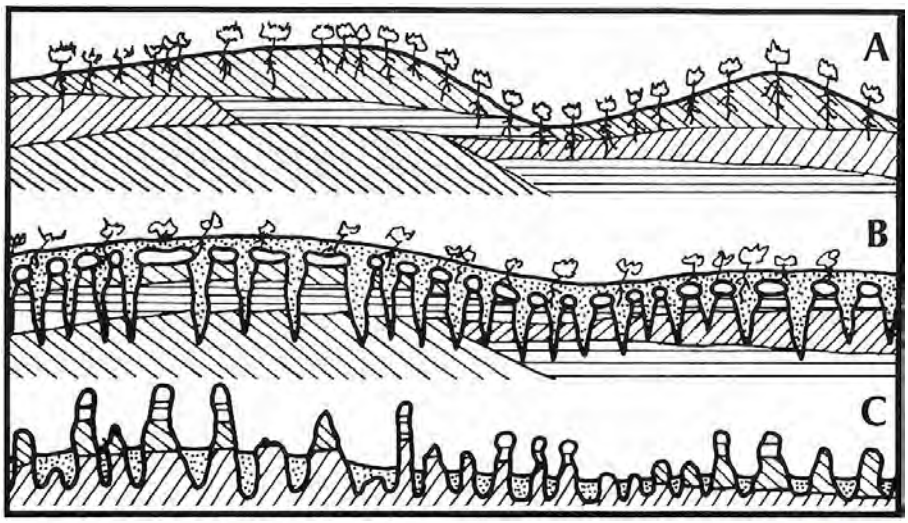
Some of the chert artefacts have been cemented to the bases of the pinnacles. This suggests that the pinnacles may have been exposed some 6,000 years ago, and then covered

The Pinnacles Desert is about 27 kilometres south of Cervantes by unsealed road (180 kilometres north of Perth). Within the Pinnacles Desert, a one-way system of vehicle tracks is marked. The National Parks Authority requests visitors not to stray from these tracks or remove pieces of any rock structures present in the area, as these activities not only destroy the features, but also disturb habitats of plants and animals and increase the rate of erosion.

PHOTOS: W.A. PHOTO INDEX



Schematic cross-sections illustrating how pinnacles might have developed.



A. Dune being stabilised by vegetation. Tap roots penetrate deep into the developing limestone, which hardens preferentially around the roots. The groups of parallel lines represent dune bedding.

B. A hard layer of calcrete has developed. In this and the underlying limestone, solution pipes have developed. The insoluble residue from the dissolution of the limestone accumulates in the pipes.

C. Following prolonged subsurface weathering, only a few residual stumps of limestone are left, swathed in quartz sand. After the wind has blown this sand away the residual limestone stumps jut into the air as pinnacles, a few capped by the remnants of the old calcrete layer.

Exposed in a quarry at Mandurah, Western Australia, these pinnacles surrounded by quartz sand are in the process of formation. The dune bedding shows them to be the remnants of an eroded bed of limestone. Photo: K. McNamara.

again by dune movement, before being exposed relatively recently. No evidence for recent Aboriginal occupation of the area has been found. Nor have any Aboriginal legends about the pinnacles survived.

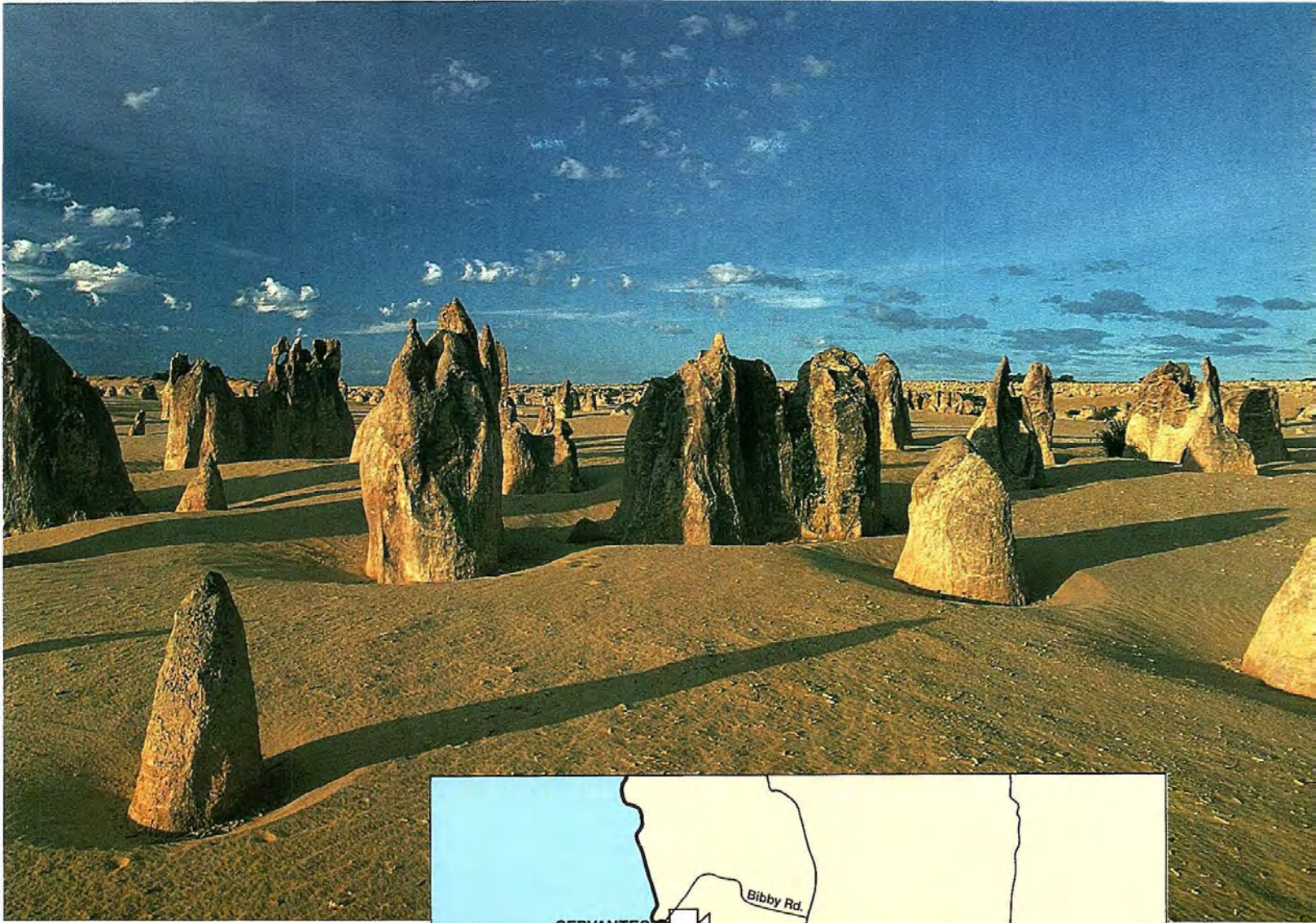
Indirect evidence to support the view that the last exposure of the pinnacles occurred relatively recently includes the lack of historical records from the last 300 years. The existence of the Pinnacles Desert was generally unknown until James Turner, in the early 1960s, explored the area and recommended its inclusion in the Nambung National Park.

Earlier explorers of the area did not record these strange limestone structures. Abraham Leeman, a Dutch navigator stranded on an island off the Western Australian coast adjacent to the Pinnacles Desert in 1658, makes no mention of the pinnacles in his diary, despite the fact that he and others explored that part of the coast and even recorded the two large hills, North and South Hummock, which lie very close to the Pinnacles Desert. Perhaps at that time the pinnacles were not exposed.

Another explorer who must have passed extremely close to the area of the Pinnacles Desert was George Grey. He made his epic journey on foot to Perth, having been shipwrecked near Kalbarri (100 kilometres north of Geraldton) in 1839. Like the earlier Dutch explorers, Grey made no mention of the pinnacles. It seems possible that they were only swept clear of sand within the last 100 years.

One persistent story is that early Dutch navigators, on sighting the pinnacles, thought that they were the remains of an ancient city. However, there is no written evidence to substantiate this claim.

The Pinnacles Desert forms a striking contrast to the richly-vegetated surrounding area of the Nambung National Park. As already discussed, the vegetation types within the Park played an important role in the formation of the pinnacles. The types of vegetation are controlled by both the topography and the character of the sand on which they occur. Immediately inland from the sparsely-vegetated foredunes that line the ocean is a series of white, lime-rich sands of the Quindalup System. The type of vegetation occurring here is strongly controlled by the relief of the dunes. On the windward side, the daisy *Olearia axillaris* is a dominant species, while in the more sheltered leeward thickets,



Set in a sea of quartz sand, the pinnacles in the Pinnacles Desert represent the deeply eroded remnants of a thick bed of limestone which once covered the region. Photo: W.A. Photo Index.

several *Acacia* (wattle) species grow.

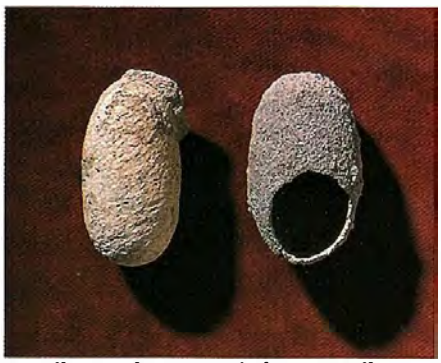
Further inland, the yellow quartz sand of the Spearwood System occurs. The vegetation here consists of Tuart (*Eucalyptus gomphocephala*) woodland in the valleys and *Banksia* and *Casuarina* species on the more exposed heaths. Here, dense aggregations of pinnacles are often interspersed with stands of the bright orange flowering *Banksia prionotes*.

The Pinnacles Desert itself supports a very sparse mammal fauna. This is hardly surprising as the Nambung National Park as a whole, like much of Western Australia, supports an impoverished native mammal fauna. Excavations of cave deposits in the Pinnacles Desert region have revealed that a much richer fauna existed immediately prior to the arrival of Europeans.

Species that originally inhabited the area but are no longer recorded here include the Western Quoll (*Dasyurus geoffroii*), Mulgara (*Dasycercus*

One of the more bizarre-shaped pinnacles. The hard cap is a remnant of the calcrete layer. Photo: K. McNamara.

Like a forest of petrified twigs, the rhizoliths which occur over much of the Pinnacles Desert represent fossilised remains of ancient plant roots. Photo: K. McNamara.



Fossil pupal cases of the weevil *Leptopius* from ancient soil horizons in the Tamala Limestone. Photo: K. McNamara.

***Banksia prionotes*, one of the commonest plants in the vegetated areas around the Pinnacles Desert. Photo: K. McNamara.**

cristicauda), Dibbler (*Parantechinus apicalis*), White-tailed Dunnart (*Sminthopsis granulipes*), Grey-bellied Dunnart (*S. griseoventer*), Southern Brown Bandicoot (*Isoodon obesulus*), Common Brushtail Possum (*Trichosurus vulpecula*), Brush-tailed Bettong (*Bettongia penicillata*), Western Mouse (*Pseudomys occidentalis*), Shark Bay Mouse (*P. praeconis*), Heath Mouse (*P. shortridgei*), Mitchell's Hopping Mouse (*Notomys mitchelli*), Pale Field-rat (*Rattus tunneyi*) and the Ghost Bat (*Macroderma gigas*). Species that still persist include the Honey-possum (*Tarsipes rostratus;* although rather rare), Western Grey Kangaroo (*Macropus fuliginosus*), Western Brush Wallaby (*M. irma*), Ash-grey Mouse (*Pseudomys albocinereus*), Bush Rat (*Rattus fuscipes*), five species of bats and the Echidna (*Tachyglossus aculeatus*). European introduction of the House Mouse, Fox and Cat has possibly had a substantial impact in halving the numbers of native mammal species in the region.

Older fossil vertebrate remains have turned up in some of the old soil horizons of the Tamala Limestone. These include the skull of an extinct species of wombat and the jaw bone of an extinct kangaroo, *Protemnodon*. Also occurring, in clusters of many hundreds, are egg-shaped objects about five centimetres in length. These are the fossilised pupal chambers of the weevil *Leptopius*. During periods when the ancient dunes were stabilised by vegetation, the larvae would burrow into the sand and form a chamber in which they metamorphosed into adult weevils. The larvae appear to have secreted a substance around them which increased the acidity of the chamber walls. Water seeping through the sand, then, would have resulted in a thin layer of sand being cemented around the pupal chamber. Fossilised chambers with a hole at one end indicate successful metamorphosis prior to fossilisation. However, the intact nature of others suggests inundation of the soil by shifting sand, thus preventing the emergence of the adult weevil.

The most common fossils occurring both within and beneath the old soil horizons in the Pinnacles Desert are those of plant roots. These are the rhizoliths or rhizoconcretions. Plant roots penetrating into the dune provided an easy downward passage for water. An increase in local acidity around the roots, dissolution of adjacent sand and its reprecipitation in a very localised band resulted in the roots' eventual replacement by redeposited calcium carbonate. When softer sand surrounding these rhizoliths is eroded away by wind, these brittle ancient roots stand up out of the desert sand looking like forests of petrified twigs. Much of the sandy area between the pinnacles is covered by these amazing structures, some standing 15–20 centimetres high.

Although much work remains to be done on unravelling the mysteries of the Pinnacles Desert, its spectacular appearance will remain a source of wonder to the many who visit the area. In terms of geological time, however, the pinnacles are transient features. Wind will determine their ultimate fate—either through erosion or inundation with another sand dune. □

PLANT VARIETY RIGHTS: A QUESTION FOR AUSTRALIA

by Margaret Brown

With the release in April of the report on Australia's plant breeding needs by Professor Alec Lazenby, the question of Plant Variety Rights (PVR) legislation once again becomes an important issue. This is a type of legislation that allows a plant breeder (individual or corporate) exclusive propagation and distribution rights over a newly-discovered or newly-developed variety of plant. It is virtually the same as taking out a patent on a plant type. To qualify for this 'patent', a new variety must be shown to be distinct, uniform and stable (DUS characteristics). The original breeder or subsequent owner then collects royalties on each plant propagated from the patented variety.

The Lazenby report has concluded that "the total resources presently invested in plant breeding in Australia are insufficient", recommending "that legislation for a Plant Variety Rights Scheme be enacted in Australia and that it should be framed such that no crops are excluded from potential coverage."

Who would control such a scheme? Suggestions have been made that the Australian Patent Office could incorporate the administration of a PVR scheme as it has already granted patents in respect of three varieties (two roses and an orchid). However Lazenby's report identifies problems with using current patent legislation and recommends that PVR legislation should be separated from patents "for as long as possible". Lazenby concludes that a small PVR Office should be created within the Department of Primary Industry to administer the scheme assisted by an Advisory Committee representing breeders, growers, seed industry, government and consumers.

Introduction of a PVR scheme would bring Australia into line with a number of other developed nations. PVR legislation has been in force for many years in the United States, Russia, United Kingdom and many E.E.C. countries, and has operated in New Zealand for about ten years. Canada and Australia (so far) have resisted implementing PVR schemes for a variety of reasons.

Although all schemes have the same fundamental objectives, they differ in their administrative procedures. Most European countries (including the United Kingdom) require field trials of new varieties to prove DUS characteristics. United States breeders are only required to produce written descriptions. When New Zealand first introduced PVR, field trials were required, but recently the expense and delays involved have led to the acceptance of varieties on the basis of written descriptions only. Lazenby recommends that determination of DUS characteristics be based on breeder descriptions for crops and pastures, and field trials for any overseas applications and ornamentals. Lack of merit testing could result in poor varieties being promoted, with testing effectively occurring in the market place. However, merit testing is costly, time consuming and labour-intensive and, to Lazenby, unnecessary.

The effect of PVR legislation overseas is difficult to evaluate. However Australian plant breeders who have recently travelled overseas report increasing pressures under the present United States administration for public plant breeding institutions to withdraw from practical plant breeding and concentrate on basic research to support private sector breeding.

Lazenby's report concedes that the advent of PVR will place increasing pressure on quarantine facilities and recognises that quarantine restrictions are an impediment to some breeding programs, delaying access to overseas varieties, in particular horticultural crops. The possibility of PVR for horticultural varieties was considered at the 1984 Senate Standing Committee on National Resources (which investigated the issue of PVR for Australia) but no special consideration was given to the problems created by our strict quarantine regulations.

During the 1984 enquiry the horticultural lobby, which includes fruitgrowers and propagators of ornamental plants, claimed many potentially useful plant varieties are being withheld from Australian growers because of our lack of PVR protection. Developers in the United States, Europe and New Zealand were said to be reluctant to sell new types to Australian propagators without PVR protection.

However, the Senate report stated that there was little evidence to support the claim that useful varieties are being withheld for this reason. Lazenby, quoting the same Senate report, claimed there was "overwhelming evidence that, for a number of reasons, many overseas plant varieties which could substantially benefit Australian agriculture are not being made available speedily for commercialisation". The fact that the Senate report contained such conflicting evidence was neither recognised nor discussed.

Lazenby's strong support for PVR legislation has several disturbing aspects which have not been adequately addressed in his report. While recognising that a PVR scheme needs to be financially self-supporting, it fails to come to grips with the fact that PVR can only operate successfully on the basis of royalties from a large and predominantly commercial trade in seeds and other propagating matter produced for farmers.

Broad-acre agriculture in Australia is unlikely to provide these conditions in the foreseeable future for reasons of crop type, environment, geography and economics. Many varieties developed overseas would be unsuitable for local conditions, especially among the field and pasture crops that form the backbone of our agriculture.

The reason for this is that Australian soils, in their virgin state, are generally infertile when compared with those of North America, Europe and New Zealand. Plants that perform well must be especially developed to make the most of soil and climatic conditions in the particular part of Australia in which they are to be grown. Because of this, Departments of Agriculture in all States have long-running breeding programs for all major broad-acre crops and some horticultural varieties.

Australian farmers also buy very little seed compared to farmers overseas for the simple reason that they don't need to. Farmers can generally grow up their own seed stocks for

several years and/or exchange seed with neighbours. This makes our commercial seed trade relatively small—insufficient to support a flourishing PVR scheme. Additional funding would be required.

The situation could be different with horticultural crops, which are generally restricted to the wetter, more fertile coastal belt and irrigation areas. Some overseas varieties (although not all by any means) have proved to be suitable.

Some additional problems associated with PVR schemes have not been fully addressed. A number of bodies, including the Plant Diversity Protection Committee, have claimed that PVR legislation would encourage selective breeding for appearance and handling characteristics rather than for nutritional benefits or flavour. They are concerned that many traditional fruit and vegetable varieties would be neglected or lost. PVR legislation has tended to hasten this selective breeding, although it was already occurring in the absence of PVR.

Recognition of the problem has led to the establishment of seed libraries in some countries (the most famous being in the United Kingdom) to protect traditional varieties and their inherent natural diversity. However the threat of withdrawal of government support hangs over some institutions, and with it the risk that many old varieties may be lost.

The Plant Diversity Protection Committee has also expressed concern that newly discovered Australian native plants could be patented and become the property of overseas interests. Lazenby's report specifically excludes "genuine native flora" from PVR coverage but states that "any cultivated varieties derived from native plants" will be covered. This means that hybrid wattles, grevilleas, eucalypts and other 'natives' may become the property of large overseas corporations.

PVR is also blamed by some for the production of crops dependent on a complex and expensive regime of pesticides, fertilisers and herbicides. Lazenby claims that much public breeding aims at reducing our dependence on chemicals. While this may be true, it nonetheless must be remembered that many of the large transnational corporations lobbying vigorously for the introduction of PVR to Australia have commercial interests in both seed production and agricultural chemicals.

The report does not address the fact that the availability of chemicals has allowed breeders to concentrate more on yield, neglecting natural resistances to disease, insects and weed infestations. Profits from increased yields have far outweighed the costs of fertilisers and other chemicals. The fact that overuse of chemicals is likely to become ecologically dangerous does not even rate a mention.

PVR is also seen as encouraging secrecy in research and restricting the free flow of information and plant materials between breeders throughout the world. Commercial interests predispose patent owners to protect their breeding processes and plant materials. There have also been claims that PVR encourages the one-way flow of genetic material from the Third World countries, where most of our food crops developed, to private corporations in the developed world. Third World countries can seldom afford to set up and maintain gene banks in which to store seeds and other propagating materials—this is generally done in industrialised nations.

Large corporations tend to keep only materials immediately relevant to their breeding programs, expecting public bodies to carry a wide range of genetic lines. Gene banks are costly to maintain—another drain on the public purse. However, as pressure for increasing farmlands to feed hungry people in the Third World increases, natural pockets of genetic diversity are threatened and gene banks assume great importance. Plant breeders in developing countries are in danger of becoming dependent on genetic materials which, although originating in their own area, are held by the United States or other developed countries, and as such may be withheld if these governments see fit to do so. The United States Government has, on occasions, restricted access to genetic materials for political reasons.

A number of experts in the field of plant breeding have put forward alternatives to PVR, notably Dr J.S. Gladstones, principal plant breeder with the Western Australian Department of Agriculture, and Mark Cole, a researcher into the Australian seed industry. Gladstones' scheme is aimed primarily at broad-acre crops, such as wheat, barley, rice and fodder and pasture crops. It aims at providing a form of payment to breeders and public breeding programs, which is based on the usefulness of their varieties in agriculture and does not necessitate patent rights or involvement of the commercial seed trade.

Coles' plan is aimed at horticultural crops and seeks to integrate an importation scheme into the existing Commonwealth Fruit Variety Foundation Committee which co-ordinates the import of overseas material.

Several private horticulturalists have also set up importation schemes through private treaty arrangements. An example is the Flemings chain of nurseries in Victoria, the directors of which negotiate with breeders overseas for propagation rights to patented varieties. To date, Flemings has successfully imported a number of varieties of fruit and, after field trials to prove their suitability for local conditions, released some to Australian growers.

Lazenby's report appears to give a very one-eyed support to PVR. In a 196-page document only six-and-a-half pages discuss opposition to PVR and there is no examination of alternatives.

However alternatives do exist, and schemes to reward plant breeders for their efforts can be implemented without recourse to PVR legislation. Many people would agree that it is preferable for Australia to follow Canada's example and avoid adopting PVR for the foreseeable future, rather than involve the government in the establishment and maintenance of a PVR scheme, which will contribute little benefit to the average Australian and probably create a considerable drain on the public purse. □

letters

A Question of Lerps

Australian psyllids (lerps) have been extensively studied during recent years, and the species illustrated on the leaves of *Eucalyptus tereticornis* in Tim Low's Wild Foods article (A.N.H. Vol. 21, No. 11) do not belong, as stated, to the genus *Spondyliaspis* or to the family Psyllidae.

During 1960, psyllid taxonomist K.L. Taylor of C.S.I.R.O. erected a new genus *Glycaspis* (Greek *glycos* =sweet, *aspis*=a shield) to contain many species previously erroneously referred to Signoret's genus *Spondyliaspis* (*Aust. J. Zool.* 8: 383). The genera *Glycaspis* Taylor and *Spondyliaspis* Signoret are now placed in the family Spondyliaspididae, subfamily Spondyliaspidinae, of the Psylloidea.

The *Glycaspis* species on *E. tereticornis* could be *G. struicis, G. brimblecombei, G. pratensis* or possibly *G. australoraria.*

Glycaspis lerps are sweet, with only a trace of starch or wax.

—K.M. Moore
Yeppoon, Qld

Tim Low informs us that the lerp was identified by the Entomology branch of the Department of Primary Industry in Queensland which has admitted its error. Glycaspis *is correct. He does insist, however, that the lerp* tastes *very waxy.*

The first of Tim Low's interesting series of articles on Australian Wild Foods includes lerps, and I would like to add my comments.

The only Australian species that build lerps belong to the Spondyliaspidinae, and all of them feed on *Eucalyptus* or *Angophora* spp. I have not heard of a red lerp on mulga, and would be glad to have a reference or see some specimens.

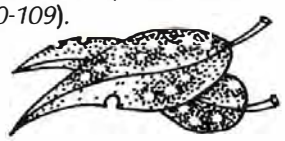
Lerps containing sugar belong to only three genera: *Eucalyptolyma, Cometopsylla* and *Glycaspis,* the latter originally placed incorrectly in *Spondyliaspis.* I suspect that the framework of these lerps, and the whole of the lerps in other genera, although mostly starches, is only partly digestible; and that early writers such as Peter Beveridge in 1884 confused lerps with manna, which is exuded by many eucalypts. Incidentally, the exudation of manna is possibly stimulated by the feeding of sap-sucking insects. I have seen heavy deposits of similar material on the trunks of gum trees following oviposition by cicadas. Hopefully Tim will mention manna in a later article in his series. Unlike lerps, it seems to be totally digestible.

Honeyeaters and pardelotes certainly feed on psyllids. I think the immature nymphs (larvae) under the lerps comprise their main food, although they could also partly utilise the lerps. I have often seen the lerps of *Cardiaspina*, which contain no sugar, prised up from the leaf surface so that the nymph could be removed.

I look forward to seeing future articles in Tim Low's series.

—Keith L. Taylor
C.S.I.R.O., Hobart, Tas.

Papers that refer to lerp on mulga include J.B. Cleland and N.B. Tindale (1959) "The native names and uses of plants at Haast Bluff, Central Australia" (Trans. R. Soc. S.A. *82: 123-40); and J.F. O'Connell, P.K. Latz and P. Barnett (1983) "Traditional and modern plant use among the Alyawarra of Central Australia"* (Econ. Bot. *37: 80-109*).



The Emu and the Mango

Mr H.J. Pollock's letter (A.N.H. Vol. 21, No. 11), and particularly the illustration regarding the grapefruit-eating Cassowary, vividly recalled one of the delights of my boyhood.

At that time the Botanic Gardens in Townsville had an Emu in a large enclosure. On our way home from school in the mango season, we would collect one or two large ripe mangoes to throw over the fence. The Emu's technique differed from that of the Cassowary in that the skin of the fruit was removed piece-by-piece by pecking and vigorous shaking, each piece being eaten as removed. Only when the mango was completely peeled would the Emu take it in its bill, look skywards, and a fascinated audience of small boys would watch the descent of the bulge and throw another mango over the fence for a repeat performance. —Don McDonald
Wulguru, Qld

'Wondering' in Morphogenetic Fields

Just as Robyn Williams' heart sank when he saw Sheldrake's work, mine sank as I read his article *The Gullibility Factor* in the Winter 1985 issue of A.N.H. (Vol. 21, No. 9). In addition to conducting a kind of self-censorship around what he perceives as 'science', Williams demeans Sheldrake himself and, by inference, those who support his efforts.

The hypothesis of formative causation is not unique to Sheldrake. The mechanism by which the morphogenetic fields are established, and by which form is transmitted to the factor being formed, is certainly in the realm of speculation.

In the matter of transmitting form, I believe that Williams' supposed implication of the hypothesis—that all other languages will eventually be suppressed in favour of Chinese—is inconsistent with it. Whereas, that we *could* learn Chinese if we *tried*—because a strong Chinese language 'field' has already been established—may well be consistent with the hypothesis. Similarly, the form of a growing foetus (or even a growing idea) may well be controlled by a morphogenetic field set in place by the species it belongs to. A general morphogenetic field might be locally adjusted by the genetic and somatic material of egg, sperm, mother and environment, just as our all-pervasive gravitational field is locally over-ridden by a magnetic field or the strong force in an atomic nucleus.

With an idea as pregnant as that of morphogenesis, I feel that we would have much to gain by giving up our habit of 'de-legitimating' notions that do not fit the conventional wisdom simply for the sake of preserving convention. Which is not to say that we should *not* try to refute new ideas that conflict with existing ones. It seems to me that if science is to retain its currency as being synonymous with wisdom, it must remain a dynamic concept ever aware of the relativity of its bases and the seamlessness of the reality it purports to explain. In other words, its tools (mechanisms and formulations) may well be distinctly bounded but science itself is not. Thus, science is demeaned when treated as if *science is as science does.*

—Frank Fisher
Environmental Science
Monash University, Vic.

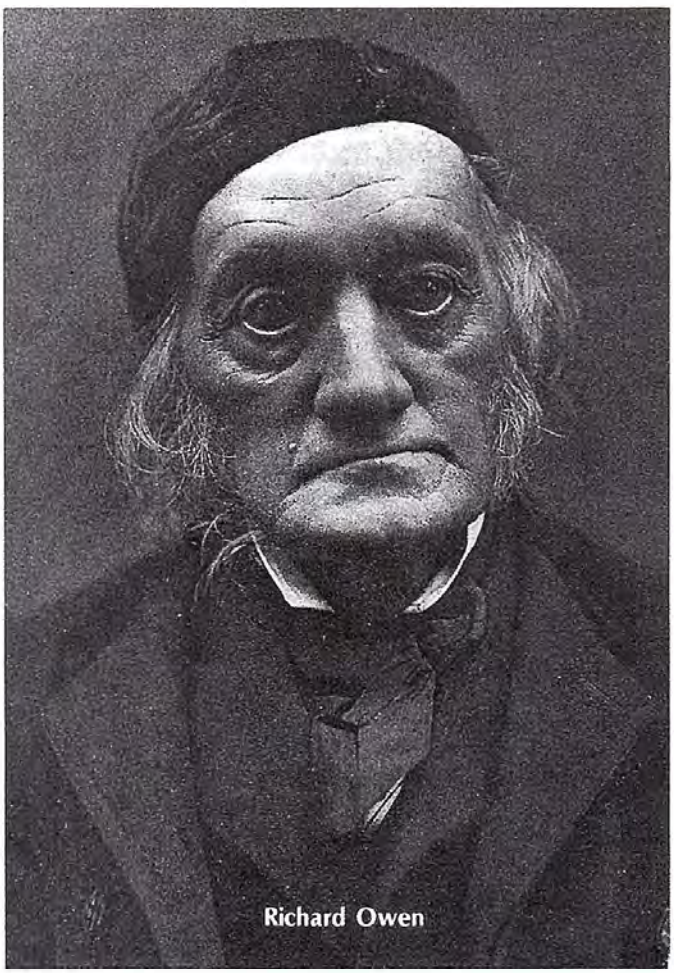
QUIPS, QUOTES & CURIOS

Owen—Dedicated Naturalist

Richard Owen (1804–1892), a leading naturalist of his time and author of many fossil and modern species (including the now extinct Marsupial Lion, *Thylacoleo carnifex*) could perhaps be regarded as Australia's premier vertebrate palaeontologist. Few people interested in natural history would not have heard about his achievements or, least of all, his name. He truly was a dedicated naturalist and would go to almost any lengths to increase the size of his collections and further his quest for knowledge. The following story (related in his 1894 biography *The Life of Richard Owen*, London) is proof of his sometimes dangerous dedication:

"My zeal and skill at assisting at *post-mortems* had gained me the rarely bestowed commendation of the doctor our preceptor. I had already begun to form a small anatomical collection, and had lately added a human cranium to my series of the skulls of dogs and cats and the skeletons of mice and 'such small deer'. It happened also that on the day when a negro patient in the gaol hospital had died, a treatise on the *Varieties of the Human Race* fell into my hands, and greatly increased my craniological longings. The examination of the body was over and the hurried inquest performed, when, slipping some silver into the hand of the old turnkey as we left the room, I told him I should have to call again that evening to look a little further into the matter, before the coffin was finally screwed down . . .

"[That evening], provided with a strong brown-paper bag, I sallied forth . . . to secure my specimen of the Ethiopian race. . . Taking my lantern and keys, I opened every door and gate, duly locking them again after I had passed through. . . The gloom of the apartment was just made visible by the light of the lantern, but it served for the business immediately in hand. The various instruments had judiciously been left behind; and when I returned through the gates —the bag under my cloak— the intimation that all was now ready for interment was received with a nod of intelligence by the old turnkey, which assured me that no inquisition nor discovery was to be apprehended on that side of the castle walls.



Richard Owen

"As soon as I was outside I began to hurry down the hill; but the pavement was coated with a thin sheet of ice, my foot slipped, and, being encumbered with my cloak, I lost my balance and fell forward with a shock which jerked the negro's head out of the bag, and sent it bounding down the slippery surface of the steep descent. As soon as I recovered my legs I raced desperately after it, but was too late to arrest its progress. I saw it bounce against the door of a cottage facing the descent, which flew open and received me at the same time, as I was unable to stop my downward career. I heard shrieks, and saw the whisk of the garment of a female, who had rushed through an inner door; the room was empty; the ghastly head at my feet. I seized it and retreated, wrapping it in my cloak. I suppose I must have closed the door after me, but I never stopped till I reached the surgery."

Paterson's Curse

The controversy over the proposed introduction of insects for the biological control of the introduced Paterson's Curse (*Echium plantagineum*) has led to discussion of the costs and benefits of the plant, mainly in terms of its infestations of pastures and value to the honey industry. Much less discussed and understood is its toxicity to grazing animals. An article in *Search* (1985, Vol. 16, Nos 7–8) explains that Paterson's Curse contains pyrrolizidine alkaloids. Most plant alkaloids are poisonous, exerting an effect on the mammalian nervous system (e.g. strychnine and nicotine), but the *pyrrolizidine* alkaloids cause chronic liver disease. The main alkaloid (echimidine) in Paterson's Curse may also increase the risk of cancer to the liver and other organs. Field evidence implies that Paterson's Curse is quite toxic to horses, pigs and, to a lesser but significant extent, sheep and cattle.

Humans are also susceptible to pyrrolizidine alkaloid poisoning. In the United States, deaths have been reported due to home treatment with herbal medicines and teas containing pyrrolizidine alkaloids. In Australia, the greatest risk of alkaloid poisoning is probably through the consumption of Russian Comfrey (*Symphytum* x *uplandicum*). As a home-grown salad plant or in tablet form from

health food shops, Comfrey is thought to cause liver disease and may increase the risk of cancer of the liver and possibly the lung. In Victoria and New South Wales, the sale of Comfrey has been restricted by its declaration as a poison.

Honey prepared from Paterson's Curse has also been shown to contain pyrrolizidine alkaloids (*J. Agric. Food Chem.* 1981, Vol. 29: 958). Paterson's Curse honey is estimated to make up 10 to 15 per cent of the total Australian honey production. The rates of intake of alkaloid from honey would most likely be very low, but the probable carcinogenicity of the main alkaloid (echimidine) gives cause for concern. This is currently being evaluated by the National Health and Medical Research Council.

Although there is no cause for alarm, pyrrolizidine alkaloids present in Paterson's Curse *do* have implications for the health of animals and humans and this, therefore, calls for the plant's rational management in Australia.

While on the subject of alkaloids, these plant chemicals have been used in a somewhat unserious attempt to explain the demise of the giant reptiles at the end of the Cretaceous (about 65 million years ago). Alkaloids are present in many angiosperms (flowering plants) and, in small doses, may cause hallucination in animals or, in large doses, death. To mammals they taste bitter and *most* animals (some humans excepted—remember nicotine?) would shun plants with a high alkaloid content. Reptiles, however, are apparently insensitive to the taste of alkaloids—but not the effects. With the rise and expansion of angiosperms during the Cretaceous, perhaps the taste-deficient dinosaurs simply 'tripped' out of existence? However, despite its appeal, this hypothesis doesn't explain the simultaneous extinction of many other groups including marine plesiosaurs and pterosaurs.

The Chicken and the Pearl

Around 200 BC, Bolos of Mendes, an Egyptian chemist, compiled a multivolume set of papyrus rolls that dealt with, among other things, gemstone-treatment processes. An excerpt (called *Papyrus Holmiensis*), copied by a scribe sometime in the third or fourth century, contains several recipes for cleaning pearls. Two of them involve feeding the pearls to chickens:

"Whenever a real pearl becomes dirty and has lost its lustre, the Indians clean it in this way: they cast the gem as food to a rooster in the evening. In the morning they search the droppings and discover it has been cleaned inside the bird and that it possesses in addition a whiteness not inferior to the original."

and

"A pearl which has become encrusted is made white in this way: give it to a chicken to swallow, thereupon cut it [the chicken] open and you will find it has become white."

Drs K. Nassau and A.E. Hanson decided to test these recipes using cultured saltwater pearls (the cultured nacre layer consisting of tiny crystals of the aragonite form of calcium carbonate, held together by the organic substance conchiolin) and one-year-old male White Leghorns. The results are published in *Gems and Gemology* (Winter 1985).

The recipes don't seem so strange when we understand a chicken's digestive process. Normal digestion takes three hours. Food goes via the oesophagus into the mildly acidic crop, where it stays until there is room in the stomach. It passes through the proventriculus, the first part of the stomach, where gastric juices (hydrochloric acid and pepsin) are added and holding time is short, and then into the gizzard (second part of the stomach). Here conditions are very acidic and the food is ground up by the strong muscular contractions of the gizzard wall acting on ingested pebbles, which stay in the gizzard for a week or more. From here, the digested food moves into the intestine for absorption and neutralisation with pancreatic juices before passing out as faeces.

Nassau and Hanson found that pearls fed to chickens were treated like pebbles and retained in the gizzard. They were not passed overnight as is specified in the first recipe. On examination they also found that the grinding and acidic conditions of the gizzard had split the pearls and removed all the cultured nacre layer. The first recipe is therefore clearly unsuccessful.

A pearl was then given to a well-fed chicken, so that holding time in the crop was increased, and cut out after an hour. The pearl had not lost weight but was no cleaner either. In another experiment, however, a pearl was fed to a chicken that had fasted overnight, so that it would move quickly through the crop. After two hours it was recovered from the gizzard. The pearl had lost about a tenth of its cultured layer and was much cleaner yet still retained an excellent lustre and orient (rainbow sheen). Although it necessitates sacrificing a thin layer of culture, it seems that the second recipe represents a valid method for cleaning pearls.

Nassau and Hanson then put pearls in laboratory hydrochloric acid. These pearls lightened in colour but lost much of their lustre and orient. Their surface was pitted and loose shreds of conchiolin were present. Although the same basic reaction between the acid and calcium carbonate is occurring *in vivo* in the chicken and *in vitro* in the test tube, it seems that the specific conditions of the gizzard (such as the presence of enzymes, which would break down the conchiolin shreds, and the grinding action) help keep the pearl smooth.

Today's jewellers place grimy pearls in a warm, soapy solution; and some use a very fine powder ('jeweller's rouge') in conjunction with a fast-spinning, soft flannel. However, they all shun acidic solutions for fear of losing any of the nacre.

Although many of the 2,000-year-old recipes given in *Papyrus Holmiensis* represent valid gemstone-treatment processes, many do not. For example, other pearl recipes relied on the 'law of similarity', which states that if you wish something to be white, then it must be placed in contact with a white substance. This would explain the use of milk, particularly the milk from a white dog, and mercury (for lustre) in several of these recipes. □

Densey

If you ever feel the urge to run up an outback sand dune without your shoes on, don't! The first time I ever got close to one, those smooth slopes glowing red in the sun lured me to climb and I was halfway up before my brain received a scream of protest from my feet. (You know how long it takes to feel pain when you stub your toe!)

Instinct said shuffle, so I shuffled. Ankle deep, the sand must have been at least 20° C cooler. I shuffled ankle deep all the way down the dune and put my shoes on. There were blisters on my soles the next day.

Well; it taught me a lesson about life in the sandy desert. No wonder most of the small animals there stay underground by day and are active by night. However, some do venture out, in the early morning and late afternoon, and a few brave the searing heat from dawn to dusk...which is what wildlife cameraman Jim Frazier and I did for a few weeks recently when filming for a documentary about wildlife in the outback.

Life here was centred around scattered clumps of spinifex, *Triodia,* which provided food and shelter for a wide range of animals. Linking some of these clumps we found the runways of the remarkable little Spinifex Ant.

Spinifex Ants may look like common-or-garden 'little black ants' but they only live in the outback. The special thing about them is their close dependence on a particular kind of spinifex and their use of the sticky resin it produces.

A covered runway takes foraging Spinifex Ants safely between clumps of spinifex.

The ants live in underground nests in the middle of the spiky spinifex clumps. They build their nests by gathering the soft resin, drop by drop, from the spinifex leaves and mixing it with sand. Like cement, the resin soon sets firm. The same mixture is used to seal and roof-over the permanent runways between the ants' nest and other spinifex clumps.

But the most intriguing use of the resin mixture is in the ants' building of shelters over clusters of tiny scale insects, which are then 'milked' for their honeydew. Extending along the exposed spinifex spikes, these shelters allow the ants to visit their charges right through the heat of the day. And it's quite likely that the scale insects would perish without their protection.

Ants of various kinds are the main food for dragons on the dunes and one of our briefs was to find and film that heraldic-looking Thorny Devil, *Moloch horridus,* (an animal surprisingly easy to handle) demolishing a column of ants. Although we were lucky enough to find a Thorny Devil not far from the dune, finding the column of ants was the problem. Spinifex Ants were just too well protected by their covered runways. There was, however, one other species of ant– small ones that could be relied on to form exposed columns along their well-worn tracks. But life is never easy for wildlife cameramen– these ants came out only in the late afternoon when shadows were creeping across the dune. For the shots of the dragon eating the ants, Jim needed strong light.

We found a solution. I fooled the ants by holding an umbrella over the runway and nest well before the ants normally emerged, whipping it away as soon as they were up and running. Our Thorny Devil, which we set down beside the trail, went to work on the outriders with his tongue, zapping them up so fast the eye missed the action. By the time the ants got hot feet and raced for home, we had our shots.

Over scale insects that they 'milk' for honeydew, the Spinifex Ants build shelters of resin and sand.

A few other insects were seen (with difficulty) around the dune: stick insects, striped katydids and mantids–all of them coloured and shaped to blend with the spinifex.

The most amazing example of deception was a small grasshopper, stippled to match exactly the multi-coloured sand grains. At rest on the sand, a fringe of hairs concealed its shadow. For further security it had only to do a quick shuffle and kick a little sand over its back and–hey presto–grasshopper gone! Next to ants, these were the most common animals around the dune.

But back to the dragons. A Thorny Devil's tongue is the fastest thing about it. No need for speed with all that well-protected covering and food provided on a conveyor belt. By contrast the Military Dragon *(Ctenophorus isolepis)* that shares the same habitat seemed almost jet-propelled. One of

Clyne looks at.....

LIFE ON AN OUTBACK SAND DUNE

A perfect match for the sand grains, this desert grasshopper can add to the deception by kicking sand over itself.

these, a male holding a territory on our dune, was surprisingly tolerant of our daily invasion.

Out on the sand all day, this dragon spent his time resting or moving about from one patch of shade to another, with an occasional dash after a stray ant. Late in the day he would settle near an ant trail for a proper meal. I think most of the time he was just 'showing the flag', because there were repeated border skirmishes with neighbouring dragons. Every time this happened, we lost him—his speed across the sand between and around obstacles was unbelievably fast. There was no fighting, just a brief confrontation before the intruder fled.

There's always a special thrill when a wild animal volunteers trust. With his remarkable eyesight, the dragon would spot our daily arrival from afar, yet always carry on as usual. It wasn't long before he was hunting ants between the tripod legs, and with care we could bend down and scratch his head. In the proprietorial way of humans, we came to think of him as 'our' dragon, looking forward to our daily rendezvous with him on the dune. Military Dragons were not written into the script...but we soon changed that.

For wildlife film-makers, time at any one location seems to run out just when you've settled down to a comfortable relationship with the locals. Now once again, and all too soon for Jim and me, it was up tripods and away. We had an appointment to keep with some termites in Arnhem Land. □

A Thorny Devil doesn't need to hurry; its strange, spiky appearance seems to deter predators.

This Military Dragon cools off regularly in the shade while patrolling its territory.

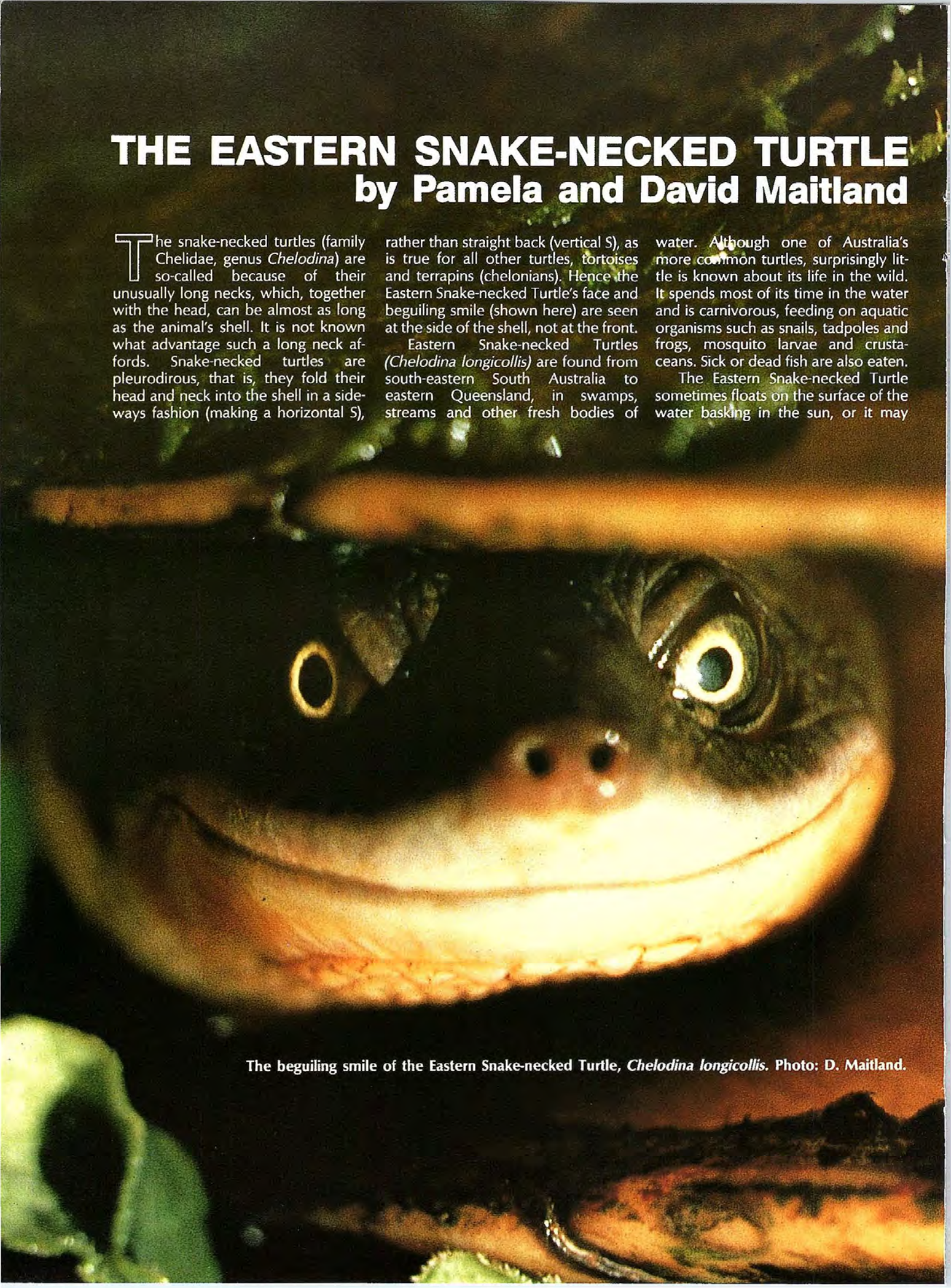
Photos: Densey Clyne.

THE EASTERN SNAKE-NECKED TURTLE
by Pamela and David Maitland

The snake-necked turtles (family Chelidae, genus *Chelodina*) are so-called because of their unusually long necks, which, together with the head, can be almost as long as the animal's shell. It is not known what advantage such a long neck affords. Snake-necked turtles are pleurodirous, that is, they fold their head and neck into the shell in a sideways fashion (making a horizontal S), rather than straight back (vertical S), as is true for all other turtles, tortoises and terrapins (chelonians). Hence the Eastern Snake-necked Turtle's face and beguiling smile (shown here) are seen at the side of the shell, not at the front.

Eastern Snake-necked Turtles *(Chelodina longicollis)* are found from south-eastern South Australia to eastern Queensland, in swamps, streams and other fresh bodies of water. Although one of Australia's more common turtles, surprisingly little is known about its life in the wild. It spends most of its time in the water and is carnivorous, feeding on aquatic organisms such as snails, tadpoles and frogs, mosquito larvae and crustaceans. Sick or dead fish are also eaten.

The Eastern Snake-necked Turtle sometimes floats on the surface of the water basking in the sun, or it may



The beguiling smile of the Eastern Snake-necked Turtle, *Chelodina longicollis*. Photo: D. Maitland.

perch on a rock or a log jutting out from the water. It will come out to warm itself at the water's edge as well, but this is less common. After mating in the water, the female turtle must venture onto land to dig a nest several inches in diameter and about six inches deep. In this she lays up to 20 white, oblong eggs with brittle shells, which hatch eight to ten weeks later.

Apart from occasionally leaving their watery home for basking in the sun or laying eggs, Eastern Snake-necked Turtles will sometimes make long overland trips. Where they go and why they do this is a mystery. Sometimes during droughts large numbers will leave their swamp or stream, but these mass overland movements are more commonly associated with wet weather conditions. What *is* certain about these trips is that man-made structures such as roads and rabbit-proof fences often spell disaster for the Eastern Snake-necked Turtle. They risk being hit by vehicles or may die of heat and starvation after futilely wandering back and forth along the length of a fence, trying to get through.

Not only does the Eastern Snake-necked Turtle have a massive shell to protect itself from its enemies (as other chelonians have), but when alarmed it can also produce a thick, foul-smelling, milky secretion from glands underneath its forelegs and near its thighs. Many other species of *Chelodina* have these well-developed musk glands but their function remains unknown. In spite of this, they can make interesting pets and are often sold in pet shops.□

POSTER

BOYD'S Forest Dragon

Boyd's Forest Dragon (*Gonocephalus boydii*), also known as Boyd's Angle-headed Dragon, is one of only two forest dragons (genus *Gonocephalus*) occurring in Australia. It is restricted to tropical rainforest areas of north-eastern Queensland and, despite its limited distribution, is apparently not uncommon, as was previously considered.

A very high nuchal (neck) crest, consisting of three large, flattened, yellowish-white spines and several small ones, and a lower dorsal (back) crest, are the most prominent features of Boyd's Forest Dragon. A pronounced gular (throat) sac with sharp spines on the front edge, is also well-developed in males.

This lizard has the ability to change colour under stress. When two males meet, they turn pale, displaying a number of dark, transverse bars. They inflate their gular sacs, erect their nuchal and dorsal crests, and bob their heads up and down, until one of the males retreats.

Reaching a length of about 30 centimetres, the tail of Boyd's Forest Dragon is nearly twice the length of its body. The hind legs are also very long. Although long hind legs are usually considered to be an adaptation for swift running, this species is reported to be rather clumsy on the ground. With its green-brown colouration and ability to keep perfectly still, it appears to rely more on camouflage than swift retreat when threatened.

Forest dragons are diurnal and generally arboreal. Their diet consists of insects, snails, grubs, worms and small vertebrates. Two to five eggs are laid per clutch. These hatch after an incubation period of three to four months. □

—Georgina Hickey

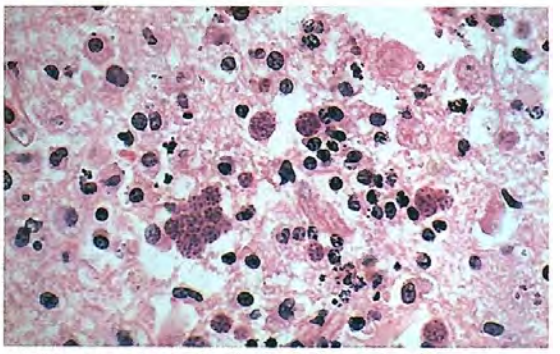
Boyd's Forest Dragon, *Gonocephalus boydii*. Photo: Leo Meier, Weldon Trannies.

Taronga Park Zoo's PATHOLOGY REGISTER

by Roff Smith

Too often, in the past, research has been delayed or needlessly repeated simply because of a lack of communication between researchers. Taronga Park Zoo is now set to change all that with the establishment of a pathology register–the only one in the world dealing with Australian native animals.

Currawong with severe lesions in the musculature due to a species of protozoan. Photo: W.J. Hartley.



▲This wombat's brain is inflamed with *Toxoplasma* cysts. Photo: W.J. Hartley.

◀Bird with mycotic infection in lungs. Photo: W.J. Hartley.

A major obstacle to pathology research of native Australian fauna has been the inaccessibility of scientific material gathered by earlier workers. All too frequently when researchers finish one project and move onto another, materials such as microscope slides or paraffin blocks that are of no further use are shunted aside and left to gather dust in a forgotten corner of the laboratory. There has never been any serious effort to collate these scattered bits of information and laboratory materials into one centralised reference collection...until recently, that is.

Funds were set aside by the Zoological Parks Board of New South Wales in October 1985 to establish a native fauna pathology register at Sydney's Taronga Park Zoo. It should take about three years to set up this facility and, when completed, will house a large collection of microscope slides, paraffin blocks and colour transparencies, together with a comprehensive library of articles and reports pertaining to diseases of native animals from around Australia, Papua New Guinea and New Zealand.

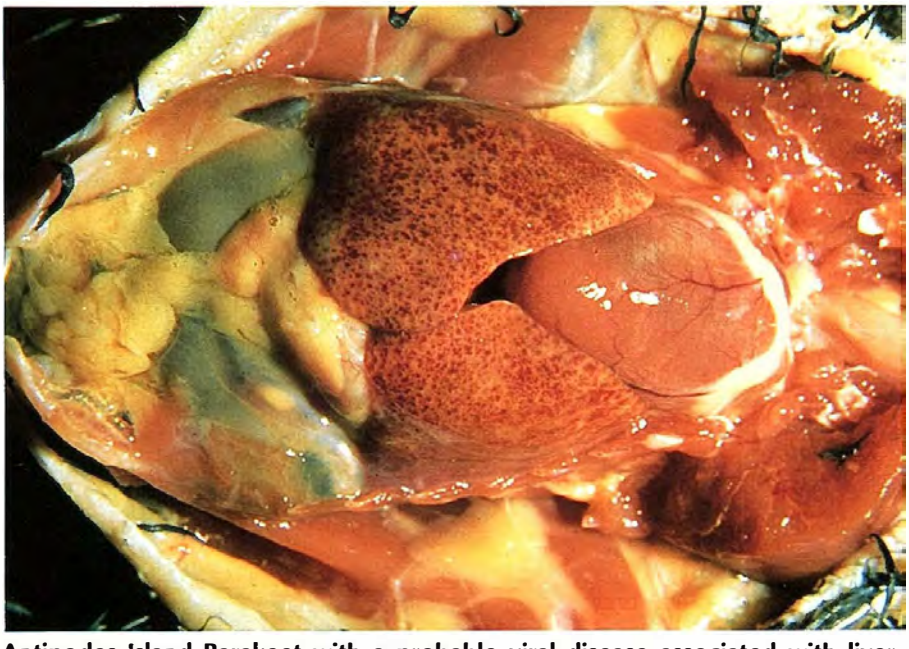
This pathology register will be the first of its kind in Australia and one of the very few in the world that deals exclusively with the diseases of non-domestic animals. Material in the register will be catalogued for quick retrieval and made available, on loan, to any interested researcher or research organisation.

This type of lending facility will save researchers valuable time and money by cutting down on needless duplication. As things have stood in the past, researchers often had to begin each project from scratch—rather like re-inventing the wheel. It will also enable researchers around the Pacific to co-ordinate their efforts. Our understanding of native animal pathology should be enhanced significantly.

There are many examples where a lack of co-ordination between scientists has hampered research efforts. The recent publicity given to the epidemic of *Chlamydia psittaci*-related infections among Koalas is a case in point. After six and a half years of research, Steve Brown of the Veterinary Anatomy Department at the University of Queensland has reported that, as a result of chlamydial infections, some Koala populations are plagued by widespread infertility,

Lion cub with bacterial liver disease. Photo: W.J. Hartley.

Lace Monitor with subcutaneous abscess over thigh region. Photo: W.J. Hartley.



Antipodes Island Parakeet with a probable viral disease associated with liver lesions and anaemia. Photo: W.J. Hartley.

blindness and a host of other potentially fatal infections*. Up to 45 per cent of such Koala populations may be infected—and this figure is drastically higher in some areas.

Despite its world-wide publicity, veterinarians confronted with a *Chlamydia*-infected Koala can do little more than try to ease the animal's suffering. Marsupial medicine, at this stage, is largely extrapolated from domestic animals, but drugs that are used to combat chlamydial infections in these – tetracyclines and erythomycin – may have side effects in Koalas. Another enigma is the Koala's suppressed immune system. In most animals, if an infection occurs, the body produces antibodies within a fortnight. In Koalas, there is a lag between infection with *Chlamydia* and a detectable antibody response. This process could take up to four months and by then the damage is done.

Scientists are beginning to realise that if they are to help animals such as the Koala, they will need to know a great deal more about them and what makes them tick. At the moment there are some large gaps in basic marsupial biology. These gaps could be most efficiently filled if there was a co-ordinated research effort. A centrally located pathology register provides a focus—a clearinghouse of information and pathology materials.

The register could have applications in human medicine as well. "Medics are very specialised", explains Dr William Hartley, a comparative pathologist and Fellow of the Royal College of Pathology, who is currently setting up the register. "They tend only to look at the human side of things. A veterinarian, on the other hand, is expected to have a general knowledge about many species. Often a comparison of pathology changes between species can be quite useful."

Useful indeed. Amalgamating a variety of information on a particular topic has often led to important discoveries, even if the cases are seemingly unrelated or obscure.

A nervous disorder in sheep and a bizarre disease affecting cannibals in a few scattered villages in the remote Papua New Guinea highlands could hardly be expected to be linked, or indeed have world-wide medical ramifications. Yet this was recently the case.

**See* Koala Disease Breakthrough *by Steve Brown and Frank Carrick, A.N.H. Vol. 21, No. 8, Autumn 1986.*

It started in 1959 when Dr W.J. Hadlow, an American veterinarian, noticed similarities in the brain pathology of sheep suffering from scrapie and victims of 'kuru', a nervous disease known only in the Fore tribe in the upper New Guinea highlands.

Kuru (from the Fore word meaning 'shivers') had been discovered two years earlier by another American, Dr D. Carleton Gajdusek. The disease, invariably fatal, is transmitted by the Fore's custom of eating the brains and other tissues of their dead friends and relatives. As adult men rarely took part in the funeral feast, kuru was confined mostly to the women and children in the tribe. In fact, during the 1960s it was estimated that as many as 90 per cent of female deaths could be attributed to kuru.

The connection drawn by Dr Hadlow between kuru and scrapie intrigued Dr Gajdusek and convinced him to continue his observations on Chimpanzees that he had inoculated with brain tissues from kuru victims. His patience paid off. Although it took several years, the Chimpanzees eventually came down with kuru and Dr Gajdusek succeeded in identifying a previously unknown type of cell invader called a 'slow virus'.

Dr Gajdusek's work on kuru opened up an entirely new area of neuropathology—one which may help solve medical riddles such as Parkinson's disease, multiple sclerosis and perhaps even senility. In 1976, Dr Gajdusek was awarded a Nobel Prize for Medicine for his discoveries.

Closer to home, a chance encounter between a medical pathologist and a veterinarian in Western Australia resulted in the discovery of a rare enzyme deficiency in children that caused deterioration of the spinal cord. The veterinarian, backed by years of experience in treating sheep, noticed a similarity in the pathology of lambs suffering from copper deficiency and that of children with the spinal affliction. Later it was determined that an enzyme deficiency in the children was inhibiting their copper absorbtion.

Hopefully, similar kinds of serendipitous discoveries would be fostered by having a wide range of pathology materials at the register 'on call' for researchers to work with.

The bulk of material for the Taronga pathology register will initially come from the extensive medical records of the Taronga Park Zoo and Dubbo's Western Plains Zoo. Taronga is the only zoo in Australia to have complete, documented medical records of its past and present animal populations extending back nearly two decades. The zoo's collection of over 11,000 microscope slides will form the backbone of the register. Although the emphasis will be placed on Australasian natives, material on non-domestic exotics will also be included.

For the register to be a complete success, however, the zoo's collection must be supplemented with material gathered from all over the Southwest Pacific. Hundreds of letters have been sent out to diagnostic labs, veterinary clinics, universities and wildlife research stations throughout the region asking for contributions.

Most of the material will be in the form of microscope slides or paraffin blocks although photomicrographs, electron microscope photos and 35mm colour transparencies will also be welcomed. The register's needs are eclectic. Material should depict lesions, either gross or microscopic; ranging from slight, almost inconsequential symptoms to long-term, chronic illness to severe, peracute stages.

A wide selection of healthy, normal tissues from animals at all stages of development—foetuses to very old adults—will be included as well. This will provide researchers with a broad data base of what is 'normal' in Australian native fauna.

All incoming slides are examined by Dr Hartley. A protocol is then written up on each and stored on a card index computer for instant recall. Should zoos, veterinarian or post-graduate students require background data on a particular disease or pathology topic, they will be able to contact the register and obtain quick, easy access to any relevant material available.

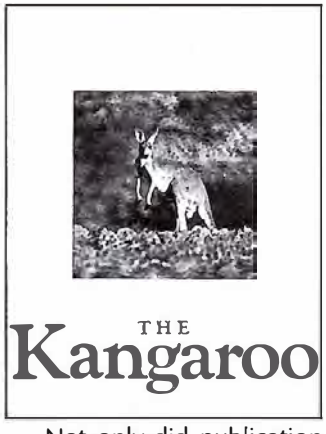
Plans are also in the pipeline to create another register for domestic animal pathology as well as initiating an exchange program between Australian facilities and other similar institutions around the world, including the giant Armed Forces Institute of Pathology in Washington. In the meantime, this efficient reference library will benefit researchers here in Australia who wish to study our unique native fauna. □

books books books books books books

The Kangaroo

Michael Archer, Tim F. Flannery, Graham Bicknell, Gordon C. Grigg. Weldon and Associates Pty Ltd, N.S.W., 1985. 263pp. $35.00.

Access to a novel fauna followed European settlement of Australia, when genera and species new to science were actively collected and described. Much was accomplished during the initial 30 years. This was followed by desultory activity until a virtual explosion of interest some 130 years later. The resulting vast expansion of knowledge finally provided detailed accounts of the life history and habitat needs of many groups of marsupials—in particular, kangaroos.



Not only did publication in the scientific literature stimulate more research but the many studies awakened the interest of the general public. The present book is one of the latest in a notable series of such publications in recent years.

The prolific writing team is responsible for an excellent book notable for quality of production, clear, readable text and particularly the illustrations highlighted by artist Rod Scott's three plates featuring impressions of some of the earliest kangaroos. Over 100 superb photographs, most published for the first time, indicate diagnostic characters as well as arousing interest in the species portrayed. In this company, Gould's illustrations lose none of their charm.

The book is divided into five sections. These are preceded by a foreword by Gerald Durrel and followed by a table listing the species, their current status and changes since European settlement, plus an adequate index.

Preparation of the first section with its up-to-date summary of the fossil record reflects the professional expertise of the primary authors. Examples of the family of kangaroos, numbering some 62 species, are introduced in the second section, which discusses their amazing diversity and adaptation to a wide range of habitats. The third section covers the interaction of man, both Aborigines and Europeans, with kangaroos as a subject of myths and a source of food and clothing; the effects of habitat change and the introduction of exotic vertebrate competitors and predators.

Section four provides illustrations, distribution maps, comment on status, measurements and descriptions of individual species. Much of this detail is based on identical sources to those utilised by Strahan (1985), but fails to attain similar high standards. Illustrations are first rate despite lack of acknowledgement of one of Gould's plates (page 148) and attributing a photograph (page 132) to Gould! Distribution maps at the scale provided are acceptable notwithstanding occasional lapses such as omission of Kangaroo Is., the type locality of the Western Grey Kangaroo and *Aepyprymnus* figured as 'formally present' in northeastern New South Wales despite references to extant populations in both species descriptions. Confusion of Port Macquarie with Macquarie River in early records of a specimen of the Red Kangaroo may account for the authors' dubious claim that the species formally occurred east of the Dividing Range. Dorsal measurements have been acknowledged as being after Strahan (1985) but then uncritically accepted as ventral 'nose-vent' lengths. Total dorsal lengths in grey kangaroos and wallaroos, if not others, have been transposed as 'nose-vent' lengths! Anecdotal species accounts may stimulate a reader's interest but the facts should be correct. Naval surgeon Lt. Alex. Collie (discussed on page 187) of HM Sloop *Sulphur* certainly examined peri-partum Tammars. He did not himself observe parturition, but reported the observations of a fellow officer on HM Sloop *Success*.

The fifth and final section summarises management of kangaroo populations and includes a balanced account of public and government attitudes to the control of those few but common species which impinge on agricultural and pastoral pursuits.

There were other errors noted in legends to plates and scattered spelling errors mar the text. Despite these lapses, the book is of value to the professional wildlife biologist, student and general reader.

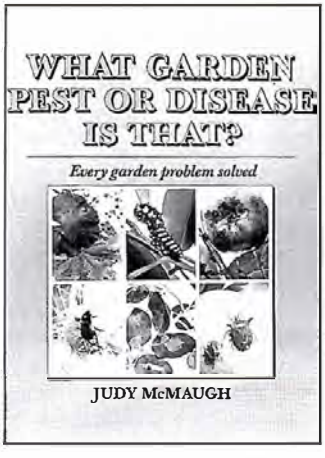
—W.E. Poole

What Garden Pest or Disease is That?

By Judy McMaugh. Lansdowne, Sydney, 1985. 312pp. $39.95.

For some years I have not been able to complain of the lack of guides to native species in Australia, but until very recently I could, and did, grumble about the lack of books to help me identify the creatures I saw far more frequently than Emus and Richmond Birdwings—namely the bugs in my backyard. As many of these were, like myself, non-indigenes, I found American and English books far more useful than any published here. Now, at last, we have Judy McMaugh's excellent publication. There is even icing on the cake—she covers garden diseases as well.

This book not only describes the major pests and diseases of garden ornamentals, fruits and vegetables and their control (with hundreds of good colour plates for identification), but also gives sound advice on the cultivation of a host of plants so that pest damage can be avoided. There are also sections on non-chemical control and sensible advice on chemicals when these cannot be avoided. I am extremely thankful that the author carefully provides scientific names as well as common names, but I must be allowed one little grumble. The organisms are set out in alphabetical order—"painted vine moth, paper bark sawfly, passion-vine hopper". That's fine if you already know the name



of the beast, but grouping by main host plant, or by the organism's place in the animal or vegetable kingdoms, would seem better, even though the cross-referencing works.

—Arthur Woods

Wild Herbs of Australia and New Zealand

By Tim Low. Angus and Robertson, New South Wales, 1985, vii + 160pp. $14.95

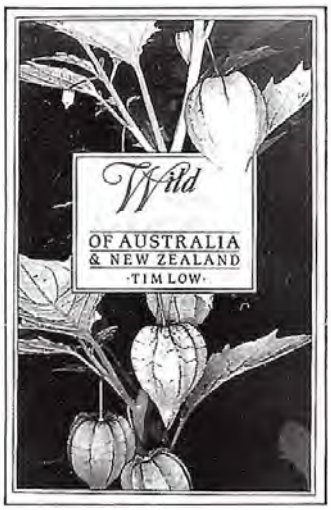
This book is an excellent guide to the recognition and culinary uses of the edible weeds commonly found in Australia and New Zealand. It effectively fills the gap between the several books available on edible native plants and the kitchen garden.

A map of Australia showing locales cited in the text is provided. Unfortunately a map of New Zealand is not. Many New Zealand locales are cited in the text, for example Southland, Marlborough, Canterbury, Otago (all of these are districts in the South Island).

"The few toxins found in weeds are usually countered by the processes of cooking. This unique stratagem is *Homo sapiens'* special adaption against plant defences...Most poisonous plants taste very bitter and others are intensely acidic or pungent". These statements from the chapter on the "Dangers of Poisoning" sum up how unlikely it is to be poisoned by weeds. Detailed accounts of the major plant toxins and their effects are given.

The chapter titled "Herbs as Medicines" is more or less a continuation of the previous one on toxins with emphasis on their usefulness in moderation.

A simple key to identification of 12 broad groupings within the 74 plant entries should make it easier to find out which weeds are at your disposal. All the plant entries are clearly illustrated by excellent line drawings mostly by the author and



reference is made to confusing species. Several Appendices give further help with identification.

Near the end of the book a selection of recipes includes such culinary delights as Weed Quiche, Dock Casserole and, for the chronically curious, Sorrelade.

—Peter Hind

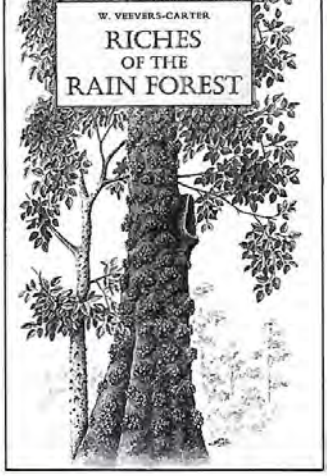
Riches of the Rainforest

By W. Veevers-Carter. Oxford University Press, Singapore, 1984. 103pp. + xi col. plates. $29.25.

Veevers-Carter has done the rainforests of Malesia too proud, for if you wish to retain or preserve something you value, you shouldn't praise it too highly!

Malesia embraces, of course, the Spice Islands, and the Dutch, French and British long exploited Malesia's forest for its products, often battling to prevent its more prized species from being exported and grown elsewhere, or contriving to steal them to do so.

Unfortunately its most delectable product, the durian, seems doomed never to leave for, as the writer makes clear, the seeds cannot be preserved and the fruit begins to rot the moment it is edible. Even when it is not over-ripe it smells "like a mixture of onions, drains and coal gas" and tastes, according to Alfred Wallace, of "custard passed through a sewer". We couldn't grow it here as we lack the necessary pollinating bat.



The durian and its wild relatives are only a few of the fascinating plants that Veevers-Carter discusses. Some of the families are represented in Australia's rainforests but, despite our closeness to Malesia, we have no dipterocarps—the giant, emergent timber trees of the region, which spread only one kilometre per century and refuse to cross narrow creeks in Borneo. Indeed, what can we offer (apart from the macadamia nut) to compare with the cloves, nutmegs, breadfruits, jackfruits, rambutans, kapulasans and versatile rattans of this unfortunately rapidly-disappearing forest? Veevers-Carter's delightful book rouses our interest, and envy, and the plates add to the charm with their evocation of the jungles of Alfred Russel Wallace.

—Arthur Woods

Wildflower Journeys

By Ninette Dutton. Macmillan Australia, Melbourne, 1985, 162pp. $29.95.

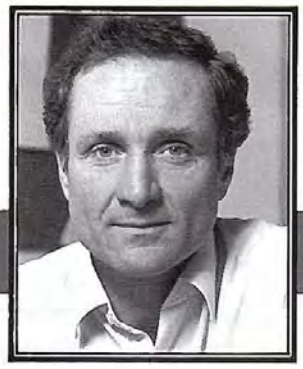
This book represents the culmination of 40,000 kilometres travelled and two years searching for, selecting and painting or drawing Australian wildflowers. During this time the artist, Ninette Dutton, made a number of journeys to the many botanically rich regions throughout the continent.

She opens her book with an informative and entertaining introduction which sets the tone throughout the book of her love for the country and dedication to her work.

The book is divided into 40 entries, each illustrated by a colour painting, line drawings and pen and wash drawings. The beautiful treatment of colour, and the sensitive selection of wildflowers representing each region, reflect the great care and planning taken throughout the artist's journeys. The pen and wash drawings, where one colour is used to highlight a botanical feature, are particularly pleasing. For each species depicted there is a brief botanical description. Interesting colour photographs showing the terrain are included with each entry, together with a diary that records her impressions of the places visited, the wildflower search, battles with the all-important light, and anecdotal snippets about the people and animals encountered. A map is given showing the area where the specimens were found.

This lovely book would appeal to a wide audience—from artist, plant person to armchair traveller—the flowing narrative style making it enjoyable reading in one gulp and the beautiful artwork for browsing at random for one's pleasure.

—Denise Greig



The Punctuated Evolutionist—Stephen Jay Gould

A.B.C. RADIO SCIENCE SHOW

On my last trip to New York I wanted, above all, to see one man. Professor Ken Galbraith—why not? Isaac Asimov—with a bit of luck. Arthur C. Clarke – 'twould be nice once more to hear the West Country vowels. But absolutely essential: Professor Stephen Jay Gould. The others would have to wait or be seen another time. Gould, professor of everything at Harvard, had a terminal disease. It had to be now.

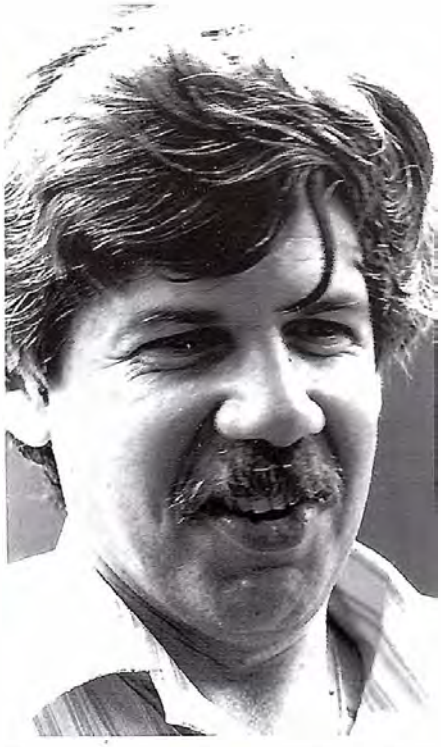
I wanted to meet the man who had beaten the creationists in their legal case to restrict the teaching of Darwinism in some parts of the United States. I wanted to talk to the man that was able to write an enthralling essay about earthworms! And I wanted to swap jokes with the guy who even dared write about the natural selective processes governing the size of chocolate bars!

He said 'Yes'–despite some groans—and suddenly there he was coming towards me in the lobby of the New York Hilton. Short, carrying a huge briefcase, and wearing clothes as does someone with cancer (as if chosen too large). Gould was brisk, no touch of whimsy here. "After the lecture you can have five minutes". I suddenly dreaded the scrummage that follows talks at big conferences, when celebrities are carried off. But he promised, grimly.

The lecture was on evolutionary theory. They had to take the connecting walls down to double the size of the big hall. (That afternoon, when Gould spoke again, they faced facts and moved everything to the ballroom!) He lectured with waving arms, scintillating verve and masterful fluency. There was no hint of his mesothelioma (an asbestos-related disease and invariably fatal) until he had finished. We met after his admirers had been shooed away and were sped to my interview room. He found the whole process quite irritating. Signs of short temper had occurred during the talk as attendants fiddled with the doors. He had leapt from the platform and slammed the partitions shut.

This was not the person I knew from the books, the impish iconoclast who displayed humour and humanity throughout, as well as a clear and obvious love for science. Here was a man with limited time and none to waste.

In his lecture he talked about punctuated equilibria, how most animals and plants stay the same as any alteration is usually disastrous. Sharks, cockroaches and lampreys have kept their basic design because it works. Nature is conservative, not driven to change. But sometimes there is upheaval. It may be a drought, ice age, giant meteorite or even a comet crashing to Earth. In each case the environment is drastically disturbed. Sunlight may dim, temperatures plummet, seas rise. And some species are wiped out. Not because they're inferior but because they're unsuited to the new conditions. Gould pointed to the dinosaur obliteration 65 million years ago. "They were fantastically successful", he said, as if



Stephen Jay Gould. Photo: National Times.

the whole argument were a statement of the obvious. "And what's more, they didn't die because the mammals came along. The mammals had been around as small shrew-like creatures running 'round the feet of dinosaurs for a hundred million years!"

The mammals were then left with an empty stage. They took the centre not because they were the realisation of any 'higher' purpose, but because the territory was vacant. The same could be said for people. There is no 'life force' or evolutionary goal, according to Gould.

He also likes the idea that a regular comet strike occurs every 25 million years or so, causing some new catastrophe and consequent punctuated recasting on the global stage.

To get a proper gauge of the subtlety of these concepts you must read Stephen Jay Gould's books. Most are collected essays from *Natural History* magazine (the American cousin of *Australian Natural History*): Ever Since Darwin, The Panda's Thumb, Hen's Teeth & Horses Toes, and The Flamingo's Smile.

As someone who opposed creationism for so long in the United States, I'm sure Gould would be pleased with the New South Wales Minister for Education Mr Rod Cavalier's statement: "just as it's unacceptable to teach sun spots as an explanation for the French Revolution, it is unacceptable to teach creationism as an explanation for biology". This was said in opposition to creationism being part of the New South Wales science curriculum. Gould avers that evolution is a fact. Only its precise mechanism is open to argument.

I was delighted to hear that his lecture tour of New South Wales and Queensland in 1985 went so well. We broadcast two of his lectures on the Science Show. As for his health, I was told his weight was back and his face full (although his impatience with journalists remains undiminished). You may be wondering why I feel free to mention his prognosis? Because he actually wrote a learned article about it last year for *Discover* magazine—on the statistical theories of being told you've a short time to live! □

RETURN OF THE PHANTOM DIBBLER

BY DR CHRIS DICKMAN
UNIVERSITY OF WESTERN AUSTRALIA

Although the Dibbler *(Parantechinus apicalis)* was first discovered by Europeans in 1838, it remains one of the most elusive of Australia's small carnivorous marsupials. In the years following its discovery, Dibblers were collected sporadically from several localities on the southern coast of Western Australia but by 1884 they had virtually disappeared. The species was not seen again until 1967 when three specimens were trapped in a patch of *Banksia* heathland at Hassell Beach (then called Cheyne Beach) 50 kilometres east of Albany. By November 1985, the Dibbler was known to be extant, but in very low numbers, in only two further localities—at Jerdacuttup and the Fitzgerald River National Park. Its chances of survival at this time appeared slim.

However, in December 1985, zoologists working for the Department of Conservation and Land Management discovered a number of Dibblers on two small islands not quite two kilometres offshore from Jurien Bay (200 kilometres north of Perth). Boullanger, the larger island (25.9 hectares), yielded 24 Dibblers, Whitlock Island (approximately eight hectares) yielded another 14. In just three days of trapping, the number of wild Dibblers seen this century had more than trebled.

Further trapping on Boullanger in February and March 1986 has confirmed that Dibblers are present on all parts of the island. The population comprises equal proportions of males and non-productive females, and a smaller proportion (0.2) of females which have previously reared a litter. Breeding probably occurs once a year, in autumn, which is three or four months earlier than for other small carnivorous marsupials. After a gestation period of one-and-a-half months and a four month period of dependency on the mother, young Dibblers are weaned very early in spring when insect prey become active.

Examination of droppings has revealed that the Boullanger Island Dibblers eat a wide variety of invertebrates, small birds, reptiles and occasionally House Mice (*Mus musculus*). A surprisingly high percentage (40%) of droppings collected in February 1986 also contained green plant parts. Dibblers at Hassell Beach have been recorded climbing flowering *Banksia attenuata* to obtain nectar but there is so far no evidence of this behaviour on Boullanger Island. Indeed, use of a fluorescent pigment tracking technique has shown that the Boullanger Dibblers are strictly terrestrial (that is, not arboreal) and spend up to eight per cent of their foraging time in seabird burrows or in tunnels excavated among the roots of sand dune shrubs. In summer, animals forage almost as much by day as by night, moving jerkily and noisily among the leaf litter. No nests of Dibblers have yet been discovered. However, Aboriginal accounts state that animals use small depressions in the ground, covering these with mounds of grass and twigs.

Sub-fossil deposits indicate that Dibblers were once widespread in Western Australia, occurring in an arc along the coast from Shark Bay in the north to Israelite Bay in the east. Although their decline was perhaps already in motion before the arrival of Europeans, there is little doubt that clearing of land for farming, increased disturbance by fire and the introduction of Cats and Foxes have drastically hastened the Dibbler's demise. The mainland populations at Hassell Beach and the Fitzgerald River National Park, although tenuous, may continue to persist in areas of heath, or heath with mallee scrub if the present management policy of minimising fire and other disturbance is continued. The island populations, numbering perhaps no more than 300 individuals, should also be secure if they remain unburnt and kept free of introduced predators.

Current work on Boullanger Island is designed to more thoroughly investigate the biology and conservation status of the Dibbler and is being supported by a grant from Australian Geographic Pty Ltd. □

A Dibbler, *Parantechinus apicalis*, on *Banksia attenuata*. Photo: M. Morcombe.

Australian WILD FOODS

RICHES FROM THE RAINFOREST

BY TIM LOW

Australia's rainforests are rich environments for wild foods. The Aborigines once harvested over 200 kinds of edible rainforest plants, mostly fruit-bearing vines and trees.

Fruits are especially abundant in rainforests. Indeed, rainforests contain more kinds of fruits than all other habitats combined. This variety reflects the close bonds between the rainforest trees and vines and the fruit-eating birds and bats which disperse their seeds.

Aborigines in northern Australia still use many of the tropical rainforest foods, but in subtropical and temperate Australia the Aboriginal relationship with rainforest was destroyed a century or so ago, long before their way of life could be recorded.

Some of the subtropical rainforest fruits – like Walking-stick Palm *(Linospadix monostachyus)* and Pepper Tree fruits *(Tasmannia insipida)* – are well-known bushman's foods, yet there is no known record of their use by Aborigines. No doubt the information has been lost.

The best-documented of all Aboriginal foods are the widespread species such as the Lilly Pilly *(Acmena smithii)* found from northern Queensland to Wilson's Promontory. This species is often referred to in old historical records.

The Lilly Pilly bears clusters of purplish to white (sometimes pink) fruits about eight to 12 millimetres wide. Each fruit has a charasteristic depressed disc at one end and contains a single large seed. The Lilly Pilly's fruits are crisp, aromatic and slightly acidic. Despite their alluring appearance, they tend to dry the palate and take some getting used to. They are not as flavoursome as the related Lilly Pilly fruits of the genus *Syzygium*, which are also common in rainforests.

The Lilly Pilly tree has dark green, glossy leaves about four to seven centimetres long. It flourishes in warm-temperate rainforests, especially along streams, and sometimes grows close to the sea. It is common in gullies in the Blue Mountains, where its fallen fruits litter the stream banks in winter.

1. Both the pith and the curled shoots of treeferns are edible but there is considerable variation in flavour between different species. Photo: T.J. Hawkeswood.

2. The shiny Red Bopple Nut is related to the cultivated macadamias. Photo: T. Low.

3. The pretty Lilly Pilly is found in warm-temperate rainforests. Photo: T. Low.

Rainforests provided Aborigines with some staple foods – mainly yams, lily tubers, large starchy seeds and pith from the trunks of treeferns. These foods were prolific in northern rainforests, but large seeds and lillies only occurred south to central New South Wales, and yams to Botany Bay, just south of Sydney. In the cooler rainforests of Victoria and Tasmania, only the treefern was available. This was an especially important food source, as the historical record attests.

In 1843 the Quaker missionary James Backhouse recalled passing through a Tasmanian forest and seeing "many of the tree ferns, with the upper portion of the trunk split and one half turned back.

"This had evidently been done by the aborigines to obtain the heart for food, but how the process was effected I could not say. It must certainly have required considerable skill."

Backhouse elsewhere remarked that the heart was as thick as a man's arm and tasted like Swedish turnip. Some kinds of treefern were evidently tastier than others. According to one early writer, the Tasmanian natives had a maxim – that the pith of one kind of treefern had to be eaten with kangaroo flesh, while that from another was so good "it might be partaken of alone".

Treefern pith is starchy. A sample of one species – Man Fern or Soft Treefern *(Dicksonia antarctica)* – tested in Tasmania scored 256 kilojoules (61 Calories) per 100 grams, whch is about twice that of turnips, although rather lower than potatoes (at 336 kilojoules or 80 Calories per 100 grams). The harvesting of treefern pith kills the trees and should not be contemplated today. Apart from the pith, treeferns have edible curled shoots, called croziers or fiddles, which were once eaten by Aborigines. The crisp, juicy shoots taste rather like celery but sometimes irritate the throat.

Australia has about 14 treefern species in the rainforests and wetter eucalypt rainforests of eastern Australia. The principal genera include *Dicksonia* and *Cyathea*.

Most of Australia's wild nuts grow on rainforest trees. The Red Bopple Nut *(Hicksbeachia pinnatifolia)* is one of these. It is found on a slender tree with a small crown of frond-like leaves and bearing strings of scarlet fruits in summer and autumn. Each shiny fruit measures two to four centimetres long and has a leathery rind enveloping a large edible seed. Red Bopple Nut trees, sometimes called Monkey Nut trees, grow in the rainforests between Bellinger River and southern Queensland, although an isolated population occurs in northern Queensland.

The tree is closely related to the two cultivated macadamias *(Macadamia integrifolia* and *M. tetraphylla),* which are also called bopple or bauple nuts, for in colonial times they grew on Mount Bauple in southern Queensland. Like the macadamias, the Red Bopple Nut is an uncommon rainforest tree with leathery leaves and pendulous flower and fruit clusters. However, the seeds of the Red Bopple are relatively low in fat (about 13 per cent) and, although tasty, cannot compare with the exquisite macadamias. They are, nonetheless, under consideration as a commercial crop and are being studied at Macquarie University. The tree is becoming popular as a garden ornamental, for its fruit clusters are a striking spectacle and the seeds they contain are well worth eating, especially when roasted over a high heat.

Happy eating...

photoart

A regular gallery of portfolios by talented Australian photographers whose work relates to the natural sciences.

Green Monday Cicada, *Cyclochila australasiae*, emerging from its nymphal skin.

Wanderer Butterfly, *Danaus plexippus*.

A praying mantis, *Orthodera* sp., eating a soldier fly.

OTTO ROGGE

From a very early age, a great fondness of nature coupled with unlimited patience led Otto Rogge to a fascinating hobby in macrophotography...a hobby that developed into a career of full-time freelance photography in Melbourne.

The intricacies of small animals, such as insects and spiders, have always fascinated Otto. Early morning is the best time to photograph these animals because they are colder and less active. As Otto explains, "there are many problems involved with macrophotography, such as focusing, depth of field and working with limited apertures but these are compounded by the most vexing problem of all—the manoeuvrability of the subjects!"

Otto always uses Kodachrome 25 Professional film for sharpness, colour and detail; together with special macro-lenses and several different flashes to obtain optimum lighting.

Despite a hectic schedule involving teaching photography, judging competitions and being president of the Ivanhoe Photographic Society, Otto's first love is nature and he grabs any opportunity to take off into the bush with his camera. His ultimate ambition is to travel around as much of Australia as possible, capturing it all on film.

Ichneumon Wasp, *Echthromorpha intricatoria.*

Tree cricket of the family Gryllacrididae.

A jewel beetle, *Stigmodera mitchelli.*

EUNGELLA
The Land of Cloud

Text by John Winter and Keith McDonald
Photographs by Paul Candlin

Mackay, a tropical Queensland sugar town, quietly swelters in the midst of a vast expanse of two-metre tall sugar cane. But wipe the sweat from your brow and the blue line of the Clarke mountain range can be seen on the western horizon. An 80-kilometre drive due west, through the ubiquitous sugar cane, up a short, steep, winding section of road that escapes from the cul-de-sac of the flat-bottomed Pioneer Valley brings you to Eungella. Dr John Winter and Keith McDonald, from Queensland National Parks and Wildlife Service, lead you through Eungella—the land of cloud.

Eungella is an Aboriginal name meaning 'land of cloud'. The village itself is perched on the very lip of the range overlooking the coastal plain and, at an altitude of 680 metres, is a cool haven from the humid heat of the lowlands. Temperatures are about 5°C cooler and the average annual rainfall is 2,240 millimetres. The vegetation has also changed from the pale uniform green of sugar cane, to the infinitely more variable colours, textures and shapes of tropical rainforest.

The rainforest forms a narrow band, only a few kilometres wide, to the north and south of Eungella, clinging to the crest of the range and spilling down the seaward face. The highest point of the range is Mt Dalrymple, 1,277 metres, to the north of Eungella township. The Clarke Range falls away to much lower altitudes to the north and south, and loses its ability to catch rain from the south-easters. To the west, precipitation falls off rapidly due to the rainshadow effect of the range. Thus the rainforest occurs as an island of about 73,000 hectares, with a subsidiary tract of drier rainforest of about 41,000 hectares on the neighbouring Conway Range on the seaward side of Proserpine. They are separated from other major tracts of rainforest by wide corridors of dry eucalypt woodland that have had a profound influence on the fauna of the Eungella area.

In 1941 Eungella National Park was declared over 49,610 hectares of the Clarke Range and included most of the rainforest area.

Sixty-four per cent of the National Park comprises rainforest of several types. Complex mesophyll vine forest is found on the plateau slopes and in the gorges. The smaller-leafed, simple and complex notophyll vine forests are on the range crest and less fertile slopes. Notophyll vine forest, with tall eucalypt trees such as the Red Stringybark *(Eucalyptus resinifera),* is found on many of the ridges of the eastern slopes and, on the drier western edge, the spiky looking heads of Hoop Pines *(Araucaria cunninghamii)* protrude through the forest canopy. In wetter areas the softer heads of feather palms are a feature of the rainforest.

A narrow band of tall open eucalypt forest, often less than half a kilometre wide, occurs on the western edge of the rainforest. The trees may reach a height of 30 metres or more and include the Flooded Gum *(Eucalyptus grandis)* and Sydney Blue Gum *(E. saligna),* which is distinguished from the Flooded Gum by its thin, outwardly-curved valves in the fruit capsule, the Red Stringybark, Gympie Messmate *(E. cloeziana)* and New England Blackbutt *(E. andrewsii).* As their names imply, the Sydney Blue Gum and New England Blackbutt are typically trees of the south-east, and the Eungella locality is the most northerly record for them.

On the drier western side of the range the tall open forest grades into a shorter eucalypt open forest typified by the White Mahogany *(Eucalyptus acmenoides).* This in turn gives way to a sparser eucalypt woodland of the Lemon-scented Gum *(E. citriodora)* and Narrow-leaved Red Ironbark *(E. crebra).*

ANIMALS FROM EUNGELLA

The animals of Eungella, particularly the isolated populations of those species restricted to the rainforest and its closely associated tall open forest, pose some intriguing problems to the person interested in the geographical distribution of species.

All 12 species of mammals that have been recorded from the rainforest at Eungella are also known to occur both to the south and north of the region. Those most likely to be seen are the Common Ringtail Possum, the Common Brushtail Possum,

which occurs in two distinct colour forms—a dark reddish form found in the rainforest and the standard grey animal of the eucalypt forests, the Red-legged Pademelon, which for some unknown reason appears on the Clarke Range to be restricted to the rainforest south of Eungella township, and the Long-nosed Bandicoot. Other mammals include several species of bats—a colony of about 15,000 Common Bent-winged Bats has been located in a cave in the northern part of the park—and a rodent, the Fawn-footed Melomys. Broken River at the drier southern end of the park is also famous for the good views that can be obtained of Platypuses swimming under the road bridge.

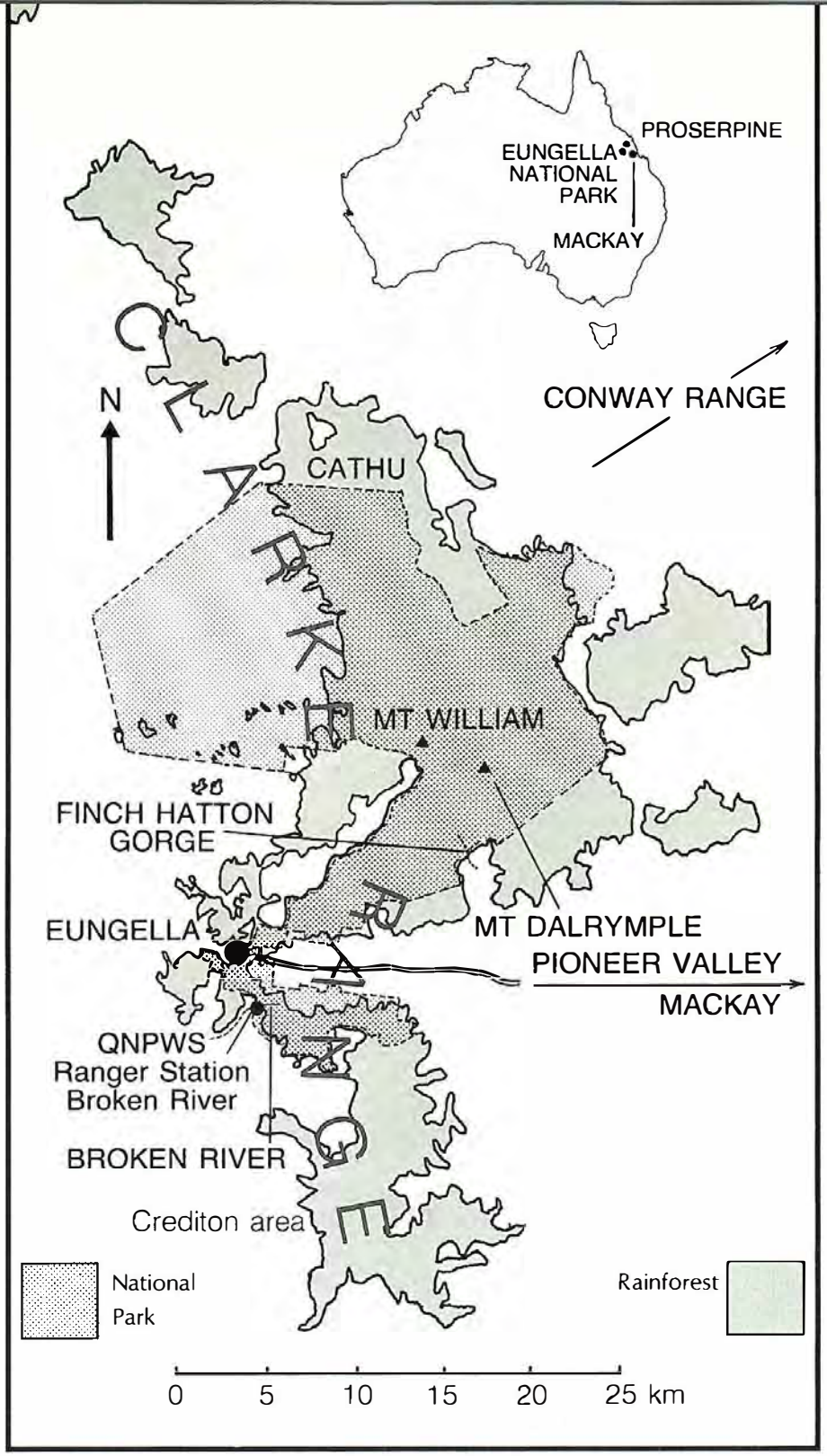
Rather surprisingly the Bush Rat and Brown Antechinus are absent from the rainforests of Eungella and the Conway Range. Both are common in the rainforests north and south of the region, so why there is a gap in their distribution in the Eungella area is a mystery.

Among the birds of the rainforest, one species is unique to Eungella. This is the Eungella Honeyeater *(Lichenostomus hindwoodi).* For many years it was considered an isolated population of the Bridled Honeyeater, a bird of more northern rainforests, until 1977 when it was recognised as a distinct species. An isolated population of treecreeper was found to be a subspecies of the White-throated Treecreeper of more southerly forests, and the Brown Thornbill is recognised as a distinct subspecies. The Brown Warbler and Eastern Whipbird also occur as isolated populations.

Unlike the mammals, a few birds have the limits of their geographical range on the Clarke Range. The most spectacular of these is the black and golden Regent Bowerbird, a bird of the southern forests, whose northern limit is Eungella. It can most readily be seen in the Crediton area. Examples of northern species extending south to Eungella are the Buff-breasted Paradise Kingfisher and the White-browed Robin. The Yellow Robin and White-browed Scrubwren are found in the rainforest at Eungella, as they are to the south, but further north they occur only in tall open forest or on the very fringes of the rainforest.

Like the Bush Rat and Brown Antechinus several birds are conspicuous by their absence at Eungella, as they occur both north and south in similar habitat. They are the Yellow-throated Scrubwren, Pale-yellow Robin, Satin Bowerbird and a catbird of which there are two closely related species, one to the north and one to the south. The paucity of fig trees *(Ficus* spp.) and stinger trees *(Dendrocnide* spp.) in the Eungella rainforests, both important food plants for catbirds, may explain the absence of this bird.

A breeding colony, one of the few known to exist, of the White-rumped Swift *(Collocalia spodiopygia)* is found in the Finch Hatton Gorge.



Reptiles are represented by two skinks that are unique to the area. The Orange-sided Rainforest Skink *(Sphenomorphus luteilateralis)* is restricted to upland rainforest above 900 metres in altitude, preferring moist areas with rotting palm stems and rainforest logs. The female gives birth to three to five young in late January and early February. The larger Rock Skink *(S. amplus)* is found in rocky areas in the park above 150 metres in altitude. Its range does not overlap that of the Orange-sided Rainforest Skink except at Mt Dalrymple. A small population

of this large skink is also found on the Conway Range. The Banded-tailed Leaf-tailed Gecko *(Phyllurus caudiannulatus)* found at Eungella, has black and white bands on its broad tail, as its name implies, but differs from the other population of the same species found at Bulburin, near Miriam Vale, which has a cylindrical tail.

Reptiles that reach their northern limit at Eungella include two small nocturnal snakes–the Golden Crowned Snake *(Cacophis squamulosus)* and Dwarf Crowned Snake *(C. krefftii)*–and four skinks–*Anamalopus verreauxii, Calyptophis temporalis, C. lepidorostrus* and an undescribed species of *Lampropholis*. However, only one northern species, the skink *Lampropholis basiliscus,* reaches its southern limit at Eungella.

The Rough-scaled Snake and the rainforest dragons of the genus *Gonocephalus* are examples of reptiles that occur to the north and south, but are apparently absent from Eungella.

The frogs of Eungella have the highest proportion of species restricted to the area of any vertebrate group, with three of the seven rainforest species found there being unique to the region. Both day frogs, Liem's *(Taudactylus liemi)* and the Eungella *(T. eungellensis),* are unique to the area, the former calling during the day and night, while the latter is more active during the day. However, the best known of the three unique species is the Eungella Gastric-brooding Frog *(Rheobatrachus vitellinus),* which was discovered in January 1984 and is one of only two species in the world (both in Queensland) known to brood its young in its stomach.

The Eungella Gastric-brooding Frog has a very limited geographical range. It is found only in fast-flowing, perennial streams in rainforests above 400 metres in altitude, in the wetter northern half of the Park. Generally, it is a dull brown frog but golden on the underside of the legs, arms and lower abdomen, hence its specific name *vitellinus* meaning egg yolk. The female, up to 83 millimetres in length, broods the young in her stomach. In the Southern Gastric-brooding Frog (the only other known gastric brooder) the mother swallows the eggs or early larval stage. Her stomach undergoes structural changes and her digestive juices are inhibited, probably by the secretion of a prostaglandin. The Eungella Gastric-brooding Frog differs in that there is no major structural change to the stomach wall and, as yet, it is not known what chemical changes take place. The female becomes very distended and finally gives birth through the mouth and, in the only record of this being seen, a female gave birth to 22 developed young frogs, each approximately 15 millimetres in length.

The smaller adult male Eungella Gastric-brooding Frogs, up to 58 millimetres in length, have been heard calling at night from September to early December, which is presumably the mating season. The females are ready to give birth in January and possibly in February. The diet of the frog includes small crayfish, caddisfly larvae, terrestrial and aquatic beetles, and even Eungella Day Frogs. It is both an aquatic and stream edge feeder.

The two day frogs are found in the same streams as the Eungella Gastric-brooding Frog, but have a slightly wider geographical range. Liem's Day Frog prefers seepage areas adjacent to the creeks, while the Eungella Day Frog is found on rocks in streams or in the splash zone of cascades and water-falls. The former has a very fast tapping call, but the call of the Eungella Day Frog can barely be heard above the rushing water with which it associates. It also communicates by visual cues, which include flicking and waving of the legs, head bobbing, and 'Charlie Chaplin'-type hops. This additional mode of communication is perhaps not surprising for a frog that is active during the day in very noisy surroundings.

Much attention is being directed by scientists at the gastric-brooding frogs because of their extraordinary method of breeding. The Southern Gastric-brooding Frog, found only in south-eastern Queensland, has caused some consternation because it has inexplicably disappeared. The last one found in the field was in 1979. The Southern Day Frog, in the same genus as the day frogs at Eungella, lives alongside the Southern Gastric-brooder in a similar fashion to the day frogs and gastric-brooder at Eungella. It too seems to have disappeared over its entire range. The disappearance of these two frogs is presently considered to be a natural fluctuation in their populations, albeit of unusual amplitude and duration, and it is hoped that

The bluey-brown Northern Banjo Frog, *Limnodynastes terraeriginae,* with its yellow and red thighs, is a burrowing frog from the open forest. It has a loud plonk call.

Liem's Day Frog, *Taudactylus liemi,* is unique to the rainforest streams of Eungella.

The Eungella Gastric-brooding Frog, *Rheobatrachus vitellinus,* lives in streams above 400 metres in altitude, at the northern end of the National Park.

The brightly coloured Eungella Spiny Crayfish, *Euastacus* sp., is found only in the creeks of the Clarke Range.

the frogs have not taken a nose-dive into extinction.

The Eungella Gastric-brooding Frog has also undergone an inexplicable decline in its population. Since its discovery in January 1984, two sites have been visited from time to time—one on the periphery and one in the centre of its known range. When the sites were visited in July 1984, the gastric-brooder and both day frogs were present. The peripheral site was next visited in January 1985, by which time the gastric-brooder and the Eungella Day Frog had disappeared, although they were still present at the central site. All were still present at the central site when visited in February and March, but when it was next visited, in June 1985, neither the gastric-brooder nor adults of the Eungella Day Frog could be found, although Liem's Day Frog was still present. At the time of writing, attempts have been made to locate the disappeared frogs in July, August, September, October and December 1985, but without success. This suggests that the Eungella Gastric-brooding Frog and the Eungella Day Frog are undergoing population fluctuations similar to those of their southern relatives. Fortunately, the Eungella Gastric-brooding Frog has nearly all of its known range within the National Park; the headwaters of the creeks it inhabits also rise within the Park. One can assume, therefore, that it is relatively free of any unnatural disturbances that might lead to a population decline, but it is with some interest, and much trepidation, that the populations of the gastric-brooding and two day frogs at Eungella are being carefully monitored by the Queensland National Parks and Wildlife Service.

Two southern frogs, the Tusked Frog and the Great Barred Frog, have isolated populations in the rainforest of the Clarke Range. Lesueur's Ground Hylid is a frog commonly found in a variety of habitats, but in the Eungella area is restricted to the rainforest and immediately adjacent tall open forest, although not in the same sections of streams as the Eungella Gastric-brooding Frog. The bright green and yellow Red-eyed Green Tree Frog can be found in the streams on warm humid nights. It is found both to the north and south, but the mid-eastern Queensland populations at Eungella and Bulburin are distinctly smaller and differ from the northern populations by having deep blue rather than orange thighs.

The large bright blue and red Eungella Spiny Crayfish *(Euastacus* sp.) is unique to the creeks on the Clarke Range. It favours feather palm areas and on wet days may be seen wandering among the palms in broad daylight. Closely related species are found on the Atherton and Carbine Tablelands to the north, and to the south in the Canondale–Blackall Ranges and other more southerly localities.

The rainforest trees have similar geographical patterns to those of the animals with respect to the Clarke Range. This is well illustrated in the satinashes *(Syzygium* spp.) and related genera. Twelve species were recorded from the Eungella area. Six of these occur in rainforests both to the north and south of the Clarke Ranges; five have their southern limit at Eungella, including the White and Red Eungella Satinashes; and one, the Weeping Satinash, has its most northerly record in the Eungella area. Like the animals, there are unexpected absences from Eungella. Two species that occur to the north and south but have not been recorded from the Clarke Range are the Killarney and Cherry Satinashes. Like the mammals, none of the satinashes are unique to the Eungella area.

Eungella National Park is predominantly a rainforest park, with 64 per cent of its area under that type of habitat. The remaining 36 per cent is mostly relatively dry eucalypt forest and woodland, with only 200 hectares, or 0.4 per cent, of the area as the distinctive tall open forest abutting the rainforest. Even the total area of tall open forest on the Clarke Range is small with a rough estimate of no more than 8,400 hectares.

A few animals are confined to the tall open forest and, because of the insular occurrence of that habitat, the animals also occur as isolated populations in much the same way as the rainforest species. The Greater Glider *(Petauroides volans)* likes the tall forest, but apparently the most restricted species is the Swamp Rat *(Rattus lutreolus).* In the Eungella area and further north, the rat's common name is a misnomer in that it does not live in swamps but in dense Blady Grass *(Imperate cylindirica)* on well-drained soils in tall open forest. The Blady Grass provides cover for the rat and the rhizomes of the grass are a staple item in the diet. The presence of the rat can often be detected by the shallow sloping scrapes it makes when digging for rhizomes at the base of grass clumps. At Eungella this type of habitat is extremely scarce and the rat is presently known from only one small population at Broken River.

Another species, whose presence has been reported at Eungella but the sighting requires confirmation, is the Yellow-bellied Glider *(Petaurus australis).* Further north the glider is restricted to the tall open forest on the western edges of the rainforest in the Cairns hinterland. To the south the glider is widespread in the taller forests of south-eastern Australia. Both

the Swamp Rat and Yellow-bellied Glider are examples of species that are widespread in south-eastern Australia but in northern Queensland occur only in isolated pockets of tall open forest, which grows at higher altitudes and is itself predominantly a south-eastern forest.

Dark colour phase of the Common Brushtail Possum found in the Eungella rainforest.

Looking up through the rainforest canopy at Eungella.

EUNGELLA 'UNDER A CLOUD'

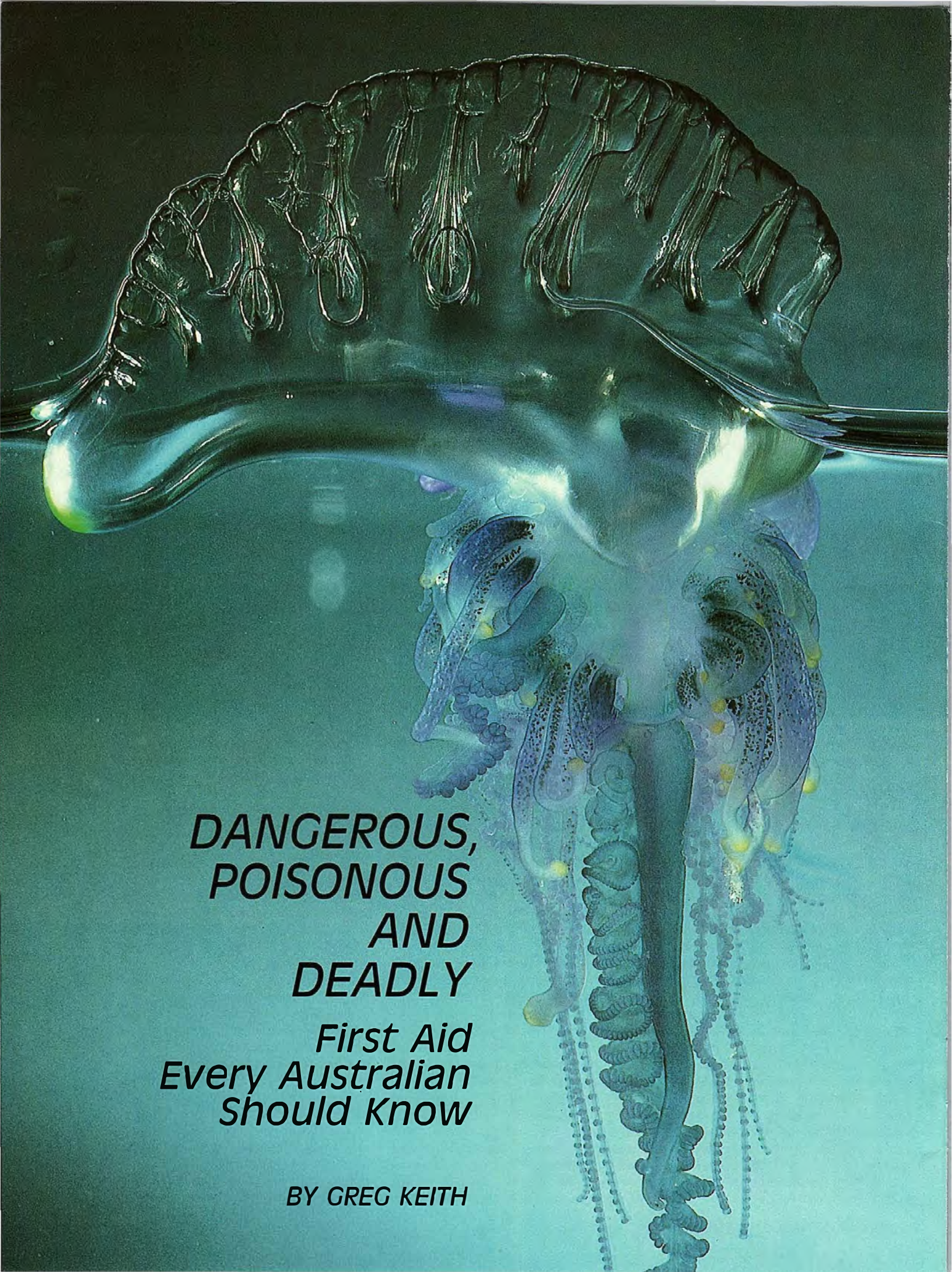
The disturbing pressures on this fascinating and important island of rainforest and tall open forest at Eungella are several. On the eastern slopes of the Clarke Range, fires that often originate in the cane fields at the time of harvesting sweep up the steep ridges, eating deeper into the rainforest each time, leaving grassy ridges largely devoid of trees, which are ideal conditions for future fires. The rainforest on the range is extremely narrow in places, partly due to natural climatic causes, but accentuated by clearing for dairy farms on its western edge and for fires on the east. In some places the rainforest band is less than a kilometre wide. There is a real danger that fires coming up the eastern ridges will break through the rainforest band, fragmenting the rainforest into smaller areas, each less capable of maintaining its present complexity of plants and animals. Already the clearing at the township of Eungella has effectively divided the rainforest into northern and southern halves.

With such a narrow band of rainforest, it means that much of the area is close to either open forest or cleared land and comes within the influence of the 'edge effect'. Although an edge or transition zone between open forest and rainforest is often rich in animals, there may only be small discontinuous areas suitable for those plants and animals that are truly restricted to rainforest and require to be beyond the influence of the edge effect. Unfortunately we know little about the requirements of rainforest plants and animals, and which plants and animals might come within this category—the Eungella Gastric-brooding Frog might be an example. All we can do is limit our disturbing activities, such as road building and development of camp sites, to the rainforest edge in the hope that we can leave core areas in their pristine condition.

The tall open forest occurs as a narrow band on the western edge of the rainforest, and only a small proportion of it is included within the National Park. Attention has previously been focused on the rainforest and the Park's tall open forest has been seen as a convenient place for camping grounds and other facilities. This focus, however, is being reappraised. Also the 'effective' boundary of the National Park has been the rainforest edge, and the tall open forest has been managed as part of the adjacent State forest by default, where cattle grazing and fire are standard management practices. If species such as the Swamp Rat are to survive in the Eungella area, then special measures may need to be taken to ensure that knee-high dense Blady Grass areas abound. These measures may include fire as Blady Grass is a natural stage following burning, but not cattle grazing, which reduces the cover provided by the Blady Grass.

The Orange-sided Rainforest Skink, *Sphenomorphus luteilateralis*, is restricted to Eungella rainforest above 900 metres in altitude.

As the evening mists close in, Eungella, the land of cloud, is many things to many people. It is a cool retreat from the humid lowlands, a place to watch Platypuses swimming in the river, a beautiful tropical rainforest with palm trees and birds, and a place of tall gum trees and possums. It is a 'half-way house' between the wet tropical forests of the north and the cooler forests of the south, and a place of extreme scientific interest because of the presence of its unique animals and unexpected absences of others. Like all such places it must be managed thoughtfully, particularly if it is to survive for future generations. □



DANGEROUS, POISONOUS AND DEADLY

First Aid Every Australian Should Know

BY GREG KEITH

***Atrax robustus*, one of the 13 described species of funnel-webs found mostly along the eastern coast of Australia. An antivenene is now available for their poisonous bites. Photo: K. Atkinson.**

Australia is indeed a lucky country, for extensive tracts of unspoilt bushland remain within reasonable proximity to our capital cities, giving all Australians the opportunity to savour an untamed land. Yet Australia is also host to one of the world's greatest assemblages of 'nasties', all of which seem intent on making a trip into the bush an expedition into purgatory.

Our land is home to probably the world's most venomous creature, the Box Jellyfish *(Chironex fleckeri)* and over ten species of deadly snakes. We also have the world's most venomous spiders, the funnel-webs, and giant man-eating crocodiles. So who in their right mind would want to venture outside their front door?

Of course the truth of the matter is that, although these creatures should command the utmost respect, they most certainly should not be objects of fear. You see, we have ways of combating their nastiness.

Snakes are probably the most commonly encountered of our dangerous creatures. Some years ago, snakebite caused an average of 14 deaths per year across Australia. Now, with the advent of specific antivenenes and venom detection kits, the fatalities have dropped to about one each year.

Most snakes will not attack if given half a chance to escape. They seem to believe in the old adage that 'discretion is the better part of valour'. Unless you deliberately provoke a snake, the most likely cause of being bitten is that you have inadvertently trodden on it.

Generally, the first sign of snakebite is a sharp pinprick felt on or about the ankle. You look down and there at your feet is a slithery creature, satiating itself on your flesh. (In fact, what it's really doing is asking you to remove your foot from its back.) Don't try to jump on it, beat it or in any way provoke it further—the snake will only continue making life as uncomfortable for you as it presently is for itself. Instead, back away (need I say quickly?) and prepare for phase one of Operation Snakebite.

A Portuguese Man-o-war or Blue Bottle is actually a group of individual organisms, each with a specialised purpose such as feeding, reproduction and bladder inflation. They can inflict painful stings via their long tentacles and are a hazard for surfers. Photo: K. ◀Atkinson.

Rule number one is 'don't panic'. If attending someone who has just been bitten, reassure them. Let them know the odds are well and truly in their favour. Having done that, it's time to put the first aid to work. Thanks to a lot of work done by Dr Struan Sutherland from the Commonwealth Serum Laboratory, the old 'cut and suck' and tourniquet methods are now completely redundant. Far more effective means are now at our disposal.

First, locate the exact area that has been bitten. In most cases, there will be two small puncture marks but, if the snake has lost a fang, some scratch marks or only one puncture site may be present. Apply a crepe bandage firmly over the site of the bite. Continue to bandage toward the fingers or toes, then back along the full length of the limb, using an equivalent amount of pressure as if bandaging a sprained ankle, that is, firm but not tight. Once the limb is securely bandaged, it should be splinted so as to minimise movement. The patient should be rested as much as possible.

This procedure is known as the pressure–immobilisation method. It effectively prevents the venom from spreading beyond the bitten area, because it both compresses the tissue and slows (but does not stop) the flow of blood. Unlike the tourniquet method, it does not cause tissue damage due to lack of circulation.

The bitten area should *not* be washed or cleaned in any way. Once you arrive at a hospital, a sample of the venom will be required to identify the species of snake. The skin surrounding the bite is a likely place from which to take this sample. With the advent of venom detection kits, the need to kill the snake for identification (thereby risking further bites) is negated, unless, of course, the snake poses further danger.

There are some cases where people have been bitten by snakes and not realised for some time afterwards. The first signs generally appear within half an hour of being bitten. Specific symptoms vary, but nausea, dry retching and headaches are all associated with the early stages of envenomation. If you feel any of these and suspect snakebite, check all exposed areas and areas protected only by thin clothing for tiny puncture marks and swelling. Once again, the same first aid applies.

The same treatment also applies to bites from sea-snakes and funnel-web spiders. However, the effects of a bite from the latter are quite different to those from snakebite. There is usually great pain at the bite site, followed by nausea and abdominal pain. Breathing difficulties and muscle fatigue are common, as are profuse sweating and saliva production.

Dr Merlin Howden, from Mac-

Scorpions eat only live prey. Not considered fatal to humans, the venom of Australian species usually only causes swelling, intense pain and numbness. Battles between scorpions and Red-back Spiders are unlikely to occur in nature. In this set-up situation, the scorpion won. Photo: B. Cropp.

The excellent camouflage of this stonefish *(Synanceia verrucosa)* can prove to be a trap for unwary swimmers and divers as its sting is extremely painful and sometimes fatal. Photo: K. Atkinson.

quarie University in Sydney, has developed an effective antivenene for funnel-web bites. It is available at all major hospitals in 'funnel-web country'. This antivenene, coupled with immediate use of the pressure-immobilisation method, has greatly reduced the risk of serious injury from funnel-web bites.

There are certain instances when the pressure-immobilisation method is either impractical or undesirable. Such is the case with the Red-back Spider. Because its venom travels very slowly; the use of a compression bandage only aggravates local pain.

The signs of a bite from the Red-back begin with a sharp pinprick from the fangs, followed by pain at the bite site, swelling, quickening pulse, nausea, dizziness and varying degrees of muscle failure. First aid is generally best left to the hospital but a cold compress should be applied to the wound and the patient rested and reassured. (Under no circumstances should the wound be frozen.) An effective antivenene is carried by most hospitals in Australia, reflecting the Red-back's national distribution.

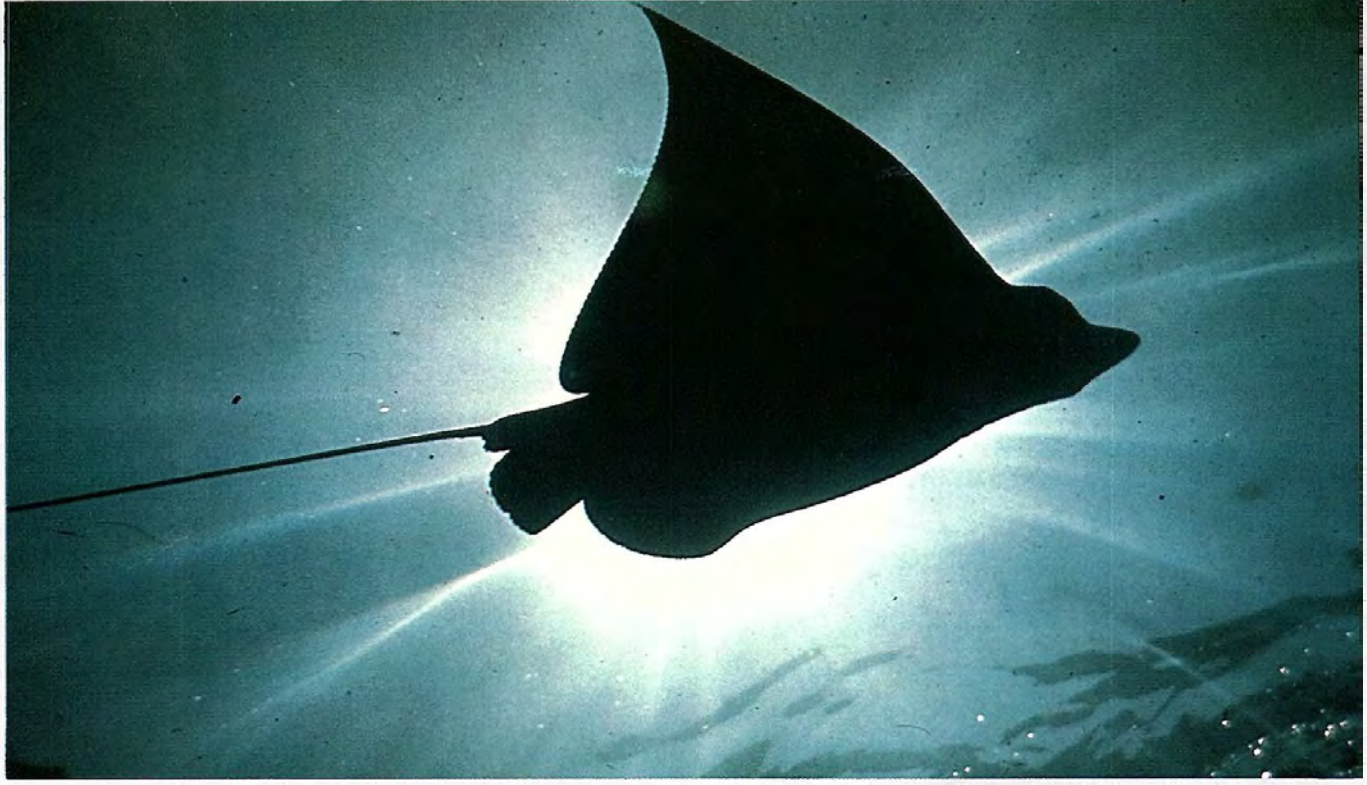
Usually associated with dogs and cats, ticks are also at home on humans. Quite often they go unnoticed, until the host experiences a general weakness of the face, eyelids and upper body, and difficulty in breathing.

If the tick is accessible, it should be killed with a drop of kerosene or mineral turpentine. If the tick is in an ear, a doctor should be consulted immediately, as extraction may be difficult. Once the tick has been killed, it should be removed by placing the open blades of a pair of scissors under the shoulders of the tick and levered out. Check also for any others that may be concealed on the body.

If in any doubt about your ability to remove the *whole* tick, or if the tick is on a young child or elderly person, a doctor should be consulted.

Moving from the land to the water, we come to a band of creatures that are sometimes difficult to avoid. How, for instance, do you avoid a stinging jellyfish (let alone realise that it *is* a stinging variety) when quite often you can't even see it coming? With difficulty. However, the risks can be minimised. When strong onshore winds are blowing, jellyfish (including Portuguese Man-o-wars) tend to be more prevalent, since they are blown towards beaches. Also, stings from fish or octopuses can be avoided by wearing sturdy shoes when walking on rocks and by not picking up anything that looks the least bit 'fishy'.

Deadly creatures likely to be found on rock platforms are the blue-ringed octopuses. Their near-painless bite and cryptic habits make these danger-



Although rarely dangerous, a stingray can inflict severe, painful wounds with the spine at the base of its tail. Photo: B. Cropp.

ous animals indeed. The casualty is often unaware of the bite but within minutes the lips and tongue become numb. Breathing difficulties may be experienced soon after and, in extreme cases, complete breathing failure occurs.

First aid involves the pressure–immobilisation method and correct application of expired air resuscitation (EAR or mouth-to-mouth). If the patient is attended to quickly, EAR is all that is usually required. Provided that an adequate supply of oxygen is maintained, the heart should continue to beat, making external cardiac compression (ECC) unnecessary. (Cardio-pulmonary resuscitation or CPR is a combination of EAR and ECC.) When performing EAR, the patient's pulse should be checked every two minutes to ensure the heart is still beating.

Creatures that many of us are likely to come into contact with at some stage of our lives are jellyfish, particularly the Portuguese Man-o-war or Blue Bottle. Favoured remedies for jellyfish stings include rubbing sand into–or pouring methylated spirits over–the wound. However, both these remedies are now outdated and serve only to aggravate the sting, so they should never be used. The most simple and effective treatment is to flood the affected area with household vinegar. Methylated spirits should not be used because it actually *activates* more stinging cells, whereas vinegar kills them. If no vinegar is available, carefully remove any remaining tentacles with tweezers–not with bare hands.

In the case of the Box Jellyfish, our most dangerous jellyfish and, arguably, the world's most deadly creature, treatment is virtually the same. Flood the affected area with vinegar, allow 30 seconds or so for all stinging cells to be neutralised before removing them, then apply a firm compression bandage as for snakebite. A sting from a Box Jellyfish is excruciating. Instant pain and red marks occur along the line of the sting. An antivenene is available but breathing difficulties may be experienced before reaching a hospital. Someone trained in CPR should therefore remain with the casualty at all times. In summer, lifesavers along the northern Australian coastline cover their bodies with pantyhose to protect themselves from the deadly Box Jellyfish.

Treatment for stinging fish, including Australia's two species of stonefish *(Synanceia verrucosa* and *S. horrida)* and the Butterfly Cod *(Pterois volitans)*, involves placing the affected area, generally the foot, in hot (but not scalding) water. This tends to inactivate and disperse the venom, thus spreading the effects over a larger area. If the spine is still embedded in the wound, it should be gently removed. Medical aid should be sought immediately as breathing difficulties may be experienced, along with intense pain.

Stingrays are marine creatures that are not often encountered and are rarely dangerous. However, at least one person has died after being stung on the chest. Breathing difficulties may follow a sting in this area but intense local pain is usually the total result. This may be relieved by bathing the affected area in tolerably hot water and the sting, if present in the wound, should be gently extracted. Medical advice must be sought, regardless of how minor the wound appears, as secondary infection may occur. This holds true for all bites and stings.

Probably the most feared of marine creatures are sharks and crocodiles. Unlike the cryptic stonefishes or near-invisible Portuguese Man-o-war, these large creatures represent an all-too-tangible threat to life and limb. The most obvious way to avoid them is not to swim in their likely haunts.

The Saltwater Crocodile *(Crocodylus porosus)*, despite its name, does not restrict itself to salt water and may travel large distances upstream. In northern Australia, particularly in secluded areas, it should not be considered safe to swim in *any* part of a river unless there lies an obstruction, such as a dam or waterfall, between the swimming hole and the coast. Even then, Saltwater Crocodiles are capable of overland travel.

Sharks are restricted to salt water but at certain times may travel up to the transition area between salt and fresh water. The safest places to swim are those beaches close to major cities that are subject to regular patrols and shark netting. If you swim away from these areas, you should accept that there is a chance, albeit a small one, that you will encounter a shark. Two rules and one old wives' tale are worth remembering. Avoid murky water; don't splash around too much (this duplicates the sound of a disabled

A seemingly inoffensive creature, this blue-ringed octopus has a highly venomous bite and has caught many rock-pool enthusiasts unaware. Photo: K. Atkinson.

The highly venomous Box Jellyfish *(Chironex fleckeri)* occurs along the northern coastline of Australia. In summer, lifesavers cover their bodies with pantyhose to protect themselves from ◀its fatal sting. Photo: B. Cropp.

The deceptively delicate Butterfly Cod *(Pterois volitans)* found mainly along the Great Barrier Reef can inflict severe stings. Photo: K. Deacon.

fish); and don't swim with the family dog. The latter adage has been neither satisfactorily proven nor disproven, so until confirmation comes either way it is probably worth believing.

Contrary to popular opinion, attacks by sharks or crocodiles do not necessarily result in death. In the case of sharks, most will not try to eat you once they realise what you are. The typical shark attack involves an initial 'tasting bite', which is not normally followed by more aggressive bites. Unfortunately, this tasting bite causes considerable damage. Crocodiles, on the other hand (as has been evidenced in recent years), may make a meal of a human, presenting problems for national park administrators in northern Australia.

In the event of an attack by a shark or crocodile, first aid centres around stemming the flow of blood from the wound. The extent of injuries dictates the procedure to be followed. In the case of 'controlled' bleeding, direct pressure should be applied to the wound either in the form of a pad and firm bandage or, if these are not available, by using bare hands until improvised materials, such as towels and clothing, can be obtained. Where uncontrolled bleeding is encountered, such as in an amputation or where an artery has been cut, a constrictive bandage is usually the only effective form of first aid and should be applied above the joint. The time of application should be noted and relayed to hospital staff, as constrictive bandages cause tissue damage when left in place for extended periods of time.

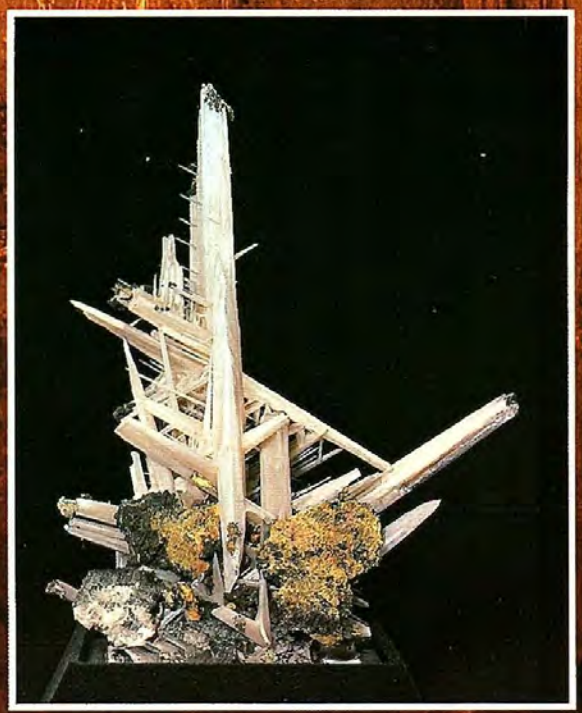
At one time, early colonists may have carried first aid kits containing a bush knife, strong cord and rum, whereas today's bushwalker or day-tripper should carry at the very least a firm bandage and, for beach areas, some household vinegar. It is very little to take with you and it may mean the difference between life and death.

You should also acquaint yourself with the correct application of CPR and the pressure–immobilisation method. These techniques, both fairly recent developments in the world of first aid, have saved countless lives. First aid courses are conducted by the St John Ambulance Association which operates in all States and can be contacted on (02) 212 1088. These courses are extremely useful. Remember: the next life saved could be your own. □

get your rocks off at the new mineral gallery

come on a mineral safari around australia .... indoors!

- walk into a quartz crystal
- see what rocks are made of under a microscope
- hear a flatulent fumarole
- watch the computer show you where to find gold
- see the cerussite on the broken hill centenary stamp
- visit the argyle diamond mine
- walk through a limestone cave
- explore a mine
- go on a museum mineral dig

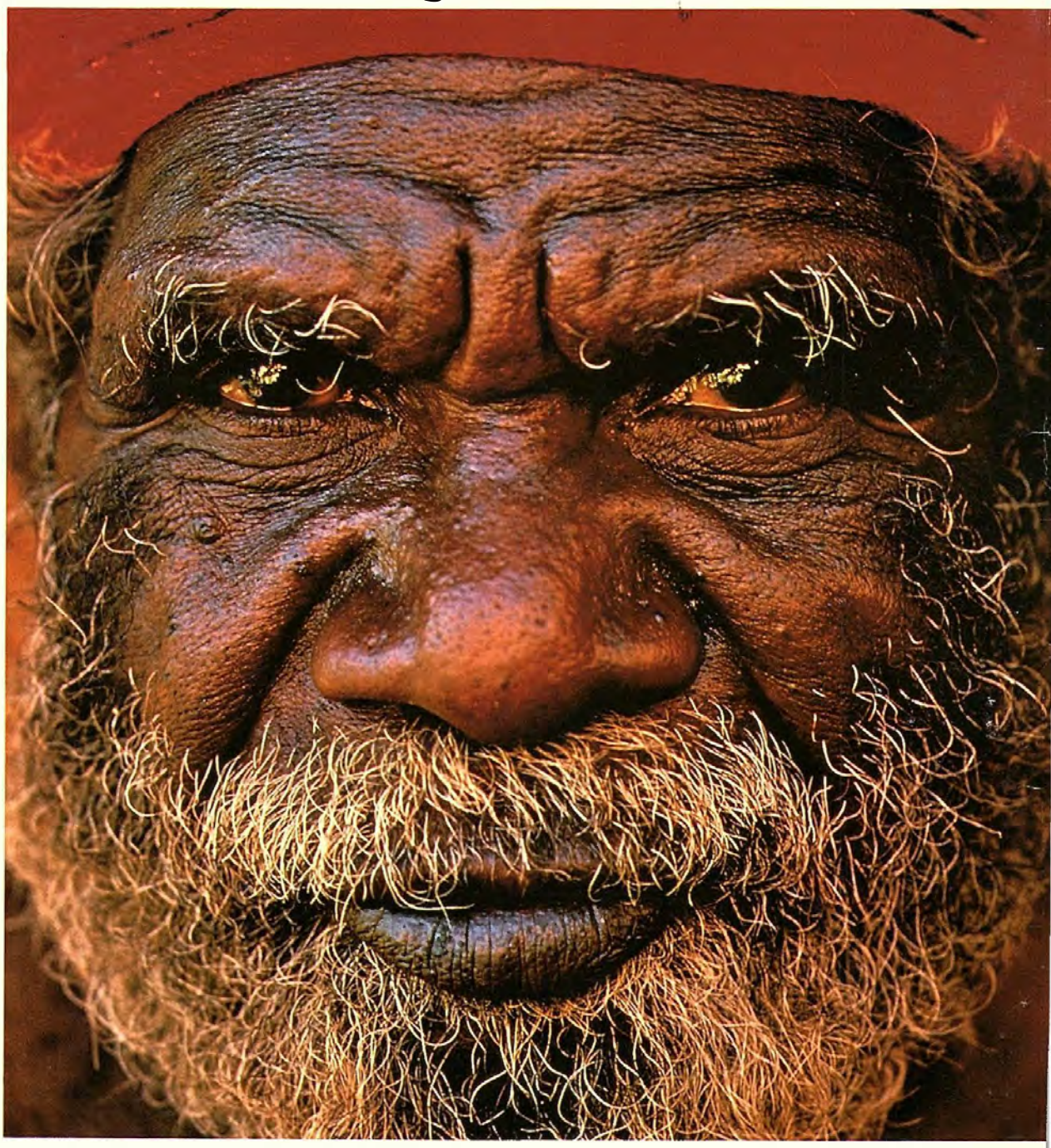


sponsored by the utah foundation and the australian museum society

australian museum

6 – 8 College Street Sydney

The Original



Since 1935 the Kodachrome name has stood for the best in color transparency film. Today it remains the favourite film of amateurs and professionals alike. Bring the original colors of Australia to life on Kodachrome color slide films.

Remember color with Kodak