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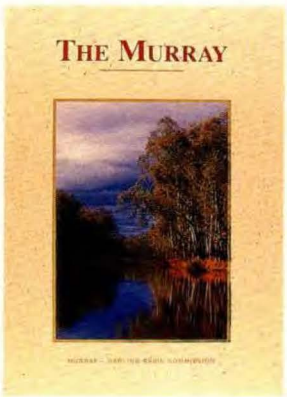

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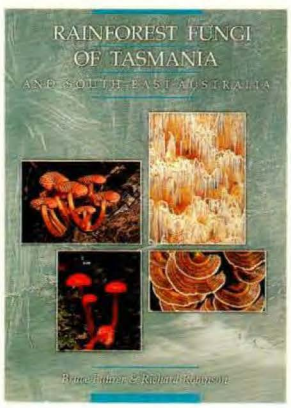

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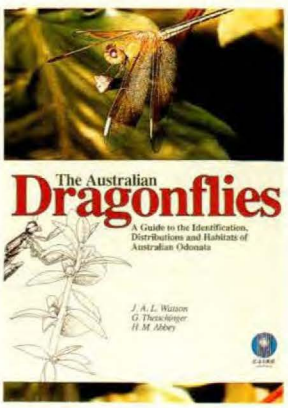
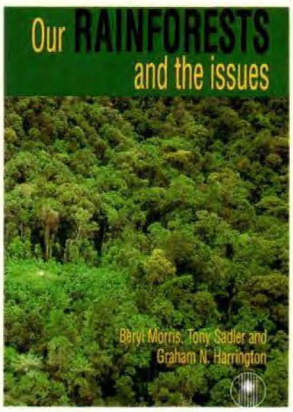


The Australian Dragonflies
Tony Watson, Gunther Theischinger and Hilda Abbey, CSIRO Division of Entomology 1991, 278 pp. colour section, casebound, 272 x 205mm ISBN 0 643 05136 8 $60.00
This book reveals the diversity of dragonfly fauna in Australia and presents their biology and affinities along with detailed keys.



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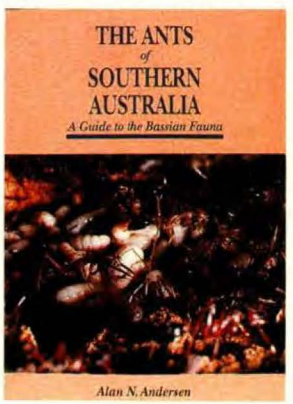

The Ants of Southern Australia: A Guide to the Bassian Fauna
Alan Andersen, CSIRO Division of Wildlife and Ecology 1991, 70 pp, illustrated, paperback, 247 x 174mm ISBN 0 643 05152 X $20.00
This is the first guide available to the ants of cool and wet southern Australia; it covers over 110 species - groups from 40 genera. (See the review in this issue.)

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Up Front

We once had a colleague whose screams on sighting a cockroach could almost resurrect extinctions. So shrill was that bloodcurdling yelp of terror that we'd shriek back in response, only to find the object of her despair was a mere insect, hardly something to be feared. Yet many of us live in trepidation of insects and their relatives, preferring to shun rather than understand them. Barely tolerating their existence, we break out a cocktail of poisons to rid our lives of their horrid presence. As urbanites, this is the kind of nature that is part and parcel of our everyday lives. Unfortunately we would do better to discover what a fascinating and unique part of our own environment they form. Well, now you can, easily and without terror, by reading the article on the making of the Australian Museum's travelling exhibition, "Gargantuans From The Garden". It's a dynamic display of enlarged garden beasts and will blow away many of your preconceptions about some of the small creatures we encounter daily. Make sure you don't miss it.

Gargantuans From The Garden . . . coming to a city near you.

The "Gargantuans" theme is further covered in our beetle-collecting story and Photoart.

Attempting to catch Mahogany Gliders.

Other articles include Steve Van Dyck's hilarious story about Mahogany Gliders and their intoxicating habits. We also explore rainforests by the sea, the ethics of the project to map the human genome and bring you a new feature on places called 'Destinations', which in this issue is on Lady Elliot Island.

–Fiona Doig & Georgina Hickey, Editors

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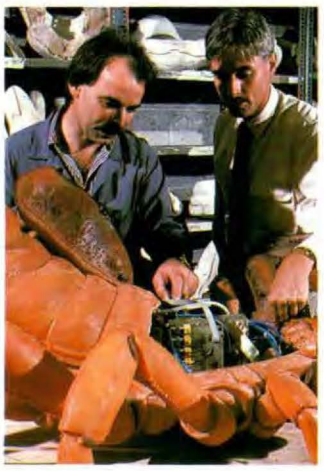
Front Cover

Mahogany Gliders are elusive animals with some peculiar eating habits. Inset: Insects and spiders have vital roles and we take a look behind the scenes of the Australian Museum's "Gargantuans From The Garden" travelling exhibition. Photos: Bruce Cowell, Queensland Museum; inset: David P. Maitland / Auscape International.



GARGANTUANS FROM THE GARDEN: AN EXHIBITION IN THE MAKING

Imagine being shrunk so small that spiders and grasshoppers tower above you! This is actually possible in the Australian Museum's new travelling exhibition and we take you 'behind the scenes' to see how the giant creatures were made.

BY CARRIE ARKINSTALL

LASTING IMPRESSIONS OF MAHOGANY GLIDERS

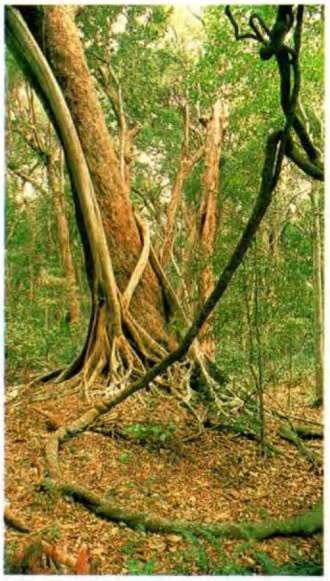
A gumboot is not ordinarily in the field scientist's study kit but this intrepid researcher found one to be most useful for catching these elusive gliders. His hilarious adventure exposes this peculiar glider's odd eating habits.

BY STEVE VAN DYCK

RAINFORESTS BY THE SEA

The word 'rainforest' conjures up images of tall, misty, green tropical places with running streams and cool gullies. However one type of rainforest doesn't quite fit this description: this is littoral rainforest or, more simply, 'rainforest by the sea'.

BY BRADLEY LAW & MERRILYN LEAN



THE POLITICS OF THE HUMAN GENOME

An extraordinarily ambitious project to map and sequence the genetic basis of humans is well under way, with major discoveries having already taken place. But what if these discoveries are used to discriminate against individuals? And what good is knowing you have a genetic disorder if it can't be treated?

BY JOHN MERSON

Regular Features

DESTINATIONS

LADY ELLIOT ISLAND

First in a new series of interesting and unusual places to visit, we take a look at Lady Elliot Island, a sanctuary for birds and other animals, at the edge of the Great Barrier Reef.

BY PETER OGILVIE

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RARE & ENDANGERED

BLACK-FOOTED ROCK-WALLABY

Superbly adapted to their rocky habitats, these graceful wallabies take effortless leaps from rock to rock. Their astounding agility led early settlers to mistake them for monkeys.

BY JACK KINNEAR

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WILD FOODS

GEEBUNGS REMEMBERED

Once greatly relished and very popular, this bushland fruit has the rare distinction of having two Brisbane suburbs named after it.

BY TIM LOW

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PROFILE

THE JOAN SUTHERLAND OF AUSTRALIAN SCIENCE

Recently appointed head of the CSIRO, botanist Dr Adrienne Clarke is equally at ease advising Dame Edna on the sex lives of gladioli as she is at talking turkey to big business and government.

BY ROBYN WILLIAMS

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PHOTOART

LARGE AS LIFE

A mantis large enough to fill your chair? A giant mosquito descending on your house? Or how about an oversized aphid? Well known for his cinematography in David Attenborough's programs, Jim Frazier shows us some extraordinary feats of his infinite focus lens.

BY JIM FRAZIER

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FROM THE ARCHIVES

THE BEETLE COLLECTOR: A DETECTIVE STORY

Tales of adventure and intrigue abound in the world of the beetle collector. These seemingly innocuous people are hell-bent on a singular mission: to obtain their ultimate beetle trophies.

BY GEORGE HANGAY

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THE LAST WORD

THE DILEMMA OF POWER

Although Environmental Impact Statements are meant to lead to informed, rational resolutions, they frequently lead to more conflict.

BY JEFFREY M. LEIS

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Columns

LETTERS

Suffer the Little Children; Genetic Engineering; Concrete Concerns; Food Fads & Facts.

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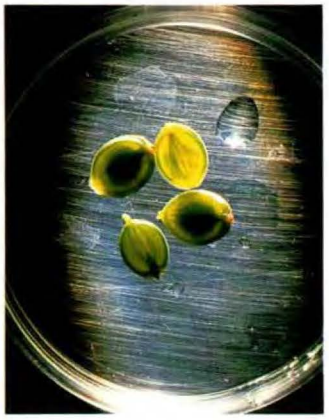

QUIPS, QUOTES & CURIOS

Duck Hunter Habits; Artificial 'Grass'?; The Puzzle of the Parsnip; Electric Update; Quick Quiz; Black Smokers and 'Eyeless' Shrimp; The Cock's Egg; Things Go Better with Coke!; Fun Runs in the Midnight Sun; Love's Chemistry; Knocking on Wood.

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QUESTIONS & ANSWERS

Identifying Funnel-webs; Frogmouth or Owl; Cat Food Creature; Answers to Quiz.

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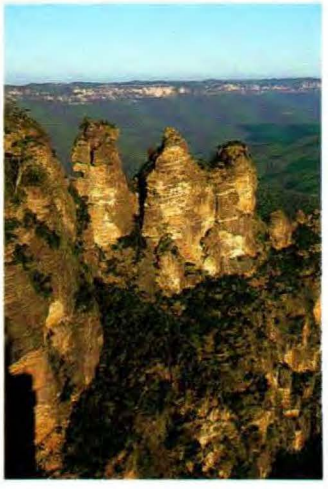

REVIEWS

The Insects of Australia; Field Guide to the Native Plants of Sydney; Biomedical and Surgical Aspects of Captive Reptile Husbandry; Riversleigh; The Australian Dragonflies; Butterfly Conservation; Australian Waterbirds; Birds of Lord Howe Island; Possums; Platypus; Short Trips from Sydney: Jenolan Caves House; Gosford Reptile Park; Blue Mountains Trips; Askania Rainforest.

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LETTERS

Comments, criticisms and congratulations from concerned correspondents. Readers are invited to air their views.

Suffer the Little Children

The QQC item "Feeling crook" (ANH Spring 1991) could be subtitled "Suffer the little children". Your photographer is more on the beam in showing a miserable crying child than is the report, which describes how flu can make you look and feel awful but ends up advising simply to endure it.

Fever—and its associated misery—does not have intrinsic virtue. It is something that happens as a result of chemicals released from the inflammatory battle of us *versus* invading viruses and bacteria. It is useful as a sign that something is wrong and can draw attention to conditions that, firstly, may be serious (such as meningitis or septicaemia), and secondly, may warrant definite treatment such as antibiotics in huge doses.

In childhood, milder and self-curing infections from viruses are much more common than in adults. They typically cause fever and misery and perhaps actual pain. Fevers in children are much higher and misery is much greater than is the case in adults. Fevers over 40°C are rare in adults but are frequently seen in children. Such fevers can endanger some children by producing convulsions—frightening for the parents to witness. Even without this there is distress to the child and family. The crying child can even be in danger from the stressed parent.

Theoretical advantages for fevers, including that it helps the human immune response or hurts the virus or bacteria, are based on a small number of experiments. The one quoted about lizards made septic and then surviving better in warmth is the least relevant because lizards are cold-blooded. Experiments that describe viruses living for a shorter time in nasal secretions in humans with fever are more to the point, but the viral infection will be self-curing anyway.

Putting these dubious alleged benefits of fever and malaise as a case for enduring it, and for withholding safe, effective short-acting relievers of fever and pain, ignores the very real harm that fever and its accompanying misery represents. Incidentally paracetamol has a considerable edge in safety and range of dosage over the older aspirin. Without the use of pain relievers, life can be awful for child and parent alike. Paracetamol can restore sanity and harmony to the home; demonstrate that the child has not had anything worse than the flu, and that antibiotics are therefore not necessary; prevent convulsion; and protect children from being injured by their distraught parents.

It is what the bawling child in the photo needs. A plague on concepts of the nobility of suffering.

—Dr Desmond L. Gurry
Subiaco, WA

Genetic Engineering

The editorial on genetic engineering (ANH Summer 1991–92) asserts there is presently no law covering genetic engineering in this country. This is actually not correct. As our leading biologist Sir Gustav Nossal has emphasised for a decade, the common law would forcefully and aptly apply to misdemeanours by genetic engineers. Also research funds can be withdrawn. Sir Gustav has described the Australian regulatory system as the best in the world.

Also in the editorial, genetically engineered organisms were portrayed as more ecologically dangerous than introduced wild species. Most population biologists would strongly disagree. My colleague Stephen Jay Gould went so far as to call such claims "excursions into science fiction".

My own primary interest in genetic engineering is its medical potential in such vital and challenging areas as inherited diseases, cancer and AIDS. I am therefore appalled when 'greens' call for a halt to all genetic engineering, as our own Australian Conservation Foundation has recently done.

To this profoundly misguided end our dark greens will promulgate the most extraordinary disinformation about genetic engineering. I am saddened to see some of that disinformation surfacing in your fine periodical.

—David Elder
Grange, SA

At the time of writing, there were no laws in Australia specifically relating to genetic engineering, so that statement was correct, but so are you: it was not meant to imply common laws do not apply in such cases.

My comments raised the concern that genetically engineered organisms actually may not be less fit than native species, and indeed it is entirely possible they could be more hazardous than exotic species. I've not found any proof either way; hence I prefer to err on the side of caution.

Feverish children can suffer badly.

CARL BENTO / AUSTRALIAN MUSEUM

Quibbles aside, I think you missed the point of the editorial. That is, we need high-level security for what can and should be a significant industry for Australia. If we can be leaders in achieving the best controls as well as the best technology, then we will be well ahead of any other less careful countries busy cleaning up (or covering up) any mistakes.

I agree that genetic engineering should not be halted. It should be advanced, but with the greatest of care.

–Ed.

WOLF HILBERTZ

Grow-your-own pipes.

Concrete Concerns

With regard to the QQC item "Sea grown building supplies" (ANH Summer 1991–92), I'd like to say that I think it's a commendable idea to use such building materials instead of concrete. However, pro-environmental though this approach may seem, its proposed use in Third World countries for sewage pipes is not. I'd go as far as to say that this is actually far worse–it is better that such countries can't afford the raw materials needed, as it prevents the ocean being ruined further in an already polluted world.

Surely common sense would suggest that, as land animals, we should dispose of our waste in a terrestrial medium, rather than straight into the seas and waterways (thereby poisoning those environments for their dependent organisms). Simply extending outflow pipes further out to sea is not the answer–it just prolongs the inevitable, while affecting even greater numbers of marine organisms than before. It is obvious that the ocean is the wrong place for human sewage –Bondi Beach is a perfect example. If we find such pollution unpleasant, I can only imagine how it must be affecting the marine life.

—Elizabeth Cotterell
Indooroopilly, Qld

Food Fads and Facts

Tim Low makes a sweeping generalisation that "most anthropologists and archaeologists in Australia appear to hold the assumption that Aborigines ate all of the available food plants" (ANH Summer 1991–92). He cites as examples, Flood 1980, and Hope and Coutts 1971. I would challenge his implication that these authors make any such assumption. Quite rightly, he points out examples from areas where traditional knowledge of plants has survived, which show that cultural factors influence the choice of foods. To these I would add abundance, taste and ease of collection and preparation, although these would seem to me to be material, rather than cultural, factors. Do we choose fast foods for cultural reasons, or because they are easy to come by? Archaeologists and anthropologists are not unaware of the complexity of reasons for choosing particular diets.

However, when one is faced with the problem of assessing Aboriginal plant use in areas where much of the traditional knowledge of plants has been lost–such as southern Australia–it is necessary to prepare lists of available resources that can assist in the interpretation of the archaeological findings. Camp sites at Thredbo, for instance, occur in an area where a plant that was used to make the nets for catching Bogong Moths *(Pimelea pauciflora)* is plentiful.

The lists of food plants prepared by ethnobotanists in southern Australia are not viewed as 'diet lists', but as 'resource lists'. Such lists are made up of species fully referenced under four headings:

1. Observed use in the area. The Murnong *(Microseris lanceolata)*, for example, was eaten over most of Victoria. Some plants, such as the Scrub Nettle *(Urtica incisa)*, have been recorded as used only in times of scarcity of other foods. Since the ethnographic evidence for use is widely scattered both in time and place, one should always be prepared for the emergence of new data.

2. Observed use outside the area–for example, the Murnong is likely to have been used in Tasmania, but was not recorded there. Low rightly points out that the seeds of *Avicennia marina*, known as the White Mangrove in Victoria and recorded as used in northern Australia, are very unlikely to have been used in southern Australia, since leaching techniques necessary for preparing them seem to have been unknown. This illustrates the judgement that must be brought to bear on each species under this heading.

3. Probable use–for example, many species of the orchid family, since other species of this family were observed to be used and all are edible.

4. Possible use, edible–an example is the seed of the Sea Club-rush *(Bolboschoenus caldwellii)*. The seed is plentiful, easily collected, and grinds to a nutritious flour.

These resource lists help us to set Aboriginal life in an ecological framework. In southern Australia, where Aboriginal people had a wide choice of root tubers, they were free to select certain species according to seasonal palatability, ease of collection, or other cultural criteria. Murnong was a favourite, especially because of the sweet juice it produced when cooked. This freedom to exercise choice indicates an easy lifestyle. No ethnobotanist, archaeologist or anthropologist working today in southern Australia accepts 'resource lists' as species necessarily used, but they are a useful tool of interpretation.

Phillip Clarke's 1988 paper "Aboriginal use of subterranean plant parts in southern South Australia" *(Records of the South Australian Museum 22:* 73–86) is an example of how Aboriginal plant diet can be critically assessed in southern Australia.

—Beth Gott
Monash University

I stand by my comments about "most anthropologists and archaeologists", but would hasten to exclude Beth Gott's research from any criticism. Like that of fellow botanist, Peter Latz, from the Northern Territory's Conservation Commission, it is excellent, and provides a standard against which other ethnobotanical research should be measured. Gott and Latz are both botanists, and they bring to their research a practical knowledge of plants that enables them to avoid the pitfalls of others. For, despite what Gott says, the papers by Flood, and Hope and Coutts do not separate plants into the categories she lists.

–Tim Low

Do people always eat what is available?

CARL BENTO / AUSTRALIAN MUSEUM

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3. Entries close on the last mail, Friday 11th December 1992.
4. Employees of the Australian Museum, TraveLearn, their families, suppliers and associate companies are not eligible to enter.
5. The winning entry will be drawn on 16 December 1992.
6. The winner will be notified by mail and published in *The Australian* 19.12.92.
7. The prize must be taken as offered and is not redeemable for cash.
8. The trip must be taken from 30.8.93 to 5.9.93.
9. Entrants under 18 years of age must have their entry authorised by a parent / guardian and be accompanied by an adult on the tour.
10. The prize includes return flights to Brisbane from nearest major airport, and TraveLearn's 6-day Great Barrier Reef / Lady Elliot Island tour ex-Brisbane (twin-share accommodation), all meals, lectures, flights with Sunstate Airlines Brisbane / Bundaberg / Brisbane, return flights to Lady Elliot Island, tours, snorkelling lessons and equipment, services of guide and information booklet.
11. NSW Chief Secretary's Department Permit No. TC92 / 1104 Vic Raffles and Bingo Board Permit Number 92 / 638 issued on 19 / 03 / 92 ACT Returns and Licences Permit Number TP92 / 0404 NT Gaming Control Permit Number NT 92 / 0363

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QUOTES & CURIOS

QUIPS

COMPILED BY GEORGINA HICKEY

Duck Hunter Habits

Do duck hunters think that brighter is better when it comes to selecting their targets? This was the question asked by Karen Metz and Davison Ankney, zoologists at the University of Western Ontario, when trying to explain why certain ducks are more vulnerable to hunters.

Past studies have attempted to explain differences in hunting vulnerability based on the bird's physiological condition. For example, ducks in poor condition may be more easily decoyed. Also behavioural differences between the sexes may make one sex more vulnerable than the other. In most species, female ducks tend to lead when they are flying in a male–female pair. Because hunters tend to shoot at the lead bird, paired females should be more vulnerable to the hunters' sights.

During a recent hunting season, Metz and Ankney examined ducks shot from male–female pairs at Long Point Waterfowl Management Unit in Ontario, and questioned hunters who brought the ducks into the unit's checking station. They found that early in the season, when sexes carried similar plumage, almost equal numbers of females and males were shot. Later in the season, however, as males began to show brighter breeding plumage, males were more likely to be shot. Metz and Ankney concluded that hunters, whether consciously or not, consistently tended to select the brighter plumaged male, regardless of where he flew in a pair.

The study's observations help to explain the shortfalls in some strategies employed in waterfowl management programs and could have major implications for the planning of future programs. For example, the point system is a popular method of managing duck harvests in the United States. It involves an allocation of high, medium or low point values to particular duck species and sexes according to their relative population status and hunting vulnerability. Shooters are restricted by a point limit, and ducks for which less hunting pressure is desired are given higher point values. On the basis of their study, Metz and Ankney suggest that the point system may have little power to increase the kill of male ducks if hunters are already, consciously or not, selecting for them.

—K.McG.

JOHN CANCALOSI / AUSCAPE INTERNATIONAL

There is a natural tendency for duck hunters to aim for more brightly plumed males, such as this Carolina Wood Duck *(Aix sponsa)*.

Artificial 'Grass'?

Cannabis, or marijuana, has been used for centuries for its medicinal properties, as well as its intoxicative effects. The active ingredients in cancannabis – cannabinoids – combat convulsions, dilate air passages in the lungs, decrease pressure in the eyes, reduce pain and lower blood pressure. However, because of their mind-altering effects, they are currently used restrictively in medicine, mainly to suppress nausea caused by cancer chemotherapy. Study into how cannabinoids work will hopefully result in the production of related drugs without the unwanted side-effects.

In the 1960s, scientists thought that cannabinoids might not bind to specific receptors but perhaps produced their effects by simply dissolving into cell membranes, as some anaesthetics are known to do. In the 1980s, however, it was found that cannabinoids were acting through

Carrie Arkinstall (education officer at the Australian Museum), Dr Suzanne Hand (biologist at the University of NSW) and Karen McGhee (freelance science writer living in Newcastle) are regular contributors to QQC.

their own, but at that time unidentified, receptor molecules—molecules to which cannabinoids must bind for their biochemical effects in the brain to be felt. And, if cannabinoid receptors exist in the brain, it seemed likely that the brain produces its own natural cannabinoid-like substance.

Scientists took a 'strong' cannabinoid (that is, a synthetic cannabinoid that binds to the receptors more tightly than natural cannabinoids) and used it to map the distribution of the receptors in the brains of rats, guinea pigs, dogs, monkeys and humans. The localisation of receptors fitted nicely with what was known about cannabinoid action. For example, the brainstem which controls respiratory and cardiac function, upon which cannabinoids have little effect, has few receptor molecules. On the other hand, movement control centres, such as the cerebellum, are rich in receptors, neatly matching the drug's ability to cause uncoordinated movements. Receptor molecules are also plentiful in the cerebral cortex and hippocampus, areas of the brain important for perception and memory.

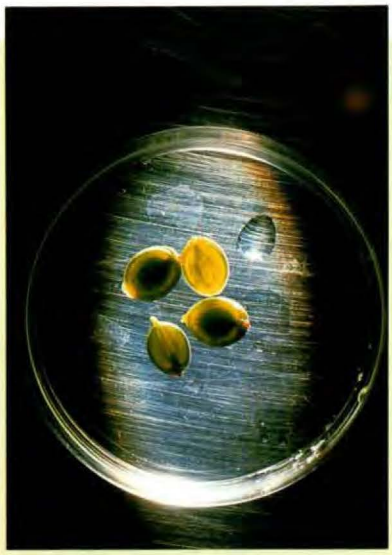
At the same time that the mapping was being done, and quite by accident, scientists at the National Institute of Mental Health in Bethesda, Maryland, isolated and cloned a gene that encodes for cannabinoid receptor molecules. This latest discovery is likely to have a big pharmaceutical spinoff, for it means that it will be much easier to screen hundreds of compounds that may bind to the receptor cells. Among these will hopefully be the brain's own cannabinoid-like chemical as well as new synthetic cannabinoids. Also, if receptor 'subtypes' can be found, then it might be possible to design drugs to specifically affect these receptors—without the unwanted psychoactive side-effects of currently available cannabinoids.

Scientists may be closer to producing a cannabis-like drug without the mind-altering side-effects.

—S.H.

CHRIS OATEN

THE PUZZLE OF THE PARSNIP



COURTESY ARTHUR ZANGERL

Seedless grapes are easy food for lazy eaters, but what use are they to the grapevine? Why would plants expend energy producing and maintaining a fruit that is of no reproductive use? This has been a puzzle to naturalists for more than a century. Now we may have an answer.

Wild Parsnip plants *(Pastinaca sativa)* often produce high numbers of fruits that don't contain seeds. They are called 'empty' or 'parthenocarpic' fruits. Arthur Zangerl from the University of Illinois and his co-workers found that these seemingly useless fruits are, in fact, very important to the parsnip plant.

The Parsnip Webworm *(Depressaria pastinacella)* feeds exclusively on the fruits and flowers of Wild Parsnip. The webworm is especially fond of the empty fruits, in spite of the fact that they are nutritionally much poorer than the 'filled' or seed-containing fruits. Webworms feeding on empty fruits grow at only one-third the rate of filled-fruit feeders.

To try to work out why webworms prefer food that stunts their growth, the researchers studied the concentration of a group of compounds called 'furanocoumarins' found on the surface of parsnips. Furanocoumarins are harmful to a variety of organisms, including webworms. They found that the concentration of the compounds in empty fruits is much lower than in filled fruits. Webworms may be able to select the empty fruits by 'tasting' for furanocoumarins on the surface. So while the webworms are missing out on superior food, they are also missing out on harmful chemicals. And, by producing and maintaining fruits without seeds, the parsnip plant is protecting its precious seeds from predators. Parthenocarpy, for the Wild Parsnip, is a way to fool and shrink the enemy.

—C.A.

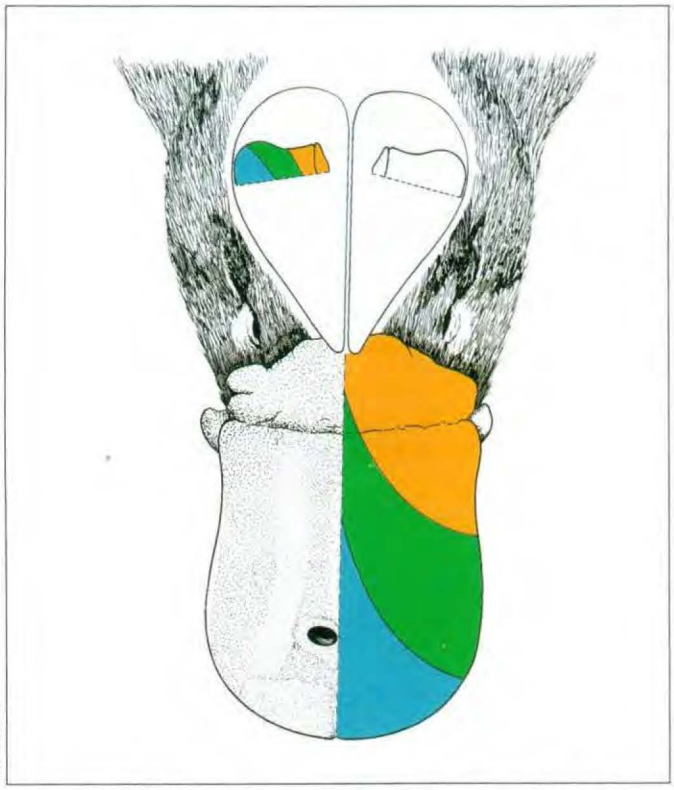
Electric Update

What does a Platypus feel when the electric sensors in its bill are stimulated by a yabby swimming past its nose?

Since the report published in *Nature* in 1986 that the Platypus has an electric sense (see ANH Autumn 1990), Monash University physiologists Ainsley Iggo, Ed Gregory and I have been exploring the transmission to the brain of nerve impulses coming from the electric sensors. We have come to the conclusion that the electric sense may be a kind of 'distance touch sense'.

As in all animals, nerves from different sense organs, like the eye and the ear, send their signals to particular parts of the brain. In cells of the uppermost layer of the brain, the cerebral cortex, the mysterious process of converting nerve signals into sensations takes place. It remains one of the major challenges for neuroscience to explain how signals in nerves coming from the ear are perceived as a sound, while those from the eye are felt as a flash of light.

A feature of cells in the visual and auditory regions of the brain is that they respond to signals from both eyes and both ears. Combining informa-



UWE PROSKE

Electrosensory nerve endings in the skin of a Platypus bill send their signals to regions in the opposite side of the brain (shown here for left side of bill only). The sensors on the front sides of the bill must be particularly important to the animal as the portion of the brain map representing this area is disproportionately large.

tion coming from two different angles, so to speak, gives us our depth vision (stereoscopic vision) and allows us to accurately locate the source of a sound. Curiously, for senses like touch, warmth, cold and pain, the arrangement is different. The left half of the body is represented by areas in the right half of the brain and the right half of the body by the left half of the brain.

An important question for us was whether the electrosensory system in the Platypus was designed to work like an electric eye or whether it was organised more like the sense of touch. To resolve this question we stimulated the electric sensors on the left side of the bill, using very weak electric pulses applied through an electrode placed just above the skin. The bill was immersed in water. Stimulation evoked activity only in the right half of the brain. So the brain representation for electroreception is crossed, as it is for touch sensations coming from the bill.

It was possible to construct a map of each half of the bill on the surface of the brain by systematically stimulating different places on the bill. Quite a large area of the brain was shown to be concerned with electroreception, indicating the importance to the animal of this sense. The shape of the map gave a distorted outline of the bill, with the front of the bill and the edge taking up more space than the base. This again provided a clue about which parts of the bill were likely to be more important.

The region of the brain to which the electrosensory nerves project lies within the boundary of the area receiving tactile information from the bill. It seemed that in the Platypus the electric sense and the sense of touch were closely associated. This conclusion was further supported by recordings from single brain cells. Here individual cells could be made to respond to both tactile and weak electrical stimuli applied to the same spot on the bill.

Could the Platypus be reading a kind of electric braille?

What does all this mean? A study of the structure of the electric sensors has led to the conclusion that they have evolved from skin structures, perhaps sweat glands. However, since touch nerve endings also lie in the skin, it seems that electroreception and touch sensation in the Platypus bill have evolved together, their respective sensors lying adjacent to one another and with both senses sharing the same area of brain for central processing. Perhaps the electric sense should not be considered a separate sense in its own right, a sixth sense, but an evolved extension to the sense of touch, a 'distance touch sense'?

An important question for the future is whether the Platypus is able to detect electric pulses emitted by moving prey, such as a yabby, some distance away. Behavioural experiments suggest that it can. But is it able to tell how far away the yabby is, that it is in fact a yabby, and in what direction it is swimming? Does the Platypus have the electrical equivalent of depth vision? Here it is worth reflecting on the fact that even a sense of touch can provide detailed spatial information. Consider, for example, the accuracy with which we can distinguish sheets of paper of only slightly different thicknesses, by simply feeling them between our fingers.

If our views are correct and the electric sense in the Platypus can be considered an extension to the sense of touch, perhaps what the Platypus feels when the yabby swims past its nose is something like the sensation of blowing air gently onto the skin.

It remains a mystery why the Platypus, when it fossicks about on the stream bottom, looking for food, moves its bill rapidly from side to side. Perhaps it is scanning for signals emitted by moving prey. When it picks up a signal, could the rapid movements of the bill allow the Platypus to decipher what kind of source the signal is coming from? Could the Platypus be reading a kind of electric braille?

—Uwe Proske
Monash University, Vic.

QUICK QUIZ

1. **Of the world's snakes, which has the most toxic venom?**
2. **When were rabbits introduced into Australia?**
3. **In which direction is the long axis of a Magnetic Termite mound orientated?**
4. **What were the names of the two major landmasses 190 million years ago?**
5. **How many mammal species have become extinct in Australia since European settlement?**
6. **Who is the director of the Australian Museum?**
7. **What is obsidian?**
8. **Which was the longest dinosaur?**
9. **What is bêche-de-mer?**
10. **What is the name of the Arizonian project that in 1990 enclosed eight humans into a 1.25-hectare, man-made closed system?**

Answers in the Questions & Answers Section.

Black Smokers and 'Eyeless' Shrimp

In the epic novel *Twenty thousand leagues under the sea*, Jules Verne's Monsieur Arronax prophesied well: "...if nature still holds secrets for us...nothing is more reasonable than to admit the existence of new species or types living in a special environment at the bottom of the sea". And, just like Captain Nemo's *Nautilus*, the three-person research submersible *Alvin* makes routine dives to the seafloor. There, scientists study communities of exotic animals that colonise deep-sea hot springs.

Hot spring environments are unusual ones. They occur along mountain ranges formed by the spreading apart of the ocean's crust. Where active spreading is taking place, the sea-floor is rent apart by earthquakes and the forces of upwelling magma. Sea water percolates through fractured basalt to depths where it reacts with hot rock. Chemically modified, the heated water then returns through conduits to exit on the sea-floor.

Known as black smokers, the plumes of rising water can reach temperatures of 350°C and more. The hydrothermal fluids are laden with metal sulphides that precipitate and form mineral chimneys; the result is a vent that resembles smoke pouring from an industrial stack.

It is a hostile environment made all the more remarkable by the animals that thrive there. In 1985, observers in *Alvin*, diving to a depth of 3,700 metres on the Mid-Atlantic Ridge, encountered thousands of shrimp crowding the surfaces of black smoker chimneys. The shrimp elicited colourful descriptions from the scientists, like "bees swarming over a hive" or, less poetically, "maggots crawling on a hunk of rotten meat".

The shrimp were given the name *Rimicaris exoculata*. The generic name derives from the Latin *rima*, meaning rift or fissure, and refers to the Mid-Atlantic Rift, while *caris* means shrimp; the specific name *exoculata* refers to the fact that this species is deprived of any vestige of the usual shrimp eyestalk. Ironically, it is in *Rimicaris exoculata* that a novel type of eye has been discovered.

Although the shrimp lack an externally differentiated eye, a pair of large organs lies within the cephalothorax, close beneath the transparent shell.

Such a light could deter the shrimp from too close an encounter with water hot enough to cook them.

Can the 'eyeless' shrimp see in the dark?

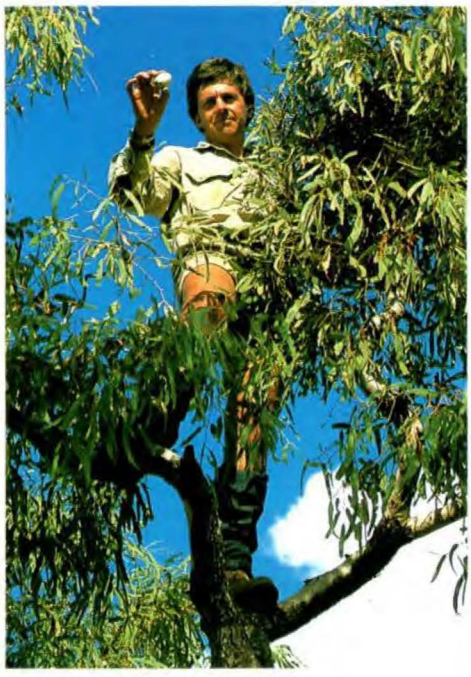
J. EDMONDS & H. ELDERFIELD

These are connected by large nerves to the brain and contain a visual pigment that is sensitive to dim light. There are no lenses or other image-forming devices, and the structure of the photoreceptor cells within is reminiscent of arthropod ommatidia (eye elements).

So, it appears that the shrimps' modified compound eyes are specialised for detection of very dim sources of light. But what could they be looking at when they live well below the surface of the sea, far beyond the reach of sunlight? Perhaps *Rimicaris exoculata* can 'see' the plumes of hot water? Visual detection is possible, since a small fraction of the total photons (units of light energy) emitted by a thermally radiating body is within the visible spectrum. The question remains whether the amount of visible light emitted from a 350°C plume of water is enough to be detected by the shrimp's visual system.

If the shrimp can 'see' the plumes of hot water, the advantages are clear. The light could serve as a beacon to draw them to areas where they can feed on the sulphur-metabolising microorganisms, and such a light could also serve as a warning signal to deter the shrimp from too close an encounter with water hot enough to cook them instantly. But the true role of the eye in 'eyeless' shrimp will remain unresolved until more is known about its physiology and the unusual hot spring environment at the bottom of the sea.

—Cindy Lee Van Dover
Woods Hole Oceanographic Institution
Massachusetts, USA



JACK PETTIGREW

Holding up a 'cock's egg' from a Letter-winged Kite's nest.

The Cock's Egg

In the Diamantina Channel Country last year, Letter-winged Kites *(Elanus scriptus)* bred at a rate they have not achieved since the 1970s, the last time that their almost exclusive prey, the Long-haired Rat *(Rattus villosissimus)*, was present in plague proportions. During 1991 it was not unusual to find six successfully reared chicks in one nest, and successful broods of five were common. In 1989 and 1990 the maximum brood was five.

Along with this breeding success came another phenomenon at some nests: one of the eggs was both infertile and white, contrasting markedly with the other red-brown mottled eggs in the clutch, and slightly different in size. It looked almost as if it was the work of some as-yet-unidentified cuckoo!

This phenomenon was first described last century and has been dubbed by ornithologists as 'the cock's egg', for reasons best known to themselves. (I would have thought it was just as likely for this egg to be infertile because the cock had *nothing* to do with it!)

The explanation for the phenomenon is obscure. By observing a couple of nests on a regular basis we have established that the odd egg is the last one laid. Perhaps, then, the reproductive system simply 'ran out of steam'? I wondered whether it might be a failure on the part of the male, rather than the female, since a nervous male is a common cause of infertility in isolated eggs of owls. I am informed, however, that this is unlikely to be the case in kites, where sperm storage by the female

Perhaps, then, the reproductive system simply 'ran out of steam'?

would protect against the occasional failed copulation by a nervous male. Male Letter-wings, moreover, show none of the tentative, shy behaviour typical of owls, despite similarities in their preference for night-time hunting. The absence of pigmentation shows that there may be some link between fertilisation and the later-occurring addition of pigment to the shell.

In good times, a Letter-winged Kite's nest will often be found to have four or five fledglings and one pale 'addled' egg. Our work suggests that this 'addled' egg is in fact the last ('cock's') egg in the clutch. More work would be required to establish the basis for the infertility of the 'cock's egg'.

—Jack Pettigrew
Vision, Touch & Hearing Research Centre
University of Queensland

JACK PETTIGREW

In a good year, the last egg laid is often infertile and unpigmented.

THINGS GO BETTER WITH COKE!

Throughout history various substances have been used for vaginal contraception. These range from honey, sodium bicarbonate, acidic fruit juices, certain oils, and various other household substances, even including that famous beverage Coca-Cola.

To find out whether Coke's effectiveness as a postcoital douche is real (some say it has something to do with Coca-Cola's acidic pH), or whether this 'side-use' has simply been exaggerated through folklore, Drs Sharee Umpierre, Joseph Hill and Deborah Anderson, all from the Harvard Medical School, decided to test Coca-Cola's effect on sperm motility.

Sperm from a healthy, fertile donor was subjected to various formulations of Coca-Cola (such as Old or 'Classic', New and Diet), with saline solution used as a control. After one minute all types of Coca-Cola markedly reduced sperm motility, whereas the saline solution had no spermicidal effect. Diet Coke had the strongest effect (no sperm were mobile after one minute), and Classic Coke was about five times more effective than New Coke (only 8.5 per cent remained mobile after one minute compared to 41.6 per cent for New Coke). Examination of the pH of the different formulations, however, revealed no significant differences. This means that something in Coke's 'secret formula' may contribute to the spermicidal effect. Although not recommended for postcoital douching, the results do indicate that, as far as spermicides go, "Coke is it".

—G.H.

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How do Adelie Penguins decide whether to slide or stride?

Fun Runs in the Midnight Sun

Antarctica's Adelie Penguins *(Pygoscelis adeliae)* are beautifully adapted for their existence in the icy waters of the Southern Ocean, their torpedo-shaped bodies enabling them to move under water like greased fish. This design, however, comes with a price. When moving on terra firma, the same shape leaves them waddling like drunken sausages on toothpicks—a mode of locomotion that is, energetically speaking, relatively costly.

But they do have an alternative way of motoring over snow and ice; they sometimes flop onto their bellies and toboggan, using their hind feet to keep them zipping along, throwing out their feet as anchors when hurtling downhill and using their flippers to assist them when moving uphill.

These impressive, if sometimes reckless, olympian skills prompted a recent study by Rory Wilson and colleagues at an Argentinian base on the tip of the Antarctic Peninsula. Here they compared the energetic costs of walking *versus* tobogganing and found, not surprisingly, that an Adelie Penguin could move faster and more efficiently by tobogganing over low-friction surfaces than by walking—even when travelling uphill.

The big question, then, had to be why do these penguins choose to walk at all? Could there be some hidden cost in tobogganing? Presuming that the choice of locomotion would be the one least energetically expensive, Wilson and his colleagues attempted to quantify the costs of these behaviours.

Snow softness, gradient of slope, snow friction, wind resistance and possibly the extent to which the belly bulged with food all appeared to be factors affecting a penguin's decision to 'bellyflop' or not. For example, they found that penguins tobogganed more frequently on soft snow and walked more frequently on hard snow probably because of the extra energy required to force their feet through soft snow.

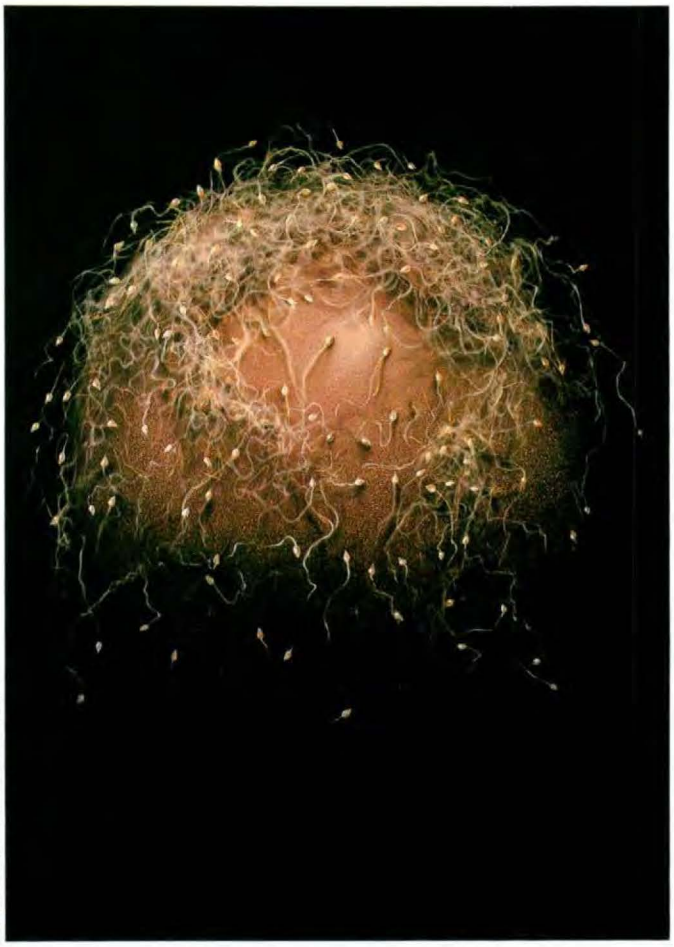
Their shape leaves them waddling like drunken sausages on toothpicks.

In an attempt to quantify the effects of snow friction, the researchers settled on the rather novel method of dragging a dead penguin on a string through the variety of situations encountered by penguins whose motors still worked.

The defunct penguin 'in drag' indicated that the cost of feather friction may take the competitive edge off tobogganing. As their experiment and penguin 'matured', the researchers found that feather deterioration diminished the ease with which the penguin could be pulled over the snow. They reasoned that in still-living penguins, abrasion of the breast feathers during tobogganing might lead to loss of oil from and damage to the ventral feathers. In turn, this might increase the time and energy required for preening to replace the oils, or lead to reduced condition and belly-sliding efficiency, perhaps until the damaged feathers were replaced in the annual moult.

Other possible explanations for the penguins' willingness to waddle were offered by Wilson and co. Perhaps the advantages of seeing what was ahead (a grinning Leopard Seal with mouth open waiting at the end of the tobogganing shute) or the need to gossip with waddling neighbours factored in the Adelie Penguin's decision about whether to slide or stride. The mystery remains.

—S.H.



FRANCIS LEROY / SCIENCE PHOTO LIBRARY

Decoding the chemical signal used by eggs to attract sperm will have enormous implications for couples unable to conceive.

Love's Chemistry

Recent research from Israel has provided the first evidence that sperm and ova actually communicate before coming into contact.

In the past, studies have observed that human spermatazoa ejaculated into the female reproductive tract will wait motionless at storage sites if no egg is present. During ovulation, however, when the egg is released, sperm become motile (and motivated) and can reach an egg within minutes of its appearance.

Dina Ralt and Michael Eisenbach from the Weizmann Institute of Science and colleagues have found an explanation for this with evidence that the egg releases some sort of chemical signal that attracts sperm.

They obtained fluid from the egg follicles of women in an *in vitro* fertilisation (IVF) program and found that in about 50 per cent of cases sperm were attracted to the fluid. When they compared these results with the outcomes of the IVF procedures undergone by the women, they obtained striking support for the presence of a chemical signal underlying fertilisation: they found a clear correlation between the eggs that were fertilised and the follicular fluid that attracted sperm.

The nature of the chemical signal present in the follicular fluid has yet to be identified but research is continuing. If it can be isolated and studied, it could help to explain questions about human reproduction that

> Why do only a few hundred of the millions of sperm make it to the fertilisation site?

have been baffling biologists for many years. Why, for example, do only a few hundred sperm from the millions found in a typical ejaculation ever make it to the fertilisation site? And how is the final important encounter between egg and sperm, which leads to the creation of life, synchronised? Of course, the practical implications are immense. The presence or absence of the chemical signal may help to explain the ability or inability of couples to conceive. Identifying the signal could ultimately lead to new contraceptives or treatments for infertility.

—K.McG.

Knocking on Wood

The Madagascan Aye-aye *(Daubentonia madagascariensis)* is a rare and endangered primate. But that is not what has made it so famous, particularly among biologists intrigued by bizarre feeding strategies. This arboreal omnivore has powerful, long, ever-growing incisors, a bit like those of rodents, and an extremely narrow middle digit on each hand. Together, this equipment has been seen in use gathering the nutritious pulp from fruits and probing wood for insect larvae. In grub-gathering, the incisors are used to tear open the wood that protects the wood-boring insect and then the grub is winkled out of its hidy-hole with the grappling-hooked digit.

But precisely how does the Aye-aye locate the beast it pursues? Does it randomly probe the wood surfaces or can it see, hear or smell surface features that betray the presence of the beast beneath? Certainly it seems to have no trouble pinpointing, presumably using its acute hearing, the position of the grub within its chamber once the chamber is found. This ability has long been known—but how does the Aye-

The Aye-aye taps with its long middle finger to locate grubs beneath the wood.

SILVESTRIS / ANT PHOTO LIBRARY

aye find the grub's chamber in the first place?

A study by Carl Erickson of Duke University in the US suggests that the Aye-aye may use echolocation or a kind of 'skin' (cutaneous) sense to find the insect-carved tunnels. The Aye-aye is known to tap wood in its search for insects and in fact taps anything that takes its interest. Perhaps the insect within the wood moves in response to the tapping ('who's that knocking?') and in so doing betrays its position.

The Aye-aye has large and mobile pinnae (ear-flaps) that are cupped forward and down when it is foraging, possibly in an effort to focus at a point immediately in front of its nose. It also sniffs along the surface of the wood it searches, at the same time tapping the wood with its narrow middle digit.

Erickson's study demonstrates the importance of sight and smell to the Aye-aye, but suggests that the Aye-aye may depend most on the tapping to locate galleries of larvae. It is likely that it has exceptionally keen auditory sensitivity, which enables it to pinpoint the movements and hence position of the beast within. In a sense, like bats, it uses a kind of echolocation to first locate the space containing its prey and then focused sound to pinpoint the precise position and nature of the prey within that space.

But the Aye-aye's skills may go way beyond even this sophisticated level. Just perhaps, Erickson suggests, this primate may be using the low mass of its middle digit as a resonating device to augment its hearing. Vibrations given off by the wood in response to tapping may be 'read' by the finger as a way of more adeptly interpreting the size, shape and perhaps contents of the internal spaces within the wood.

All of this should kick-start similar research with Australia's and New Guinea's Striped Possums *(Dactylopsila* and *Dactylonax)*. These too are arboreal omnivores with powerful lower incisors and elongate digits (the fourth) on their hands. They are known to forage for insect larvae burrowing through dead wood. Do these antipodean grub-crunchers have similar or perhaps even more amazing abilities to locate the gooey munchies hidden beneath their feet? **—S.H.**

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It has become one of the most diverse nesting sites for seabirds on the Great Barrier Reef.

LADY ELLIOT ISLAND

BY PETER OGILVIE

LADY ELLIOT, WIFE OF THE GOVernor General of India and Bengal, was probably blissfully unaware that the ship which bore her name had, through a convoluted process, donated that name to a coral cay at the southern end of the Great Barrier Reef. The sighting of the cay took place one day in late September 1816 while the *Lady Elliot*, under the command of Joseph Abbott, was en route from Port Jackson to Calcutta.

A few other visitors to Lady Elliot Island in the first half of the 19th century have provided some tantalising clues as to what may have lived there before the island was mined for guano during the second half of that century. The droppings of countless seabirds, accumulated over many centuries, provided a high phosphate fertiliser, which was dug, bagged and shipped to various parts of the world. The miners cleared almost all vegetation and removed or rearranged the nesting sites on what was regarded as one of the major seabird breeding islands on the Great Barrier Reef. They added insult to injury by leaving behind a herd of goats. For 100 years, goats grazed and browsed the Lady Elliot moonscape, thereby preventing regeneration of vegetation and frustrating recolonisation by seabirds.

Armed with this information, you can appreciate that the natural history of Lady Elliot today is a product of those massive disturbances that started almost 130 years ago. With removal of the goats in the mid-1960s, a substantial revegetation program was undertaken by the lighthouse keepers and the proprietor of a day-visit tourist operation that commenced in 1969. Native and alien species from other reef islands and from the mainland were planted throughout the island. The most common species introduced, and one that thrived in the conditions, was the Coastal Sheoak *(Casuarina equisetifolia)*. Although a native of barrier reef cays, it is marching boldly across Lady Elliot to places where, according to the few early descriptions, no trees occurred prior to mining.

The seabirds have since returned with a vengeance and Lady Elliot has become one of the most diverse nesting sites on the Great Barrier Reef. Ten seabird species have been recorded breeding there, including one tree-nester, the Black Noddy *(Anous minutus)*, and one ground nester, the Wedge-tailed Shearwater *(Puffinus pacificus)*. The remainder are ground-nesters. Two species, the Bridled Tern *(Sterna anaethetus)* and Silver Gull *(Larus novaehollandiae)*, require some vegetative cover for their nests. The Crested, Black-naped and Roseate Terns *(Sterna bergii, S. sumatrana* and *S. dougallii)* use relatively bare ground on which to lay their eggs. The latter two prefer sites just above the high-water mark, while the Crested Terns clump into fairly discrete, tightly packed colonies where conditions are favourable in the north-eastern corner of the island. Lady Elliot stands alone as a breeding site for the Common Noddy *(Anous stolidus)* in the southern Great Barrier Reef.

Perhaps the most exciting species, and a rare nester on the Great Barrier Reef, is the majestic Red-tailed Tropicbird *(Phaethon rubricauda)*. One pair bred on Lady Elliot Island in 1983. The colony had grown to six pairs in the 1991–92 season, all current nests being located no further than ten metres from one of the resort buildings. One offspring of the second nesting pair returned to breed in 1990, and two other Lady Elliot progeny were recorded nesting in 1991. This is a very healthy indication that the colony will continue to grow.

LEN ZELL / QNPWS

The Great Barrier Reef is just a few steps away from the shore.

COURTESY TRAVELEARN

Aerial view of Lady Elliot Island.

The Black Noddies have also recently established a breeding colony, now that suitable trees and shrubs are present. From an initial 30 nests in 1985, several hundred pairs now breed on the island and the numbers are increasing.

Many other bird species use Lady Elliot on a permanent or part-time basis. Breeding residents include the Buff-banded Rail *(Rallus philippensis)*, Eastern Reef Egret *(Egretta sacra)* and Silvereye *(Zosterops lateralis)*, along with an unwanted colony of House Sparrows *(Passer domesticus)*. Both the Great and Least Frigatebirds *(Fregata minor* and *F. ariel)* are frequent visitors, often roosting overnight in sheoaks behind the northern beach. The species that was probably responsible for the bulk of the guano deposits, the Brown Booby *(Sula leucogaster)*, has not been recorded nesting, but large numbers visit the island and roost there regularly. Depending on the advancing sheoaks and the ubiquitous Mother of Millions *(Kalanchoé tubiflora)*, both of which have the capacity to choke potential nesting sites, the boobies may yet return. Of the many wading bird species that pass through, the Lesser Golden Plover *(Pluvialis dominica)*, Ruddy Turnstone *(Arenaria interpres)* and Bar-tailed Godwit *(Limosa lapponica)* are the most obvious, often choosing to feed on the island when the tide is in.

It is worth remembering that the island is merely a portion of the surrounding coral reef that has, for perhaps three or four thousand years, managed to hold its head above water. The island and surrounding reef is part of the Great Barrier Reef Marine Park. When the tide is out, the reef flat adjacent to the resort offers

Red-tailed Tropicbird.

reef walkers an opportunity to experience a rich and colourful diversity of marine organisms. On the flood tide, the snorkeller can traverse the same area in the company of many species of damselfish, butterfly fish, angelfish, parrotfish and others not in evidence during the ebb. Diving opportunities are excellent, with easy access available to the reef edge in the north-western corner, or adjacent to the lighthouse, at any stage of the tide.

Bear in mind that many fascinating natural history events are seasonal. Most seabird breeding occurs during October to March. Nesting and hatching of Green and Loggerhead Turtles *(Chelonia mydas* and *Caretta caretta)* take place between November and April. At night, usually when the tide is well in, visitors can watch female turtles emerge from the sea. Each turtle will dig a body pit and egg chamber, lay over 100 eggs, fill in the holes and return slowly to the sea.

You may also see Humpback Whales *(Megaptera novaeangliae)* travelling past on their annual migration to and from Antarctic waters. From July to September, observant visitors have a chance of seeing a 'blow', an elevated flipper or tail fluke, or even a breaching whale in the vicinity of Lady Elliot.

The small tourist resort caters admirably for the diver, snorkeller, reef walker, bird watcher and turtle watcher. It has its own environmental education centre with displays and aquaria, plus staff to help visitors discover the vast array of life forms the island and its reef have to offer.

Lady Elliot is an island very much in transition. From a virtual rubble desert 25 years ago, a fascinating process of colonisation and extinction is being played out before our eyes as the island strives to achieve some level of equilibrium. Witnessing that process can be exiting and, to the keen natural historian, immensely satisfying. ■

Peter Ogilvie is Principal Conservation Officer with the Queensland National Parks and Wildlife Service and has been associated with island and marine parks in the Great Barrier Reef for over 20 years.

GRAHAM ROBERTSON / AUSCAPE INTERNATIONAL

LADY ELLIOT ISLAND

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Facilities: Learn-to-dive certificate courses available (all diving and snorkelling equipment can be hired); dive shop; glass-bottom boat rides; day tours.

Rock-wallabies have persisted longer than many other species because their rocky fortresses provide a measure of security.

BLACK-FOOTED ROCK-WALLABY

BY JACK KINNEAR

ROCK-WALLABIES ARE AMONG the most engaging members of the kangaroo family. Superbly adapted to live in their rocky habitats, they move in a three-dimensional world where graceful, effortless leaps from rock to rock reflect their long association with their habitat.

The agility of rock-wallabies can be quite astounding; indeed, the early settlers mistook them for monkeys, but they are unmistakeably wallabies with three distinctive features of their own. The first is the 'non-slip' soles of the hind feet, which provide the necessary traction to traverse and grip smooth rocky surfaces; the second less obvious characteristic is their muscular build, which enables them to leap and bounce about in their habitat with consummate ease; and the third feature is their long furred tail, which they carry extended in a graceful downward curve to balance themselves as they dart about.

The Black-footed Rock-wallaby *(Petrogale lateralis)* was first described in 1842 from the Swan River colony where it was very common. Subsequent collections revealed it was widely distributed, ranging from the Kimberley region to islands off the south coast of Western Australia. Scattered colonies persist in gorges and rocky outcrops throughout this vast area, but in general the numbers are low.

The rocky habitat of these wallabies affords certain advantages. When temperatures reach 40°C day after day, rock-wallabies retreat to their cool caves and live in climate-controlled comfort, emerging at night under cooler conditions to feed. This lifestyle, when combined with a low requirement for water, enables rock-wallabies to live in arid environments devoid of free water.

But living in rock piles also has its disadvantages. Because rocky country is generally not the most fertile or productive, the wallabies are forced to leave their shelter to graze and browse on whatever vegetation is available. In one sense they are specialised rock-dwellers, but from a dietary viewpoint they are generalists—a characteristic that accounts for their wide distribution across Australia.

The impact of European settlement of Australia has been catastrophic for the mammalian fauna. Over much of mainland Australia there have been widespread and numerous extinctions of species, or contractions of their ranges. On other continents, the fauna responded to European colonisation by adapting or by retreating to wilderness areas where they still persist and even thrive. But in Australia this did not happen and, indeed, it is in our remote desert regions where the decline has been greatest. Here we cannot blame the massive habitat destruction brought on by agriculture or mining because, in such remote regions, human disturbances have been minimal.

N. N. BIRKS

Many hypotheses have been advanced to explain the demise of our mammals. These include the absence of traditional Aboriginal patch-burning practices, rabbit plagues, agricultural disturbances, aridity and climatic change. Clearly the issue is complex, and the causes have not been easy to unravel or rank in order of importance. However, recent studies involving rock-wallabies and exotic predators have increased our understanding of the problem. At a site 250 kilometres east of Perth, five small Black-footed Rock-wallaby populations had managed to persist, albeit precariously, on their isolated rocky outcrops. An experimental study revealed that, when foxes were controlled, rock-wallaby numbers increased; moreover, they failed to increase significantly without fox control.

Fox control has been applied elsewhere and so far six other marsupial species differing in habitat and lifestyle have been shown to be likewise threatened by foxes. This work is being extended to other species suspected to be vulnerable to foxes.

Rock-wallaby predation ecology has produced new insights into the factors affecting the conservation of Australia's mammals. We have learned that foxes are relentless and efficient predators that have probably done untold damage in the past. Rock-wallabies have persisted longer than many other species because their rocky fortresses provide a measure of security. But rock-wallabies are still vulnerable because they cannot venture too far from shelter to feed. Thus, under siege, they can only exist in small numbers—a precarious situation, and one that makes them prone to extinction in the long term.

Recent studies in Queensland have implicated feral cats as predators of rock-wallabies. Studies involving hare-wallabies in central Australia have revealed that, in addition to foxes, feral cats are also a major threat. This greatly complicates predation studies and feral cats are proving to be difficult to control.

If we do not address the problems posed by foxes and feral cats, then the future for mammal conservation is bleak. There is a pressing need for more research on these exotic predators and their control. The immediate objective is to lift the siege under which our surviving mammals exist (invariably, in low numbers) wherever foxes (and cats) are present. Because wide-area fox control would be impractical and prohibitively expensive, local control of foxes in selected areas carrying threatened species is our only viable option.

The ultimate solution will have to be by some biological control method that is self-sustaining. Already, steps are being taken in this direction by conservation agencies throughout Australia. With powerful new tools and knowledge gained from advances in molecular biology and genetic engineering, the prospect for ending the siege is much brighter. ■

Suggested Reading

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Dr Jack Kinnear is a Principal Research Scientist with the Department of Conservation and Land Management, Western Australia. His special interests relate to the conservation of endangered mammals.

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Eating a geebung is like sucking sweet cottonwool.

GEEBUNGS REMEMBERED

BY TIM LOW

THE POPULARITY OF BUSH FOODS today is nothing new. Last century, Australian wild food plants were well known and widely written about. Bush pioneers needed to know their wild tucker, and city gentlemen were interested in native plants as possible crops for cultivation and export.

Not many people today have heard of geebungs *(Persoonia* species), but 100 years ago these small stringy fruits were popular enough to appear in the common literature. In Rolf Boldrewood's *Robbery under arms* (1885) the bushranger Dick Marston is heard to exclaim, "You won't turn a five-corner into a quince, or a geebung into an orange". Banjo Patterson wrote a poem about a polo game in which the Cuff and Collar Team "from the city's smoke and steam" battle the Geebung Polo Club "from the land of rock and scrub". And in colloquial language a geebung was also someone who lived for money.

In Brisbane there is even a suburb called Geebung, named in the 1880s by the Railways Department after local geebung shrubs. This naming shows how widely the word had spread, for geebung is an Aboriginal word from the Sydney area. Brisbane tribes called the fruit dulandella.

Curiously, there is also a new Brisbane suburb called Doolandella. I rang the Queensland Place Names Officer, Denis Cleary, and he told me he had proposed this name in 1975 after noting numerous geebungs *(Persoonia sericea)* in the area. The spelling was changed to preserve the pronunciation. Brisbane thus has the rare distinction of two suburbs named after one fruit.

Geebungs, also called jibbongs or geebongs, often feature in narratives on colonial life. G.C. Mundy, in *Our Antipodes* (1855), describes them as a "native plum, very woolly and tasteless". P.M. Cunningham, in *Two years in New South Wales* (1827), dismissed them as "another tasteless fruit...much relished by children". In *Australian life* (1885), R.M. Praed told how "We gathered the wild raspberries, and mingling them with geebongs and scrub berries, set forth a dessert".

Aborigines were fond of geebungs. Around Brisbane the fruits were "greatly relished" according to settler Constance Petrie. In the Kimberley the fruits were sun-dried, roasted in ashes, hammered to crush the seeds, and stored in paperbark for future use.

Geebungs grow on shrubs or small trees, and there are about 100 species, found mainly in south-eastern and south-western Australia. They favour sandy infertile soils in heathlands and woodlands. One species, the Nanchee *(P. falcata)* grows in the tropics.

Geebungs belong in that quintessentially Australian plant family, the Proteaceae. Many members of this group produce edible seeds, including macadamias *(Macadamia* species), Red Bopple Nut *(Hicksbeachia pinnatifolia)* and Atherton Oak *(Athertonia diversifolia)*; others secrete delicious nectar, such as grevilleas, hakeas, banksias, Waratah *(Telopea speciosissima)* and Mountain Devil *(Lambertia formosa)*; but only the geebungs are known to produce a succulent edible fruit.

The foliage and growth form of different geebungs is variable, but the flowers and fruits are distinctive. The flowers feature four slender, arching, yellow or cream 'petals', and the fruit is egg-shaped or rounded, with a persistent spike-like style, and with sweet, fibrous flesh surrounding a large stone. The ripe fruits are green, sometimes streaked purple or black, usually ripening only after falling to the ground.

Eating a geebung is like sucking sweet cottonwool. The fruits are flavoursome (not "tasteless"!) but very fibrous. Judging by their very hard stone, fibrous flesh attached to the stone, typically greenish colour, and habit of ripening after falling, they appear to be adapted for seed dispersal by mammals (see ANH Summer 1987–88). Wallabies find them by sniffing beneath the shrub.

The tastiest geebung I have tried is the Tasmanian *P. gunnii*, a very distinctive fruit. It is bright purple, ripens on the shrub, and has sweet soft pulp that cleaves easily from the stone. Unlike the mainland geebungs, it has evolved to be eaten by birds.

The Pine-leaf Geebung *(P. pinifolia)* is common around Sydney.

PHOTOS: TIM LOW

The Brisbane suburb of Geebung is probably named after the Broad-leaved Geebung *(P. cornifolia)*, found on sandy soils around Brisbane.

One of the tastiest of alpine fruits is the Tasmanian geebung *P. gunnii*.

Along the Overland Track south of Cradle Mountain, Tasmania, I found heavy crops of these fruits sprouting on low shrubs. No better example of why plants produce edible fruits have I ever seen. Beneath the shrubs lay scores of old geebung stones. Every one had been gnawed open and the seed eaten by native rodents. Only those seeds regurgitated far away from the shrubs by currawongs had any chance of survival and germination.

Geebungs are interesting plants. Their fruits are so clearly shaped by their symbiotic relationships with animals. In some forests they are the dominant shrubs, providing food for mammals or birds. They are rich in historical associations and the fruits are well worth trying as bush snacks.

I look forward to the day when the geebung is again a well-known fruit. Australia has just passed through a revolution in environmental thinking, yet Australians remain remarkably ignorant about their natural heritage, which includes bushland fruits like the geebung. Nineteenth-century colonists lived much closer to nature and knew more about it. Their knowledge didn't stop them from destroying the bush, but our ignorance today certainly won't help us save it.■

Tim Low is a full-time nature writer living in Brisbane. He is the author of four books about plant use, the most recent of which are Bush tucker *and* Bush medicine *(Angus & Robertson).*

I was warned about her formidable, no-nonsense style. In fact she is direct, enormously friendly and unfailingly sensible.

THE JOAN SUTHERLAND OF AUSTRALIAN SCIENCE

BY ROBYN WILLIAMS

Professor Adrienne Clarke.

THE YEAR 1991 WAS AN ASTONISHING year for botanist Dr Adrienne Clarke. The Order of Australia, Fellowship of the Australian Academy of Science and then, in December, named by the Minister for Science Ross Free as the next Chairman of the CSIRO. Not bad for the woman who once taught Dame Edna Everage about the sex lives of gladioli!

When I first met Dr Clarke, at the University of Melbourne where she held a personal chair in the Department of Botany (she is now Head and Director of the Plant Cell Biology Research Centre), I was warned about her formidable, no-nonsense style. In fact she is direct, enormously friendly and unfailingly sensible.

She will be an inspiration to young Australians.

I wanted her to appear on ABC TV's "Uncertainty Principle", in which I interviewed scientists for over half an hour. This is particularly difficult for those with only a brief summary of 'work in progress' in them—they flounder and waffle thereafter, especially if they haven't thought much about the politics or philosophical implications of their work.

On the morning I took on Dr Clarke I was feeling awful, having caught some debilitating bug. Indisposition has never kept me away from work and so I turned up in the studio with, unfortunately, a physical presence only and my mind well out of gear. She spotted this immediately and, like a helpful host with a shy guest, took my faltering questions and launched into full and entertaining replies.

"Er . . . Plants Breeders Rights", I stumbled. "Well", she replied brightly, "it's not as if private companies will be able to own the genetic blueprint of a breed indefinitely . . ." And off she went with a marvellously coherent answer.

"Um . . . what about multinationals?" "Well, if you mean that it's the large US and European companies that have put the most investment into genetic engineering . . ." Again Dr Clarke took hold of the crux of the question, which through my fog I'd intended to put, held it up, shook it a bit, and gave a reasonable summary of the commonsense position.

It's that clarity, organisation and cheerful commonsense that enables Dr Clarke to get through so much creative work and public duty (she was already a member of the CSIRO Board and Chair of Biological Sciences for the Australian Research Council). Her field is the invention of new plants. This is actually a process involving the transfer of genes cloned from a species carrying some useful characteristic to a crop plant, so providing the receiver, for example, with resistance to a pest, drought endurance, prettier flowers or whatever.

This work has taken her to the United States and Europe regularly, where very large sums of money are spent on designing better crops for the future. It can be a controversial area. How do the companies protect their designs for what, after all, is a product of nature?

Adrienne Clarke did not have a straightforward privileged girl's gilded path to success. Her school provided some good grounding in science, but there was plenty she had to teach herself. She was born in Melbourne in 1938 and studied at the University of Melbourne and in the USA—Baylor University in Houston and at the University of Michigan. She was trained in biochemistry and chemistry but has specialised in the genetic basis for the way plants breed sexually: how they manage to avoid self-fertilisation if both genders are found on the same flower. It was this expertise that years ago attracted Barry Humphries (and Dame Edna) to Melbourne University's Botany Department for detailed advice on the sex lives of gladdies. He was a responsive student.

Now botany has become so much more than a naming of parts and classification of species—it is as well a molecular and biochemical science in which Australia is pre-eminent. We have several centres of world renown: the Waite Institute in Adelaide, the CSIRO Division of Plant Industry and, of course, the Plant Cell Biology Research Centre at the University of Melbourne. But are Australians aware of the brilliance of their botanists?

Adrienne Clarke will be a superb advocate. She and her colleagues at the Academy of Science have already taken genetics to the supermarket with an audio-visual display on genetic engineering that started in February (1992).

She also has a decisive way of dealing with ordinary people's concerns: on the day her appointment was announced she told the press that an extra $3 million would be given to research aimed to rid our waterways of the toxic blue-green algae that exploded so destructively in the drought of 1991.

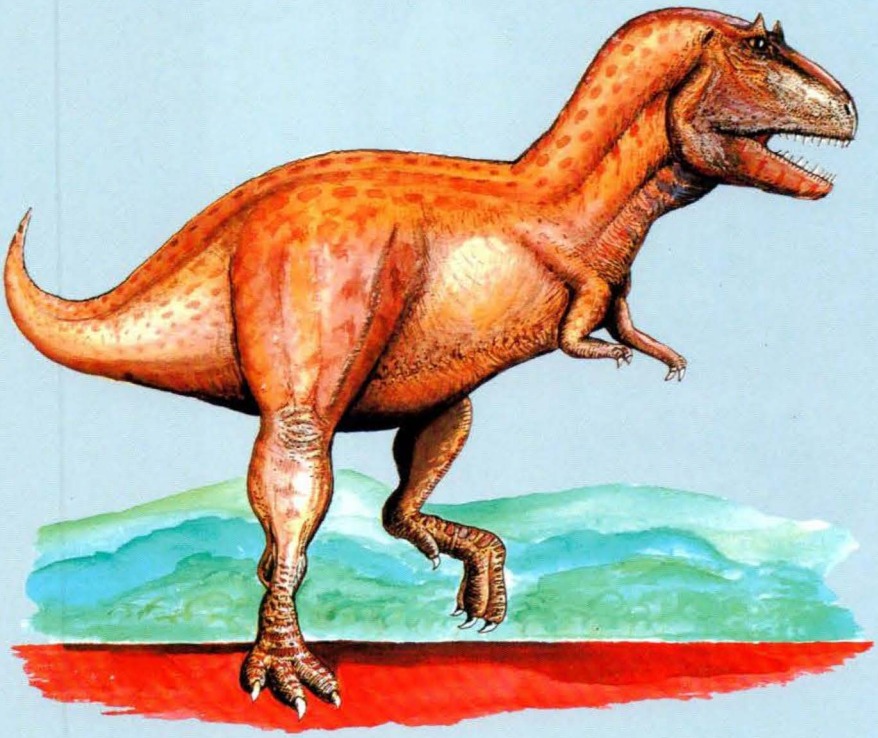
A small bird told me that the then Senior Minister in charge of Industry, Commerce and Technology, Senator Button, wanted a businessman to chair CSIRO. The outgoing chairman, Neville Wran, insisted on a scientist, one of the first rank. Adrienne Clarke was offered the job. She will be an inspiration for young Australians and someone who can talk turkey to big business and government.■

As Presenter of Radio National's Science Show, Robyn Williams has the opportunity to interview many interesting people in science.

COURTESY ADRIENNE CLARKE

THE DINOSAUR CLUB

(no, not something you use to hit dinosaurs with)



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The Dinosaur Club is a non-profit organisation run by the Western Australian Museum for the advancement of science and education in the Community.

RIC BOLZAN / AUSTRALIAN MUSEUM

The scorpion at final stage of assembly having its animatronics tested. The next stage is the painting and finishing touches.

Gargantuans From The Garden 'shrinks' its visitors and sets them loose in a life-like backyard to see the world as an insect would see it.

GARGANTUANS FROM THE GARDEN

BY CARRIE ARKINSTALL

AN EXHIBITION IN THE MAKING

A desert scorpion *(Urodacus* sp.) from the Northern Territory.

M.W. GILLAM / AUSCAPE INTERNATIONAL

ESTHER BEATON / AUSCAPE INTERNATIONAL

Most people consider all insects to be pests, yet in reality it is only one per cent that are.

WHEN IT COMES TO INSECTS, MOST Australians have an 'attitude problem'. Say the word 'insect' and many people reach for a shoe or a can of spray. That is certainly true in my house where the effects of the last fumigation are starting to wear off and the cockroaches are coming back with a vengeance. In our household of couch potatoes, cockroach-squashing has become a major form of exercise. It is a vigorous indoor sport that draws loud cries of encouragement from spectators: "There it is, get it!", "Hey! Use your own sneakers!". But do insects really deserve this kind of rough treatment?

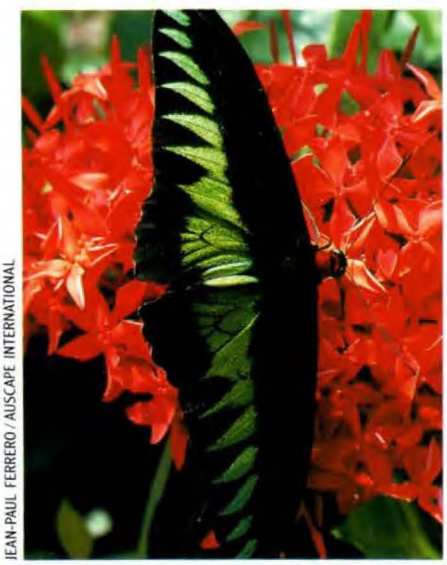
As a rule, no. That's what the people who have developed 'Gargantuans From The Garden' would say. Gargantuans From The Garden is the Australian Museum's new travelling exhibition about insects and their relatives: spiders, ticks, scorpions, millipedes, centipedes and crustaceans. They are the arthropods.

The word 'arthropod' means 'jointed legs', which is what all arthropods have. They also have no backbone (they are invertebrates) and they have a skeleton on the outside of their body (an exoskeleton). This body plan has been very successful for arthropods, having remained relatively unchanged for more than 300 million years. Today, arthropods live almost everywhere.

Although physically small, the incredible diversity and sheer numbers of arthropods make them one of the most important groups of animals on Earth. About 80 per cent of the animals we know about today belong to this group. There are at least 750,000 species of insects, more than any other kind of living thing, and 130,000 species of other arthropods. And there are sure to be many more arthropod species yet to be discovered.

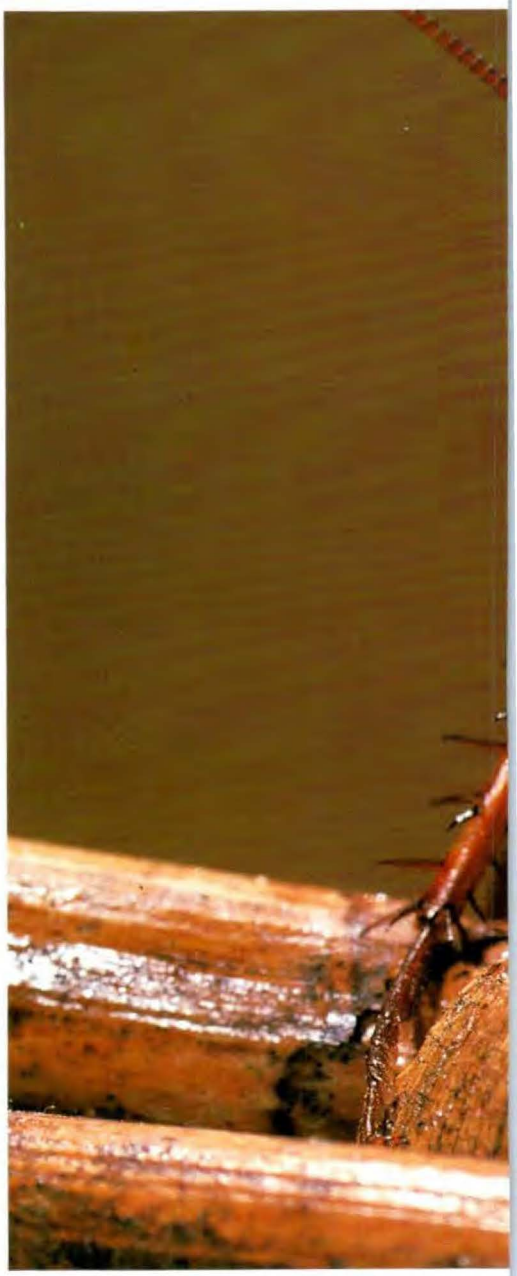
Dan Bickel, an entomologist (insect specialist) at the Australian Museum, says that most people are not kindly disposed to insects. They see them as dirty, irritating, disease-ridden 'creepy crawlies', even though only one per cent of insect species are considered pests. We may pause to admire a beautiful butterfly flutter among the flowers on a sunny afternoon, but we generally don't have much time for insects, except perhaps to spray them, squash them or bomb them.

While most people are simply *repelled* by insects, they are usually *frightened* by spiders. Mike Gray, an arachnologist (spider expert) at the Museum, believes that people actually like to be scared of spiders. Mike has a collection of horror movie posters stuck up on filing cabinets around his lab. The stars of the movies are invariably giant, poisonous, terrifying spiders. Just last year the film "Arachnophobia" drew large audiences of people happy to pay $11 to be frightened by scenes of 'killer spiders from South America' (which were actually relatively harmless Australian huntsman spiders).



JEAN-PAUL FERRERO / AUSCAPE INTERNATIONAL

While we often pause to admire beautiful butterflies, we shun most insects. Pictured is the stunning Rajah Brooke's Birdwing Butterfly *(Trogonoptera brookiana)* from Malaysia.



Mike Gray and Dan Bickel would like to see people fascinated by arthropods rather than just being scared of them or wanting to smear them on the wall. And one way they hope to correct this 'attitude problem' is by helping people understand arthropods.

What better way to understand arthropods than to step into their world? Imagine watching a giant praying mantis moving among blades of grass that tower above your head. Gargantuans From The Garden 'shrinks' its visitors to arthropod size and sets them loose in a life-like backyard to see the world as an insect would see it.

Seven giant moving robotic models (scorpion, Redback Spider, praying mantis, dung beetle, bull ant, cicada and mosquito) help to bring about the transformation to arthropod size. Each model is about 60 times the size of the real animal. Seeing them at this scale, up this close, is bound to change the way we look at them when we get back to our own backyards.

KATHIE ATKINSON / AUSCAPE INTERNATIONAL

Most people reel back in fear when confronted with insects like this American Cockroach *(Periplaneta americana)*. But the insects and their relatives comprise an important—and extremely large—group of animals.

THE TECHNOLOGY USED TO CREATE THE models is called 'animatronics'. Animatronics uses air forced into cylinders to make the models move. A separate computer unit controls the movements and sound. Walt Disney pioneered the use of animatronics in the 1950s for his theme parks but animatronics has come a long way over the years. The working parts have become more compact, more reliable and better controlled as computer technology has improved.

Liz Cowell, Project Manager and Chairperson of the multidisciplinary team responsible for putting the exhibition together, says the intention was to make an exhibition that was much more than just animatronic animals. The exhibition looks at such things as arthropod communication, how arthropods change as they grow, and the huge variety of arthropods. Hands-on exhibits, static models, photographs, funny cartoons, nature videos, live insects and other kinds of displays are all used to support the models and to show visitors that arthropods are fascinating and worth trying to understand.

Consider the house fly, an insect most of us are all too familiar with. How many family picnics have they ruined by crash-landing into our lunch? How many too-long opened mouths have they flown into? How many times have we had to fight them off from landing on our noses or buzzing into our ears? They may be part of the Australian way of life; they may have brought us 'the great Aussie salute'; but don't ask us to like them.

Fair enough, the exhibition says, but at least find out how they work. In a *son et lumiere* (sound and light show), a common house fly gives us a guided tour of its sense organs. As a light shines on the feet of the model fly, the voice-over tells us how flies taste their food with their feet. That's why they like to take a walk in your lunch. To see, the fly tells us, flies look through hundreds of tiny facets, each of which gives its own view of the world. Together these make up the two large 'compound eyes'. And as a light moves to the fly's proboscis, we are told that flies

RIC BOLZAN / AUSTRALIAN MUSEUM

The polystyrene foam cicada body being released from its mould by Justin Robson (in background), while his assistant cleans out the other half. Justin's work may be familiar to many; it includes some amazing rice sculptures featured in a television commercial.

eat by dribbling onto their food saliva that contains digestive enzymes like the ones in our own gut. The enzymes break down the food into smaller components, and then the fly sucks it all up.

Another section of Gargantuans From The Garden looks at insect societies. A display maintained by the New South Wales Apiarist Association shows three hives of busy live bees at work—collecting food, looking after the needs of the queen, nurturing the young bees and doing other tasks. Elsewhere, a moving electronic sign panel, like the ones you see in shop windows, continually runs messages. Catchy headlines and short statements about arthropods are flashed up—locust plague movements, recent successes with biological control, whatever is newsworthy—to remind us that arthropods affect our everyday lives.

Among all this, placed around the garden, are the animatronic models. They have been made in Australia, which has meant that the Museum was able to keep a close eye on the models as they were being built. Each model took two to three months and six to eight people to make.

SALLY ANIMATRONICS, THE COMPANY CONtracted to produce the animatronics for Gargantuans From The Garden, is based in one of Sydney's northern suburbs. When I visited the Sally Animatronics workshop near Dee Why, I was amazed to find, in addition to one massive scorpion, two half-finished Elmer Fudds, a Yosemite Sam with a moving moustache, and a Bugs Bunny leaning on a tree that had a 'No Rabbit Shooting' sign nailed on to it. Greg Eccles, the Managing Director, explained that the cartoon characters were being built for a fun park in Texas. Sally Animatronics had successfully competed against a number of overseas companies for the tender, as it had done for the animatronics in Warner Brothers 'Movie World' on Queensland's Gold Coast. With multi-million dollar projects like this to their credit, my first thought was that Gargantuans From The Garden must be fairly small time for the people at Sally Animatronics. Greg assured me this was not the case; in fact he said the Gargantuans work was one of the most challenging they had ever done because of the scientific accuracy required.

Museum scientists gave Greg and his team videos of live arthropods so they could develop movements that seemed as believable as possible. Mike Gray and Dan Bickel also visited the workshop a number of times to make sure the models moved authentically. One of the Sally Animatronics engineers showed me how the animatronic scorpion, 60 times its

I was amazed to find, in addition to one massive scorpion, two half-finished Elmer Fudds, a Yosemite Sam and a Bugs Bunny.

normal size, reaches forward menacingly with its pincers and flicks its stinging tail out. I certainly found it very convincing. More than 1,000 Mexicans die each year from scorpion stings, so it is comforting to know that the sting of Australian scorpions is relatively harmless. Nonetheless, being this close to a two-metre long, one-metre high scorpion was quite an unsettling experience. It seemed so real I wanted to step back out of the way. So now I know what it's like to be scorpion prey!

The scorpion moves because its limbs contain air fed from valves through air lines to cylinders. The valves and the cylinders they control are the mechanical 'muscles' of the animatronic animal. By removing part of the fibreglass shell, which in the case of the scorpion is a lid in the head, engineers can get to the muscles to make any necessary adjustments. A computer 'brain' in a separate unit away from the model and out of public view controls the valves and cylinders. The program that directs the model's movements is basically a repeated sequence or 'loop', which is long enough so that the movements appear random and natural.

The manufacturing of animatronics involves a blend of many skills—sculpting, mould making, fibreglass techniques, engineering in a variety of materials, pneumatics and computer control, together with special airbrushing techniques.

I was fortunate enough to get a behind-the-scenes look at the cicada model being made. Before starting the model, the fine structure and surface details of real cicadas were studied. Dan Bickel had given Sally Animatronics some cicada specimens, photos, scanning electron micrographs and drawings to analyse. From these, a plan and elevation view of the whole insect was drawn, and then the general shape of the cicada was made out of polystyrene foam.

Sally Animatronics contracted Justin Robson to do the sculpting for the models. I visited the workshop at the time he and his two assistants were making the cicada's legs. The floor was encrusted with a thick layer of plaster. On a chair near the wall sat what looked like the tangled hair of a madwoman. This was sisal—plant fibres used for strengthening the plaster moulds. A microscope was set up in one corner, and some dried insect specimens from the Museum were pinned to a small block of styrofoam.

Like the body, the cicada legs were first shaped out of polystyrene foam, during

Justin building up clay around the sculpture of one of the cicada's legs.

RIC BOLZAN / AUSTRALIAN MUSEUM

RIC BOLZAN / AUSTRALIAN MUSEUM

The Redback Spider model being assembled, with animatronics partially inserted.

which stage Dan came in to check that the sculptures were scientifically accurate. A layer of clay was then put on over a plaster bandage. That's when the surface details of the cicada legs, like spikes, ridges and ripples, were added. After that the moulds were prepared by encasing each leg in layers of plaster, some of which included the strengthening strings of sisal.

Very carefully the plaster moulds were removed and I watched as the workers scraped out the clay stuck in some of the crevices with a metal spatula. Every last trace of the clay had to be removed so that the final shape of each leg would be right. The next step was to coat the inside of the plaster moulds with a special sealing and releasing agent. Without this step, the casting material, which in this case is fibreglass, would have stuck to the plaster and the models would have been ruined.

Fibre was packed into these plaster moulds, then resin was poured in to make fibreglass casts. Sally's engineers inserted metal reinforcing into each leg to make them sturdy. After several hours, the waste plaster moulds were broken away. This, said Justin, is the best part. The gradual unveiling of the model's surface texture is like watching your own child being born.

The next stage, and one of the most difficult, was to build into the insect the mechanisms (pneumatics) to provide movement. Finally, all the pieces of the model–body and head, legs, wings, antennae–were put together like a puz-

zle, making sure the right parts went in the right place. That wasn't as easy as it sounds. Insects have six legs that can look pretty much the same to the untrained eye. The specimens helped solve the puzzle. After that came the last-minute painting and airbrushing, and addition of the final surface structures. Hairs, for example, were needed for almost all the models, even the ones that look shiny and hairless from a comfortable distance. These hairs were glued on strand by strand.

The final product is what you see in the exhibition–a model that looks and moves just like the cicadas we spent hours climbing trees to catch as children. A computer controls the sound of the animatronic cicada but, in nature, a cicada sings by vibrating a thin membrane at the base of its abdomen. The choruses we hear in our own backyard, loudest at dusk, are males calling for a mate.

The entire process of model-making is lengthy and not without its trials. Justin had to work out how to make the antennae for the praying mantis, which, at four metres, are the same length as the model's body! If he had made fibreglass antennae that long they would probably have broken during transport. So, with a bit of lateral thinking, he came up with the idea of using two fishing rods. I wonder whether fishing rod manufacturers ever realised their product would be used to help build a giant insect?

The completed models were finally set in their garden for us to wander through like leprechauns. Giant blades of grass, huge concrete pipes, and an enormous big toe finish the scene.

I think Gargantuans From The Garden works. At the very least, visitors are entertained by the 'gee whiz' value of the huge animatronic arthropods set in a garden like their own. But I suspect that many people will also take on board the fuller message of the exhibition–that arthropods are interesting, fabulously detailed, even beautiful. Maybe it will cure us of our 'attitude problem' towards insects. Maybe I'll ignore that cockroach that just scuttled across the carpet. But then again . . . ■

Suggested Reading

CSIRO, 1991. ***The insects of Australia. Volumes 1 and 2.*** **2nd ed. Melbourne University Press: Carlton.**

Nascord, R., 1977. ***Australian spiders in colour.*** **Reed Books: Sydney.**

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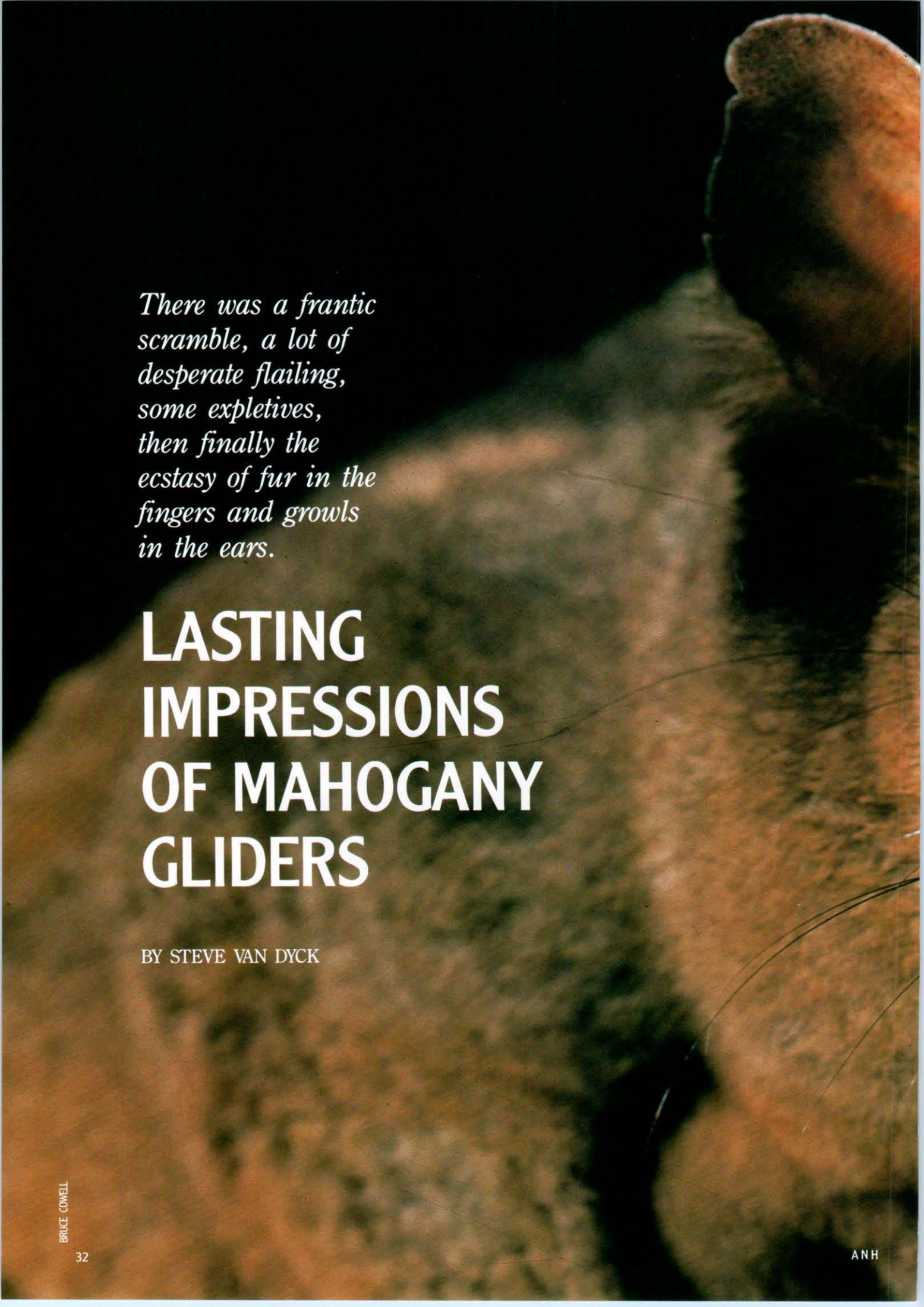


There was a frantic scramble, a lot of desperate flailing, some expletives, then finally the ecstasy of fur in the fingers and growls in the ears.

LASTING IMPRESSIONS OF MAHOGANY GLIDERS

BY STEVE VAN DYCK

BRUCE COWELL

IT COMES AS A RELIEF TO ME THAT gumboots can't talk, otherwise one appalling pair I know might confess a a few home truths about just how much of science gets stumbled upon rather than deduced.

They might recall May 1991. For two weeks my colleague Paul Stumkat and I had nailed wire traps up trees trying to catch Mahogany Gliders but without success. We were depressed and, as a measure of our mental health, we had started eating the gliders' bait.

Possum-watching south-east of Tully in Queensland can be a frustrating affair. The infertile coastal strip where we worked between the Murray and Tully Rivers is an exclusive tropical woodland devoid of nature's commoners–no Brushtails or Ringtails, no Greater Gliders or Koalas. But it does support the only known breeding population of Mahogany Gliders *(Petaurus gracilis)*, recently rediscovered after the species was lost to science shortly after its description in 1883.

Because we thought it was our last night in the field, Sunday the 19th had been celebrated with a trip into town and a monumentally greasy pizza for dinner. Soon after the feast Paul felt sick and went to bed, and I felt sick and went for a drive. I'd parked the truck in the middle of a large tract of woodland whose northern side was methodically being thrashed to death by a pair of bulldozers dragging a 50-tonne chain between them. With no good reason to dress myself in anything more elaborate than singlet, shorts and gumboots, I walked off with torch and compass along the swampy track that led through the forest.

BRUCE COWELL

Like horses, gliders are measured in hands, not feet!

Then I smelt my gumboots and the plan jelled . . . if a gumboot could contain a foot, why not a possum?

I'd been sauntering along for an hour or so when, off to the left of the track, a waving flag in the grasstrees signalled the end of the night's constitutional. A Mahogany Glider, some 15 metres away, clung to the top of a long grasstree *(Xanthorrhoea)* spike that swung and wheeled under the shock of the hanger-on. There was no time to work out a sophisticated plan of action. A glider so low down was worth nothing less than an unsophisticated stampede-and-grab.

If gliders knew what gumboots and swamps were to fleetness of foot, this one may have waited a lot longer before leaping off its perch. Instead, the dreadful crashing and slurping that bore down on it sent ahead such a shock wave that, rather than taking stock of the commotion and jumping to the large bloodwood immediately adjacent, the glider leapt onto a spindly sapling that offered no more safety than the drowning man's straw.

In a gumbooted leap I hit the sapling and we were whipped on to the ground in a daze. But gliders are used to missing their marks occasionally, and this one put its head down and went off through the kangaroo grass like a rat. There was a frantic scramble, a lot of desperate flailing, some expletives, then finally the ecstasy of fur in the fingers and growls in the ears.

At that very moment of triumph when the combined thump of heartbeat and pump of adrenalin threatened to blow a hole in my head, my new $70 Mag-light torch picked up the vibrations and had a stroke.

Everything went black. The wisp of a moon was five minutes off the horizon, my compass' luminous needle didn't glow, It was an hour's walk from wherever I was to the truck, and I had no bag in which to carry the clawing, spitting captive. The *pas de deux* to follow needed some careful choreography.

First the compass; its needle tip catching the last hint of moonlight pointed the way not to go out. Next the torch: how to change a bulb with one hand, in the dark, with the other holding down the rabid glider. Then I smelt my gumboots and the plan jelled . . . if a gumboot could contain a foot, why not a possum? So the foot came out, I upended the glider and pushed it down into the awful rubber Bata. And, to stop its desperate efforts to resurface and squeeze out, I folded over

Paul Stumkat gets honey in his hair while easing yet another unsprung trap off its bracket. The inability to catch these gliders using traditional baited traps can be quite frustrating.

STEVE VAN DYCK

the top of the boot and gripped it tightly. Next the bulb changeover with one hand.

The end of a four-cell Mag-light torch is screwed on by approximately 400 metres of microscopic thread behind which strains one of those springs used on indestructible rocking devices in childrens' outdoor playgrounds. Even in daylight with two hands, the end, once off, is virtually impossible to screw back on without pipe clamps and a laser guide. Still, the fumbling went on, the spare bulb was eventually found under the spring, the top end screwed off, and the changeover effected. And while the right hand holding the straining gumboot was pleading for muscular relief, the left hand grappled with the torch's end until finally a blast of cold glorious light came on the final screw.

A wet sock and a gumboot don't make for marathon footwear and, after slopping

Mahogany Gliders bite gouges from young grasstree stems in anticipation of the amber jelly that will ooze from the wound by the following night.

along for an hour or so, the sight of the truck with the pillowcase inside was like a vision from Lourdes. I forgave the torch and was at peace with my Maker. I flung open the door and, standing by the cab, performed the grand inversion whereby the open end of the pillowcase was gathered around and married to the top of the gumboot. The lot was upended and, after a couple of sharp downward shakes, a flop in the bag told of a job well done. With the fetid boot pushed to the side, I looked down into the bag.

But what should have been a great and memorable moment of self-indulgence turned to monumental dismay as the worst imagined scenario unfolded. There was not the slightest movement coming from the form in the bottom of the bag. It was dead.

That rancid gumboot, by olfactory assault and brute suffocation, had robbed the night of its only reward. With depression unspeakable I shone the torch into

BRUCE COWELL

As it growled and gurgled and chewed, I heard above my own shrieking a grunt up in the trees.

This female Mahogany Glider, caught and studied between February and May 1991, had raised a pair of young almost old enough to leave their nest by December.

the bag for a guilt-ridden look at the poor limp thing. And there in the bag's inner depths was the unmistakeable limp, foot-long form of . . . my gumboot's inner sole.

In the haze of expletives I couldn't believe my eyes; the whole abortive night had now sublimed to the ridiculous. The glider hadn't asphyxiated but given me the duck and hung on inside the gumboot while I'd shaken the inner sole out from under it. I swung around to curse the filthy Wellie but who should be doing its final pre-flight wind-up on top of the teetering Bata but the confused glider all set to launch from the cab.

Something told me the next part was going to be painful but, like a five year old in a vaccination clinic, there was no choice. I pounced on it and grabbed a fistful that quickly found its own mark on the soft web between my thumb and forefinger.

Then something good and totally unexpected happened. As it growled and gurgled and chewed, I heard above my own shrieking a grunt up in the trees. Another bite and gurgle (I stuffed the pillowcase further into my mouth), and another grunt from the trees getting closer. I was running out of fresh skin to bite, but it was true—every time the glider in the hand snarled, it was answered by a grunt from the bush.

We had stumbled onto our first really helpful method of attracting Mahogany Gliders. By recording the grisly captive's defence gurgle and later playing it back in the forest, we often got the grunt and the sighting we wanted. Similarly a human version of the very deep, nasal grunt 'na-where . . . na- where' could also produce a retort from an elusive wildling. This lucky break enabled us to chase down gliders or follow them to their nesting hollows from which they could later be extracted, radio-tagged and followed.

ONE OF THE FIRST REVELATIONS OF THE nightime tracking program was of a remarkable relationship between the gliders and the grasstrees that graced the forest floor. From about May to August when the local gums and mahoganies are setting seed, the grasstree *Xanthorrhoea johnsonii* can be seen in flower. During daytime, the long nectar-laden spikes are visited and fought over by various birds.

This female glider has been fitted with a retrievable radio transmitter that will fall off after a fortnight. Part of the aerial can be seen hanging under her belly.

BRUCE COWELL

Gashes in Pink Bloodwoods are licked and teased by gliders to yield a fiery claret of alcohols and sugars, leaving them with little appetite for much else.

But when night comes and the beads of syrup swell and glisten, Mahogany Gliders leave the tree tops and claim each stem as their own.

In their enraptured licking at the syrup, the gliders can be approached to within a hand's reach before they tear themselves away. This interest in grasstrees, however, is not limited to just the flowering, syrup-rich javelins. In the young, green, tender spikes, Mahogany Gliders sense a liquor worth tapping. After spear-hopping from one grasstree to the next, a glider may climb head-down to the very base of a selected spear, and there among the newest of the spiky leaves, bite a hunk from the base of the stalk. This is followed by a trip to the top where just at the bottom of the flower-head a few more chunks are taken.

The top-and-tail gouging of supple green spikes is purely spadework and akin to the human occupation of grooving maple trunks for syrup. By the following night, an amber mucilaginous jelly will have oozed from the wound like a dribble of oversqueezed toothpaste. And the gliders appear to find this complex bland clag of polymerised and unpolymerised higher alcohols and acids just as luscious as the syrup of the more mature flowers.

This practice may cause some cattlemen to raise their eyebrows, particularly those whose stock may have died from the 'Wamps'—a condition that gets its name from the peculiar sound a dying cow makes when it overbalances and falls on its side to hit the ground, poisoned from eating young green *Xanthorrhoea johnsonii* stalks. Dr David Bedford, a plant taxonomist at the Royal Botanic Gardens Sydney and *Xanthorrhoea* authority (see ANH Winter 1992), is quick to point out the dearth of information available on grasstree toxicology, but adds that in young stalks, some of the known poisons, like phenols and flavinoids, can have devastating effects on mammals. Dr Peter Olrieks of the National Environmental Toxicology Centre in Brisbane has already shown that death can occur in mice soon after being injected with a small amount of *Xanthorrhoea* gum exudate. But just how Mahogany Gliders deal with the toxic cocktail is a matter of ongoing research.

So for those few months when very little else around them blooms, Mahogany Gliders spend about 80 per cent of their foraging time no higher than two metres off the ground, testing, tapping, gumming, licking and leaping among the grasstree spears.

ALL THIS GRASSTREE LOVING, HOWEVER, is not without its spinoffs for the biologist. This is because on every spear that the glider checks, it leaves behind a stamp. Not just on the tapped stalks or on those with mature flowers, but on every one of the current year's blooms visited.

In much the same way that dark-skinned grapes carry a powdery white 'bloom' on their flesh, so to varying degrees do the spears of many species of *Xanthorrhoea*. Around Tully, this chalky sprinkling on the shafts of both mature and very young stalks is particularly heavy and durable . . . as long as it is not touched. Once you brush against it or grab it, the copy book is blotted. So too when a glider climbs and descends a spear its visit is automatically recorded in a series of clear, unambiguous footprints that may last for months.

Viewed under a scanning electron microscope, this 'bloom' appears as a sea of boiling lava, with great bubbling crests and deep pits. In fact, the surface is covered with a waxy substance that may be teased out into long fine filaments, waxy spicules and platelets. When a paw hits the surface, the 'fingerprint' striations that give grip to fist and foot take up much of the wax and, when the paw is lifted, a large negative 'Mahogany footprint' is left. If the animal then jumps to a burnt or dead tree limb after leaving the spear, a series of white positives will shine on the black.

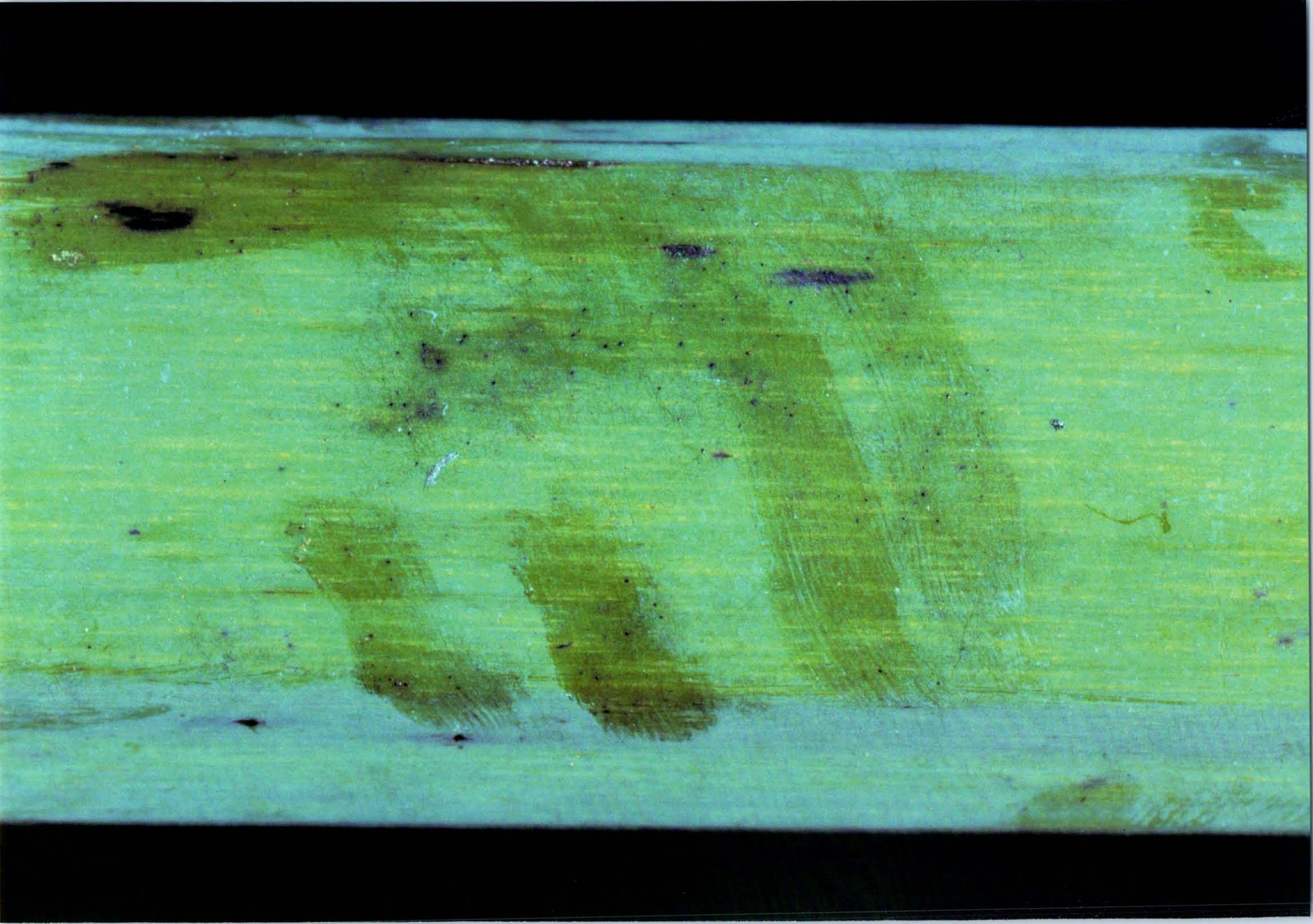
For at least the period of late autumn through winter, the presence of Mahogany Gliders in unsurveyed areas of woodland can now be suspected with some accuracy by an inspection of the local grasstree spears. By August, however, when conditions are very dry and most *Xanthorrhoea* stalks have 'wooded-up' and seeded, there is no free flow of gum even in young stems, and these, along with mature sugary blooms, hold no interest for the gliders who dump them for juicier pastures high up in the outer twigs of large, mature gums.

Here, for weeks on end, at a time when the females are carrying one or two new pouch young, they clamber over the big glossy leaves of the Large-fruited Red Mahogany *(Eucalyptus pellita)*, scraping at the infestations of scale insects *(Eriococcus* sp.) from twigs and leaf veins.

BRUCE COWELL

The flowering stalks of grasstrees note every call made by attentive gliders. Footprints alert researchers to their presence (pictured here are the prints from the front feet). Under the scanning electron microscope, the grasstrees' sticky bloom is revealed.

KYLIE WILLIAMS



Mahogany Gliders occasionally tear into Green Tree Ant nests to eat the occupants. Likewise, tiring glider-watchers on the midnight shift crush and sniff these aromatic insects to stay awake.

KATHIE ATKINSON

Such feasting gives them a mixture of 20 per cent protein, 13 per cent lipids, 55 per cent water and 12 per cent carbohydrate. As the night progresses and the scales exude their sticky honeydew, the gliders lick leaf after leaf, only stopping to flick off the competing Green Tree Ants whose infestation of the trees matches that of the scales. Occasionally, and at considerable personal discomfort, a glider will tear into a Green Tree Ant nest and consume some of the occupants.

When not preoccupied with scales and honeydew, the gliders service their familiar and faithful gashes torn in the outer thumb-thick branches of mature Pink Bloodwoods *(Eucalyptus intermedia)*. These semi-healed gouges are licked and coaxed until the stimulated flow of deep red 'blood' is enough to leave the gliders sitting in a daze of repletion for hours. This bloodwood claret is a very cheeky dry red, impossibly low in protein (1.3 per cent) but with a fiery mix of higher alcohols and complex sugars that leaves them with little appetite for much else.

Such exudate feeding is not limited to bloodwoods, and at other times of the year the main trunks of wattles *(Acacia flavescens, A. crassicarpa* and *A. mangium)* will be gashed for gum as well as gouged for boring grubs. The dependence on wattles, however, culminates in November–December when the seed pods of *Acacia crassicarpa* contort and dry in the searing summer sun. Unlike so many other wattles whose pods burst and fling seed in all directions, this species' thick, woody cases twist open to hang out their flint-hard fruits for all to see. Each of the pod's six or seven seeds are suspended individually along the inside of the open case on a long, thick, coiled spring that lets the seeds clatter in the breeze like a breastful of Anzac Day medals. Female gliders reserve all their efforts for these wattles and spend hours quietly exploring the pods, carefully separating seeds from cases then consuming the thick gummy strings and discarding the seeds. Many acacia gums are known to be high in calcium and these spaghetti-like coilings may be especially important to the females that at this time have young almost ready to leave the nest.

But life is anything but all chewing gum and sweet dreams for the Mahogany Glider. Its need for such a rich mosaic of odd but reliable food sources scattered over a relatively large home range (30 hectares) appears to be unappreciated given the richer mosaic of some local primary producers and land-clearing contractors. At present the Mahogany Glider is not known outside Cardwell–Tully's marginally productive coastal swamps and sand ridges, which are being knocked over and drained for sugar cane and grazed at a rate that almost makes a monkey of environmental awareness. After quietly avoiding us for over a century, heaven help us if this animal slips away now and leaves us with little more than a handful of impressions.■

Suggested Reading

Van Dyck, S., 1991. Raising an old glider's ghost . . . a devil of an exorcise! *Wildl. Aust.* 28(2): 10–13.

Steve Van Dyck is a zoologist with the Queensland Museum. He is grateful to the Australian Research Council for funding this glider research and to all those who helped resolve the small tropical inconveniences associated with it..."in particular Dr Neale Henry who caught Paul's appendix just before it burst, Paul Stumkat himself for carrying me over his shoulder to the hospital, and Dr Jeremy Bartlett whose nose for gas gangrene saved my leg".

WESLEY TOLHURST

The brilliantly plumed Regent Bowerbird is a typical inhabitant of the littoral rainforest.

GEOFF BIDDLE/NPWS

In a slow death-grasp, strangler figs entwine rainforest trees at Iluka.

Littoral rainforest is one of Australia's most poorly understood and least preserved forests.

RAINFORESTS BY THE SEA

BY BRADLEY LAW & MERRILYN LEAN

B. LAW & M. LEAN

In the early morning light, Cabbage-tree Palms are clearly visible in the wind-sheared canopy of this rainforest by the sea.

IF ASKED TO IMAGINE A RAINFOREST, most people would think of the equatorial or tropical kind, with tall, dark, green-leaved trees, drip tips, buttress roots, running streams, steep cool gullies, and perhaps swirling mist. This is what we learned of in geography lessons at school. However there is a poorly known type of rainforest stretching along the coast of New South Wales that does not totally fit this description. Littoral rainforest, as these forests are collectively called, simply means 'rainforest by the sea' and it is one of Australia's most poorly understood and least preserved forests. After working in these forests for the past two years, we became interested in what makes a littoral rainforest. How do they grow and develop in harsh environments characterised by poor sandy soils and salt spray? Our great appreciation for these cool green places with the sound of distant waves crashing and the smell of salt in the air, prompted us to write of their charm and unique nature.

Rainforests can be defined in many ways. They grow in areas of relatively high annual rainfall, and possess a dense closed canopy with a rich diversity of fire-sensitive species and varying numbers of epiphytes and lianas. In New South Wales there are four broad types of rainforests: subtropical, warm temperate, cool temperate and dry. Subtropical rainforests are the most complex of these forests and they are usually found in warm, fertile areas with high annual rainfall. When these forests grow on coastal headlands and sand-dunes they are modified by the continual barrage of salt in sea-breezes and the poor quality of sandy soils. In such areas they are called littoral rainforests. Evidence for a subtropical origin of littoral rainforest stems from the fact that 90 per cent of their tree species appear in subtropical forests, while only 30

TIM LOW

Riberry, one of the dominant plant species in the Iluka rainforest, provides an important food source for many fruit-eating species.

Thick, leathery leaves protect the Coast Banksia from the drying and damaging effects of wind and salt, enabling it to grow on the seaward edge of littoral rainforests.

per cent are found in dry rainforests.

Littoral rainforests are typified by a variety of form. They range from highly complex forests on Fraser Island and northern New South Wales to a more simple form at their southerly extent on the southern coast of New South Wales. Within this range palm forests are a prominent variant. Depressions that form between dunes can create waterlogged conditions that favour the dense growth of either Cabbage-tree Palms *(Livistonia australis)* or Bangalow Palms *(Archontophoenix cunninghamiana)*. The coastal location, however, and thick closed canopies of these forests define them as littoral rainforest.

Although simpler in form, southern littoral rainforests still have a high diversity of tree and shrub species. Epiphytes and ferns are noticeably rarer and often these forests appear as little more than vine thickets growing on exposed beach dunes and headlands. Growing to only a few metres in height, again a closed canopy defines them as rainforest.

More complex littoral rainforests were once widespread on the northern coast of New South Wales. Similar forests can still be found on the great sand island of Fraser Island and they reach their southerly extent at Bundagen, near Coffs Harbour. The Iluka rainforest, covering approximately 90 hectares, is the largest remaining stand of this complex forest in New South Wales. The unique nature of the Iluka stand was recognised with the declaration of the Iluka Nature Reserve as a World Heritage Area. The canopy of this particular forest reaches a height of 23–30 metres, and is dominated by the alliance of Broad-leafed Lilly Pilly *(Acmena hemilampra)* and Riberry *(Syzygium luehmannii)*. The more typical elements of rainforests such as lawyer-vines, strangler figs *(Ficus* spp.), Brush Box *(Lophostemon confertus)* and epiphytic elkhorns, staghorns and bird-nest ferns are also found here. It is truly a special place.

HOW DO RAINFORESTS GROW AND DEVElop in these harsh environments? The extreme coastal location of littoral rainforests gives them their distinctive horizontal rigid canopy. Individual plants that grow on the edge of littoral rainforests are specifically adapted to exposure from salt-laden winds blowing in from the nearby sea. These resilient species give protection against the drying and damaging effects of wind and salt. The Tuckeroo *(Cupaniopsis anacardioides)* and Coast Banksia *(Banksia integrifolia)*, in particular, have thick leathery leaves that form a barrier to protect the more sensitive species of the forest interior. The resulting effect is the typical wind-sheared canopy, which if opened up,

TIM LOW

H. EHMANN

Littoral rainforests provide a haven for the Angle-headed Forest Dragon.

exposes the vulnerable, sheltered species to the harsh conditions of the sea.

Although some littoral rainforests grow on clayey headland soils, the majority of these forests grow in sand that has poor water-retaining abilities and low nutrient levels. However, low levels of surface moisture are not a problem for the vegetation when the watertable is near the ground surface. In addition, constant seabreezes maintain high levels of atmospheric moisture and the salt spray itself adds an abundance of mineral nutrients, such as calcium, phosphorus, potassium and magnesium. Specialised fungi or mycorrhizae, which surround the root systems of many trees, help to improve the uptake and recycling of these nutrients. In fully developed littoral rainforests, organic matter accumulates through litter-fall to form a thin but nutrient-rich surface layer. Littoral rainforests are obviously fragile ecosystems!

Physical barriers are also needed to give protection against spring and summer bushfires, which are usually fanned by fierce westerly winds. The presence of a water body, such as a lagoon, estuary or river, can effectively isolate narrow coastal peninsulas to keep rainforests free from these severe fires. A good example of this occurs at Iluka Nature Reserve, where branches of the Clarence River have provided fire protection for the beautiful Iluka rainforest.

On a walk through this or other littoral rainforests, you might be treated with flashes of colour from the White-eared Monarch *(Monarcha leucotis)*, Eastern Yellow Robin *(Eopsaltria australis)*, or Lewin's Honeyeater *(Meliphaga lewinii)*. You may be entertained by the antics of

the brilliantly plumed Satin and Regent Bowerbirds *(Ptilonorhynchus violaceus* and *Sericulus chrysocephalus)*, and the Spangled Drongo *(Dicrurus hottentottus)*. Some birds, such as the Noisy Pitta *(Pitta versicolor)*, are migratory and use the forest as an over-wintering area before breeding at higher altitudes. The abundance of fruit, especially figs, provide a keystone food resource for fruit-eating pigeons, such as the Wonga and Wompoo Pigeons *(Leucosarcia melanoleuca* and *Ptilinopus magnificus)*. Fruits tend to ripen earlier in these coastal areas compared to rainforests at cooler altitudes and latitudes. In conjunction with the cooler areas, littoral rainforests are crucial for providing a continuous food supply to fruit-eating species.

It is not only birds that you will discover in the rainforest. Reptiles, such as the Angle-headed Forest Dragon *(Hypsilurus spinipes)* and one of the world's largest skinks–the Land Mullet *(Egernia major)*–regularly scuttle through the leaf litter. By night this special forest takes on a different atmosphere. At certain times of the year ghost-like luminescent fungi signal to forest mammals that might be potential spore dispersers. With a powerful spotlight many of the nocturnal animals, such as the Dusky Antechinus *(Antechinus swainsonii)*, Long-nosed Bandicoot *(Perameles nasuta)*, Carpet Python *(Morelia spilota)* and Golden-crowned Snake *(Cacophis squamulosis)*, can be seen, but beware of the ticks, leeches and mosquitoes. Small long-eared bats *(Nyctophilus* spp.), weighing only nine grams, flit along the rainforest paths using echolocation on their frenzied search for insect prey. Up in the canopy, flying-foxes squabble over pungent smelling fruit and blossom. As flying-foxes regularly fly over vast areas of New South Wales in a never-ending search for food, littoral rainforests may serve as important staging posts.

Another species of bat that requires a littoral rainforest home is the Blossom Bat *(Syconycteris australis)*. This cryptic mouse-sized member of the flying-fox family has a specialised diet of nectar and pollen, which necessitates it feeding in areas of prolific flowering. In northern Australia and New Guinea this usually takes place in dense tropical rainforests, however in New South Wales, coastal heathland is the primary producer of nectar and pollen. This presents a problem to Blossom Bats because their tropical origin appears to have left them with a requirement to roost in cool and moist areas during the day.

By radiotracking Blossom Bats caught feeding in heathlands we have been able to show that they roost solitarily in rainforest foliage, often only a few metres above the ground. Littoral rainforests therefore appear to be their preferred roosting habitat in New South Wales. This

By night this special forest takes on a different atmosphere.

M. & I. MORCOMBE

Lewin's Honeyeater.

KEN GRIFFITHS

One of the world's largest skinks, the Land Mullet, is found in littoral rainforests.

B. LAW & M. LEAN

The tiny Blossom Bat roosts by day in the foliage of littoral rainforest trees. Their highly specialised diet of nectar and pollen is obtained from nearby heathlands.

is probably because littoral rainforests provide the moist and thermally buffered conditions that most bats require, while being situated in close proximity to the prime heathland feeding areas of Blossom Bats. This demonstrates an important point for conservation—the interrelationships of different habitats. For the Blossom Bat in New South Wales, conservation of both coastal heath and littoral rainforests are essential.

ONLY 100 YEARS AGO LITTORAL RAINforests and thickets stretched almost continuously along the eastern coast of Australia. These have been dramatically reduced and fragmented by extensive coastal development and sandmining. Despite the difficulty in estimating the status of our remaining littoral rainforests, a meagre 8.4 per cent (1,200 hectares) of the original area of littoral rainforests may be all that is left. Of this Alex Floyd, a forestry scientist, estimated in 1990 that only 58.3 per cent is protected in reserves (including forestry reserves), while a huge 41.7 per cent is thought to be left on private property. Although the New South Wales Government has implemented an environmental planning policy to protect littoral rainforests, the effectiveness of this policy has yet to be tested.

Further protection is urgently needed as development continues, while those that are protected currently face danger from weeds, such as Bitou Bush *(Chrysanthemoides monilifera)*, Lantana *(Lantana camara)* and asparagus ferns *(Protasparagus* spp.)

Asparagus and Lantana, both native to South America, are well established in many littoral rainforest areas. Their habit of climbing and smothering poses serious threats to rainforest species. Bitou Bush is the extreme case, as it is a prolific seeder and it vigorously climbs over just about any vegetation. Originally introduced from South Africa to stabilise dunes after sandmining, it is now rampant over much of the northern coast of New South Wales, smothering heathland and attacking the edges of littoral rainforest alike. Not only are established trees killed, but germination and recruitment of seedlings is severely hindered and in some cases totally inhibited.

Public money seems to be unavailable to fund the extensive revegetation required to rid littoral rainforests of this weed infestation, and so community involvement may be one way to run these labour-intensive programs. This has already proved to be a successful strategy. At Brunswick Heads, local residents worked together to successfully remove weeds and fill canopy gaps without the forest suffering excessive damage from sea-breezes. Dune work is very difficult, as it is necessary to avoid the destabilisation of the sand-dunes during weed removal, but it can be done. In the case of Bitou, removal by weeding from the rainforest edge towards the dune, with subsequent planting of salt-tolerant acacias and banksias, proves most successful (see also Wingham Brush article, ANH Winter 1990 for details on the problems associated with regeneration of rainforests).

Why should we bother conserving such rainforests? For one thing, they remain the last stronghold for many rare and endangered plants, many of which are found on private land. The Scented Acronychia *(Acronychia littoralis)* is one such example. It is a small tree confined to the littoral rainforests of northern New South Wales. These trees are currently inadequately reserved, with the largest stand of only about 30 individuals occurring on private land. A recent vegetation survey at Broken Head Nature Reserve indicated that some patches of littoral rainforests contained up to 13 species of plants listed nationally as either endangered, vulnerable or rare. These forests are also significant faunal refuge areas for migratory and nomadic birds, and other animals such as the Blossom Bat. Little research has been carried out in littoral rainforests, so it is difficult to predict the full range of species that may fully or partially depend on these forests.

Despite our poor understanding, littoral rainforests are a distinctive community type and its limited occurrence makes it of significant scientific, educational and aesthetic value. Without adequate protection, management and rehabilitation, the quality of our remaining areas will quickly diminish. Like so many areas of our natural heritage, it is something that needs immediate help. Without it, our descendants may not be able to enjoy a quiet stroll through rainforest by the sea.■

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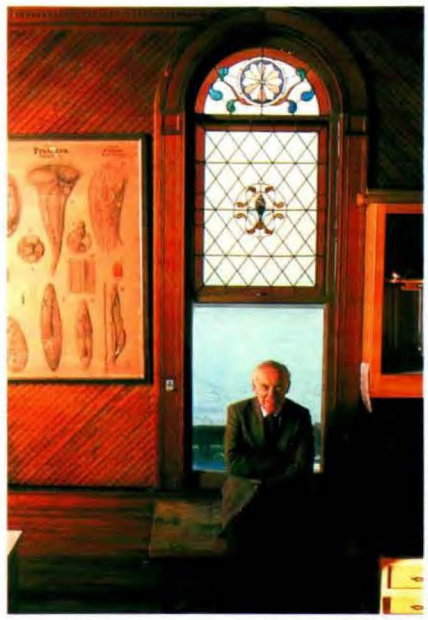
Bradley Law is currently researching his Ph.D. in the Zoology Department of the University of Sydney, studying the ecology of Blossom Bats in New South Wales. Merrilyn Lean is a science teacher in Sydney, with a strong interest in wildlife and the environment.

LENNART NILLSON

Learning that one is likely to become schizophrenic or develop heart disease may cause sufficient anxiety to induce the very condition you're trying to prevent.



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James Watson originally headed the human genome project.

THE POLITICS OF THE HUMAN GENOME

BY JOHN MERSON

IN JANUARY 1990 THE NATIONAL INSTITUTE OF Health in Washington opened the doors of its National Institute for Human Genome Research. Initially headed by Dr Jim Watson, Director of the Cold Spring Harbour Laboratories in New York, this $3 billion venture has been described as biology's Manhattan Project. Its extraordinarily ambitious goal is to map and sequence the three billion nucleotide bases that form the strings of DNA in the 100,000 genes of the human genome. Over a 15-year period, scientists from around the world intend to create a functional map that will document the DNA code and hopefully clarify its role in governing our physical and mental character. More importantly perhaps, there is the hope that from this knowledge we will be better able to treat the 4,000 known genetic diseases, as well as a whole range of ailments that have a genetic component, ranging from Alzheimer's disease and schizophrenia to heart disease and cancer.

The project enthusiasts assure us that in the future it will be possible to identify, from genetic screening carried out at birth, those who are likely to fall victim to a wide range of ailments and to take appropriate preventative action. However, the inappropriate use of such information raises profound legal and ethical issues. It is for this reason that three to five per cent of the Human Genome Project's $3 billion budget is being spent on examining

The project to map the human genome may provide insight into a child's medical destiny before it is even born.

social implications of how this new genetic information might be used.

The idea of mapping and sequencing of an entire genome was first proposed in 1963 by Sydney Brenner at the Molecular Genetics Unit, Cambridge University. At the time Brenner was working on the genetics of the nematode—a tiny worm measuring less than a millimetre in length. One attraction of the nematode is that it only has six chromosomes, 959 genes and around 100,000 nucleotide bases. However, despite these advantages the technical problem of sequencing the DNA of even the tiniest of creatures was not to be overcome until the mid 1970s, and Brenner did not get his program with the nematode started until the mid 1980s.

The Human Genome Project was the brainchild of Robert Sinsheimer of the University of California, Santa Barbara, and Renarto Dulbecco of the Salk Institute of Biological Studies, California. In 1984 they proposed an institute to sequence the human genome and to produce a map for researchers exploring biology's last great frontier. They began to lobby and soon found an ally in the US Department of Energy, which was responsible for monitoring nuclear power stations and therefore the genetic defects associated with radiation exposure. The next supporter was the National Institute of Health (NIH). With the backing of these two powerful ministries, Sinsheimer and Dulbecco were able to get the approval of the Congressional Office of Technology Assessment and eventually to win the support of Congress itself.

GETTING THE PROJECT OFF THE GROUND was one thing, but it was quite another to overcome the technical and organisational obstacles of meeting the 15-year deadline. The task was made increasingly difficult by continued criticism from some leading biological researchers who saw it as an inappropriate allocation of much-needed funds for biomedical research. They believed that the money would be better directed to other areas of biology such as cures for genetic diseases whose genes were already known and sequenced. Nevertheless the project is going ahead, with Britain, France and Japan having developed their own human genome programs. There is no coordinated program in Australia however; the major

Dr Peter Lichter mapping DNA fragments from human chromosome 11 at Yale University Medical School.

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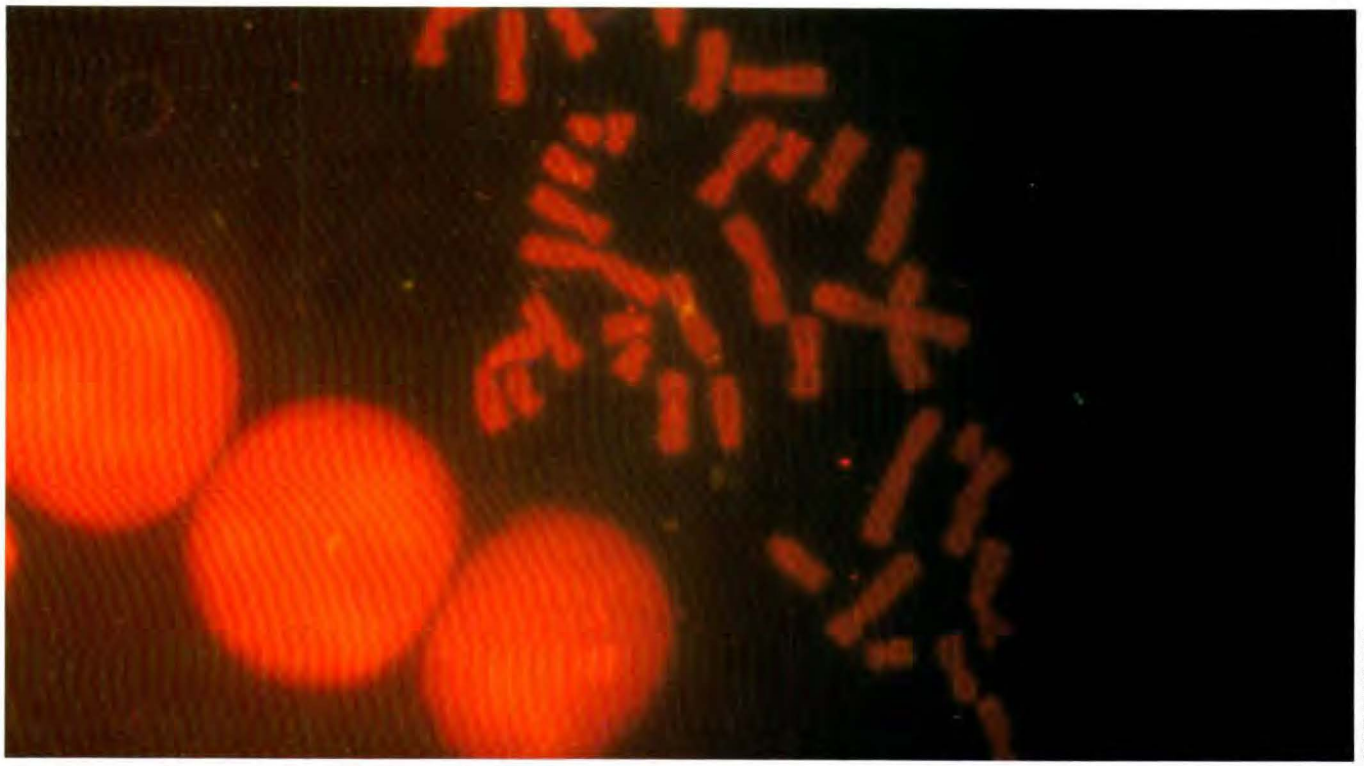

GRANT SUTHERLAND

Fragile X is arguably one of the world's most common genetic diseases. An Australian team cloned the gene in 1991 and found a unique genetic mechanism that may help explain a number of other misunderstood genetic diseases. The central yellow marker is attached to the X chromosome, the bottom marker indicates its 'fragile' point.

genome research group in this country is led by Grant Sutherland at the Adelaide Children's Hospital, receiving most of its funding for the mapping of human chromosome 16 from the US Department of Energy.

Horace Judson, a science historian from Stanford University, was consulted by the Office of Technology Assessment about the Human Genome Project. He believes that there is a basic conceptual problem in trying to make single functional maps of the human genome. Judson gave the analogy of common land maps we use to find our way about the countryside. If we are going across country, we require relief maps showing the terrain. On the other hand, if we are trying to find the best train route from Sydney to Cobar, or we are wanting to sail up the coast from Melbourne to Sydney, we would want very different details from what we would find on a road map. This is particularly relevant if one takes into account Brenner's argument that perhaps as little as two per cent of the information coded by our DNA is of any immediate importance to researchers. The rest, he argues, is 'genetic junk'. Brenner wants to see research grow out of a 'needs to know' basis. By contrast, Jim Watson, in defence of the broad vision of the Human Genome Project, describes it as biology's equivalent to NASA's moon project, "however in this case the whole of humanity will benefit". It all comes down to differing priorities of how limited research dollars, in biology and genetics in particular, should be spent.

Alongside the critics there are many eminent researchers who believe that important benefits will flow due to the sheer scope of the project. Francis Collins from the University of Michigan is one of the leading genetic sleuths in the US and defends the Human Genome Project on the grounds that the international concentration of effort will provide the critical mass of research needed for major breakthroughs in medical genetics, and unnecessary duplication can be avoided. Collins used his revolutionary technique called 'chromosome jumping' to locate the gene that codes for one of the most common and debilitating genetic diseases, cystic fibrosis. But just what are the medical benefits that can be expected to flow from this $3 billion Human Genome Project?

THERE A NUMBER OF GENETIC EVENTS for which the molecular basis is either unknown or poorly understood, and cannot be explained by classic genetic mechanisms. One such case is the Fragile X syndrome, the most common cause of familial mental retardation, affecting approximately one in every 2,500 children. Grant Sutherland's group at the Adelaide Children's Hospital cloned Fragile X in 1991, and found the condition to be due to a unique genetic mechanism that could possibly explain a number of previously ill-understood genetic phenomena. In addition, accurate prenatal diagnosis of the syndrome is now possible by direct detection of the unstable DNA sequence responsible for this condition. The gene for a muscle disorder known as myotonic dystrophy (DM), which is on chromosome 19, has also recently been isolated by scientists in Wales, Holland and the USA. The interesting aspect of this is that the DM mutation is of the same type as that in Fragile X syndrome, a heritable unstable DNA sequence. Now two genetic diseases are known to be due to this newly discovered mechanism of mutation. How many more surprises does the genome project have in store for us con-

cerning the way our genetic material functions and malfunctions?

It has become evident that, where the genetic component of diseases can be isolated, more effective methods of treatment may emerge. Take for example phenylketonuria, a recessive condition in which a double dose of a gene inhibits a baby's capacity to metabolise a specific amino acid. Accumulation of this amino acid in the blood leads to a toxic effect that can produce brain damage in the infant. However, with this knowledge and a program for screening for the condition at birth, it is possible to identify babies with the condition and, by restricting their diet to food that does not contain the specific amino acid, the children can grow up to live a perfectly normal life. It is a simple and elegant success story in applying genetic knowledge, and points toward a new form of preventative medicine.

Many enthusiasts for genetic screening see a time when it will be possible to identify from a child's genetic profile a much wider range of ailments that may be corrected or treated at an early stage.

Many were denied insurance and even employment on the basis of a misplaced assumption that they would become a liability.

However it is here that the Human Genome Project hits a tricky ethical dilemma: it's one thing to provide insight into a child's likely medical destiny, but there may be little or nothing that can be done about a condition. In such cases, knowledge could be worse than ignorance. Learning that one is likely to become schizophrenic or develop heart disease may cause sufficient anxiety to induce the very condition you're trying to prevent. Take the case of Professor Nancy Wexler in the Department of Neurology and Psychiatry at Colombia University. Wexler is from a family that has Huntington's Chorea, a debilitating degenerative genetic condition that has no known cure. She has a 50 per cent chance of being a carrier of the gene and, even if she is, there is no certainty at what stage the symptoms will begin to show up. Wexler is adamant that she doesn't want to know. She argues that, because increased clumsiness is one of the first symptoms, every time she simply knocked over a glass she may think of it as a sign of the disease. Life may be made intolerable by the constant threat of the disease for which there is no effective treatment.

It's a dilemma that gene therapists such as Francis Collins confront constantly, and there is growing debate about the issue of disclosure. The gene that causes cystic fibrosis (CFTR) has been known since 1989, yet we are still a long way from finding a cure for the disease. Collins' team at Michigan, along with collaborators in Toronto, have successfully implanted a normal CFTR gene into a cultured cell from a cystic fibrosis patient. In the laboratory they were able to repair the malfunction that inhibits the flow of chloride ions across cell membranes. However, as Collins is well aware, it is a considerable step from the laboratory to making such changes work in a real patient. Research is now underway to see if a virus can be used to transport normal CFTR genes to cystic fibrosis patients by inhaling the virus via an aerosol.

This method of 'gene replacement therapy', where a viral vector is used to transport a normal gene into a cell where there is a defective gene, is one of the most promising treatments being explored. A virus, as we know all too tragically in the case of HIV, is able to penetrate the protective armour of the cell. A viral vector works by losing its capacity to transmit a disease while retaining its capacity to penetrate the cell. So it simply transports the desired normal gene attached to the virus to the targeted cell. If this technique can be perfected, it should be possible in the longer term to apply the knowledge acquired through the Human Genome Project to prevent the onset of well-known genetic conditions. The problem is that many genes serve more than one function. Take the gene that in a double dose (one from each parent) results in sickle cell anaemia.

Sickle cell anaemia is a condition that affects the functioning of red blood cells, which collapse under stress into a sickle shape, hence the name. The disease also undermines the ability of the haemoglobin in the blood to take up oxygen. It is a very debilitating condition and one might assume that through natural selection there would be few carriers of the single sickle cell gene. Not so: the sickle cell gene is very common among people from the Middle East, Africa and Asia. The simple reason is that the single gene provides a person with greater resistance to malaria. The same phenomenon applies to diabetes: carriers of the cluster of genes associated with this condition are more able to cope with sustained periods of famine. It is for this reason that the medical

Highly specialised sequencing machines are used to 'read' genetic information.

profession has universally condemned 'germ line therapy', where changes are made to the genetic information in the chromosomes passed on to one's offspring. Where there is an obvious genetic cause for an illness, such as Huntington's Chorea or cystic fibrosis, there would be an obvious temptation to eliminate these dreadful afflictions from the lot of future generations. The problem is, where does one stop? While it is possible to eliminate undesirable genetic characteristics, it may be equally possible to improve desirable ones such as greater intelligence. This viewing of the gene as the primary cause and therefore solution of ill health has been described by some critics of the Human Genome Project as being dangerously 'reductionist'. This is another reason why five per cent of the Human Genome Project's budget is being spent on examining the legal and ethical issues that will flow from the application of this knowledge.

CLEARLY THESE ETHICAL AND LEGAL issues are not just medical but take in the broader social consequences of how this new genetic knowledge might be used. Take for instance what happened when screening for sickle cell anaemia first began in the US. In 1969, four black American servicemen with sickle cell anaemia died. They were otherwise healthy soldiers who had not been diagnosed as suffering from the condition. It was only during a high-altitude training exercise that the haemoglobin in their blood was unable to provide sufficient oxygen and their condition was revealed. This event led to genetic testing in the army and soon became a widespread practice outside the services. However public understanding of the condition was such that, in many cases, carriers of the single sickle cell trait were to become the innocent victims of quite prejudicial treatment (only those with a double dose of the gene have any problems—among the black community, carriers are quite common). Many were denied insurance and even employment, on the basis of a misplaced assumption that they would fall sick or in some way become a liability. In Greece a similar phenomenon occurred when screening was introduced to identify the carriers of Thalassemia. The goal was to identify couples at risk. However families that were carriers of the single gene were soon being stigmatised. Concern about genetic information on the part of employers and insurance companies is understandable. By 1970 a large number of genetic disorders had been identified as predisposing some people to adversely react to toxic substances in the workplace. With increased litigation, employers have been concerned to screen out people who might prove to be unduly vulnerable. In the US, there are now 40 different medical tests that are carried out

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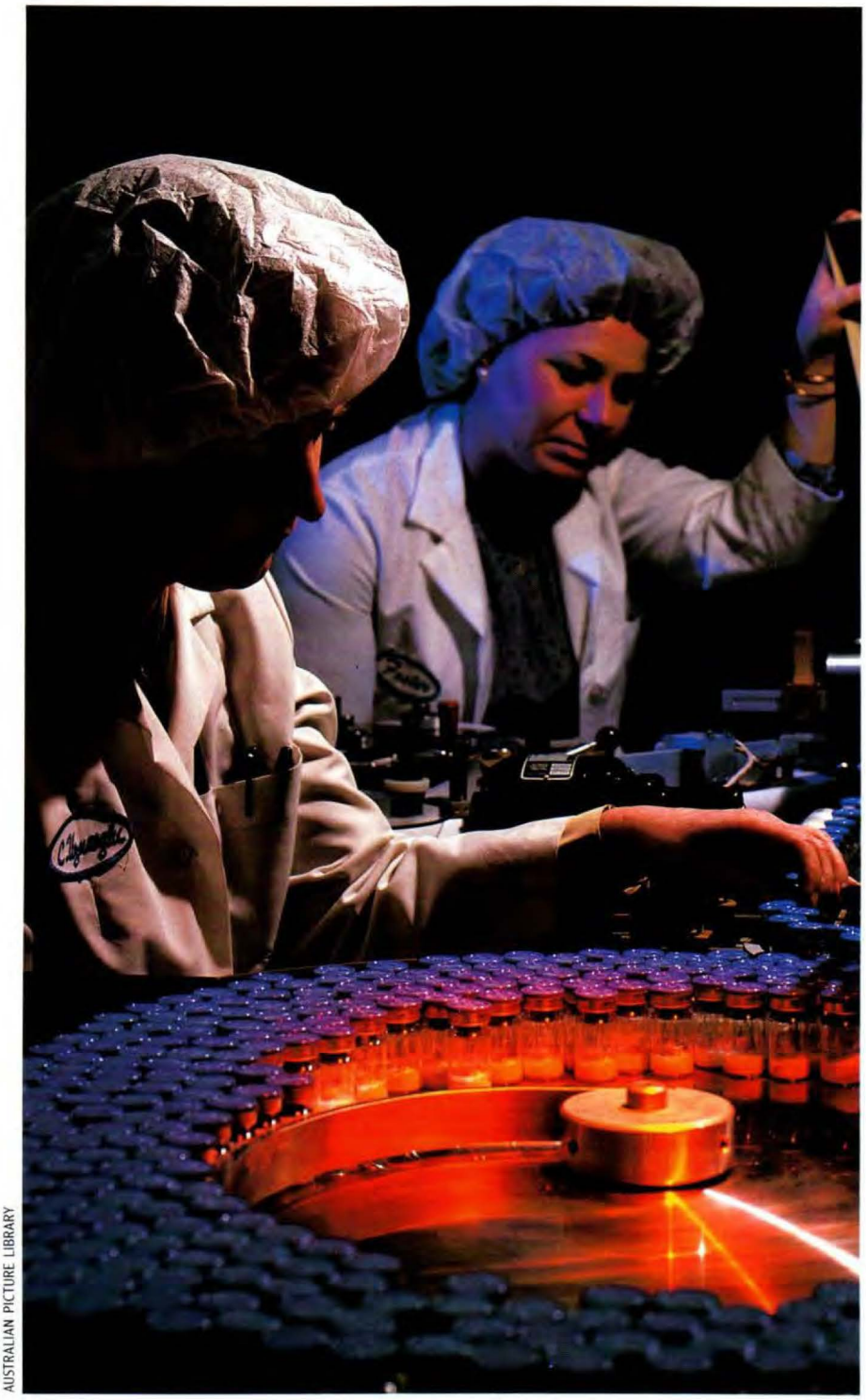

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Technicians bottling medications made through genetic engineering.

to try to determine the suitability of an employee, and a similar battery of tests are increasingly required to take out medical and life insurance, especially in the wake of the HIV epidemic. However, given the complexity of genetic data and its interpretation, there are very great dangers of abuse where genetic screening is used.

The legal and ethical issue that arises here is simply this: what right does the individual have over who has access to his or her genetic information? It is at present a criminal offence to withhold or misrepresent medical information when taking out health or life insurance. If genetic screening is introduced to help improve health services, particularly in areas where preventative action can be taken (as in the case of phenylketonuria), then this issue must be resolved. Unfortunately our legal institutions usually lag behind in responding to developments in science and technology. However, in the case of the Human Genome Project, there is both the opportunity for a broad public debate into the costs and benefits of genetic screening and gene therapy, and the opportunity for our legislative institutions to be slightly more pro-active and show some leadership and foresight in this matter. Over the next decade, as genetic screening becomes more common and our understanding of the link between genes, ailments and human behaviour increases, we will be confronted with some difficult ethical choices.

It is to the credit of Jim Watson and his committee that, for the first time in such a major scientific endeavour as the Human Genome Project, money has been set aside at the outset to address the social and ethical consequences of the research. ■

The legal and ethical issue that arises here is simply this: what right does the individual have over who has access to his or her genetic information?

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John Merson is a Senior Lecturer in the School of Science and Technology Studies at the University of New South Wales and a member of the ABC Science Unit.

Jim's new lens creates startling effects. A monstrous mantis sits next to Densey Clyne.

A giant mosquito attacks Jim's finger.

Blowfly on the screen door.

LARGE AS LIFE

BY JIM FRAZIER

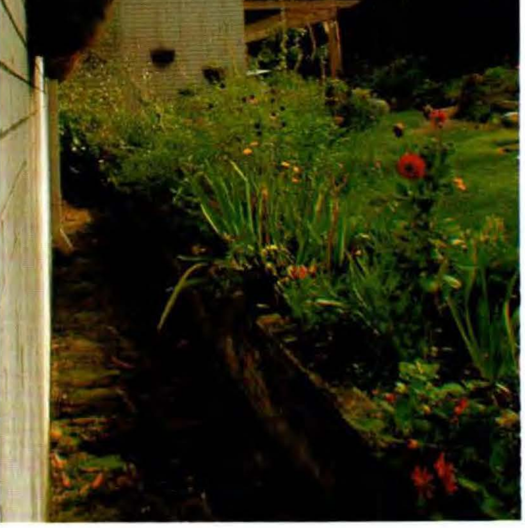
FOR MANY YEARS NOW I HAVE HAD A DEEP passion to record on film animals large and small—especially small—in their environment. The way to achieve this, I felt, was by way of a deep focus system that avoids the distortion of wide-angle lenses and also enables extreme depth of field.

I started fiddling about with optics in the late 1970s while filming wildlife for television, and finally built several systems for achieving what I had in mind. My use of these gathered some notoriety in David Attenborough's "Trials of Life" series.

However, devising optics for 16-millimetre film is a different matter to making optics work for 35-millimetre still film, which is four times larger. What I have come up with for this format is by no means perfect, and all the lenses without exception have faults in them, as you may see in some of the photographs.

The lenses are still prototypes at this stage. Further refinements can only be achieved with proper computer design. Meanwhile I continue with my 'fiddling', with perfection my ultimate goal.

Southern Leaf-tailed Gecko.



Wildlife author and photographer Densey Clyne shrinks behind this moth caterpillar.

LARGE AS LIFE

Huntsman spider on the garage door.

A gecko the size of a house?

A caterpillar dwarfs surrounding trees.

Joe offered the San Paolo Museum 600 longicorn beetles in exchange for a single rare beetle specimen.

THE BEETLE COLLECTOR: A DETECTIVE STORY

BY GEORGE HANGAY

THE COLLECTOR'S ELUSIVE TROPHY is not necessarily rare in the scientific sense. Of the world's 350,000 known beetle species, a few rare and curious specimens have been 'romanticised' into legendary status by a passionate and dedicated type of detective: the beetle collector.

One such 'trophy' beetle is the fabled *Titanus giganteus*, a longicorn beetle that can reach over 200 millimetres in length; possibly the largest beetle on Earth. Although described by Linnaeus in 1771, only a few specimens could be found in collections. In 1914 a perfect specimen fetched 2,000 gold marks, and until the late 1930s only about 30 specimens were known. Most of these were found dead, either washed up on the shores of the Rio Negro in Brazil, or taken from the stomach of a large fish in the same river.

As a budding beetle collector, this mysterious creature was the subject of my childhood fantasies. In 1958, when mercury vapour lights were introduced as street lamps in some remote Brazilian jungle-towns, the strong UV component of these attracted longicorn beetles. Among these were some *Titanus giganteus*, making them a little less rare in collections.

However, I still had to wait another 33 years before I could obtain one for my own collection, through exchange with a Peruvian monk. Even today the beetle is not easy to find and Brother Rosario risked his life travelling through country infested by bandits in order to obtain mine.

Beetle collectors often go to extremes to obtain a specimen. Joe Sedlacek, the doyen of beetle collectors in Australia, told me about another longicorn *(Macrodontia cervicornis)* he had come across that was about 20 millimetres larger than the largest-known *Titanus!* Having seen it pinned on the wall of a Brazilian collector's house, Joe offered the San Paolo Museum 600 species of longicorn beetles in exchange for that single specimen. Museum scientists rushed off to get the beetle but only to find the collector had since passed away and the giant *Macrodontia* gone!

In the last decades of the 19th century, British collectors chartered fast-steamers to meet East Indian clippers out on the ocean in order to be the first to see the beetles brought back by sailors from the Far East. Bargaining started on boarding and deals were clinched by the time the clippers arrived into harbour.

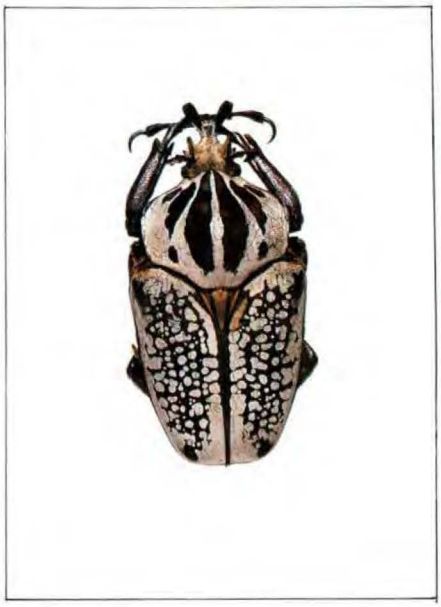
The beetle collector's ultimate trophy: *Titanus giganteus*, at up to 20 centimetres in length, is allegedly the world's largest beetle.

The cunning of beetle collectors is without limit; there is a saying that every serious collector is a potential thief. Our sceptical collection manager took note when an avid work experience student worked through his breaks when no-one was around. A secret inspection of the student's bag revealed the budding collector's good taste: inside was a very handsome and rare goliath beetle *(Goliathus goliathus orientalis)*. He'd pinned the beetle in a small insect box before squirelling it away. Nothing was said but we watched with great interest when our friend took leave, clutching his bag lovingly. If only we could have seen his face as he opened his little box later on to find 'his' beautiful beetle missing! Of course dishonest enthusiasts soon find their reputation excludes them from access to all channels for futhering this hobby, as several collectors have found in the past.

Beetle collectors also have astutely honed observation skills. On a trip to Paris in 1990, I was strolling down Rue de Bac, a narrow street jam-packed with expensive shops, when a sign that simply read 'Deyrolle' caught my eye. Instantly I was plunged into an imaginary journey into the Malaysian rainforests, where the particularly handsome stagbeetle *Hexarthrius deyrollei* lives. This beetle was named after the French explorer Deyrolle who, in 1830, established a taxidermist–naturalist–curio business in Paris and whose name became a legend in naturalist circles.

When I came to, I wondered—could this sign refer to the same Deyrolle? Through the window I saw familiar things: butterfly nets, pinning boards and other paraphernalia of the naturalist. It was that Deyrolle! The 18th-century walls, lined with the traditional Deyrolle turquoise panels, and polished parquetry floor harked back to bygone days. The shop's contents were a collector's dream. Stuffed puffer fishes, desiccated seahorses, rare exotic birds, carefully coiffured circus monkeys, and mounted cats lounging after mounted pigeons, frozen in an eternal chase. At the back, dozens of large cocoons hung from

PHOTOS: CARL BENTO / AUSTRALIAN MUSEUM



a clothes line: pupae of the world's largest moths awaiting their re-birth through metamorphosis, to be followed by a new 'life' as mounted specimens. Above me, on another clothes line, a trio of fully articulated human skeletons dangled while I chatted with the shop assistant.

He echoed my own sentiments: time had changed and the days of amateur collecting and taxidermy were nearly over. Only in the twelfth hour have we begun to understand that living creatures are more important than dead ones. Little has changed at Deyrolle's, the assistant reassured me, except that there is no longer a flow of new specimens.

Dozens of large cocoons hung from a clothes line.

"But we still have great rarities here, Monsieur!" he smiles as he pulls out another drawer. For a moment I forgot to breathe. In front of me were the treasures of the Orient, the most spectacular assemblage of stagbeetles from the Far East. The old-fashioned handwriting on the labels revealed they were collected at the turn of the century or earlier. Old beetle specimens have a 'nice' feel about them, stagbeetles especially. Their wing covers resemble matured wood of old string instruments. I feasted my eyes on these rarely seen stags, the fabled Golden Stag *(Allotopus moseri)*, the many different species of *Odontolabis*, and a magnificent specimen of *Phalacrognathus muelleri*, the beautiful metallic bronzy green insect that was labelled by Keith McKeown in his *Australian insects* (1945) as "the finest of all the Australian stagbeetles". And of course there were truly beautiful specimens of *Hexarthrius deyrollei*. Many of these beetles were excellent examples of their species–large specimens with well-developed 'antlers' and, despite their age, good full colours.

Could *Macrodontia cervicornis* (far left) contend for the title of world's largest beetle? At left is the goliath beetle *Goliath goliathus* from Africa and above is Deyrolle's Stagbeetle.

It would be difficult today to find better stagbeetle specimens or even match those in the Deyrolle collection. Why? Did all those eager collectors pick the best out of many generations of beetles, thus 'degenerating' the species? Nonsense! It would be difficult to find a proven case where a particular species of beetle was 'degenerated' or exterminated by collectors. Changes in the environment, especially those introduced by human activities (indiscriminate logging, burning, pollution and 'high-tech' agriculture) are to blame. *Lucanus cervus*, the largest European beetle, for instance, became extremely endangered when its food plant, the oak, became a valuable timber. Diligent forestry workers removed the old, decayed trees from the forest, without which *L. cervus* cannot breed, and this once-common stagbeetle is now a rarity in many areas.

But change is afoot and perhaps as beetle collectors we can continue to pursue our hobby, using our exceptional powers of observation and rat cunning to study and more fully understand the creatures that so elude our grasp. It would be nice to be fascinated by the living organisms rather than seek more objects to pin in our collections. Like the big game hunters, collectors can change their tack a little to continue our speciality as observers and discoverers. ■

Suggested Reading

Klausnitzer, B., 1983. *Beetles.* Exeter Books: New York.

McKeown, K.C., 1945. *Australian insects.* Royal Zoological Society: Sydney.

Weng-Yew Fung, V., 1983. *Common Malaysian beetles.* Longman Malaysia: Sdn Berhad Kuala Lumpur.

George Hangay is a Project Manager at the Australian Museum. Although not a zoologist by profession, he is keenly interested in beetles. He has added over 10,000 specimens to the Museum's collections.

QUESTIONS & ANSWERS

COMPILED BY
JENNIFER SAUNDERS

J. LOCHMAN / NPIAN

Identifying Funnel-webs

Q. During recent extensions to our home, we have unearthed a number of unpleasant-looking spiders and I am concerned that they may be funnel-webs. Is there any information you can give me that would enable me to identify whether they are in fact funnel-webs?

—B. Meecham
Hornsby, NSW.

A. Your spider has to meet the following points if it is indeed a Sydney Funnel-web Spider. Failure to meet all these points indicates that it is not a Sydney Funnel-web. (When trying to identify your spider, please refer to the illustration.)

1. Is it a large dark spider with a shiny black or brown head and legs (that is, does it have a high-gloss finish)?
2. Do the spinnerets (silk-spinning organs) project like little fingers from the back of the abdomen? (If they are only short and stubby, they do not qualify.)
3. Does it have a spur (shaped like a rose thorn) on the second long leg from the front? (This is for the male spiders only.)

If your spider meets both points one and two, then there is a high probability that you have a female or juvenile Sydney Funnel-web. However, no deaths have ever occurred from female or juvenile Sydney Funnel-web bites. If your spider meets all three points, in particular the third point, then you have a male Sydney Funnel-web. As it is the male Sydney Funnel-webs that are the most dangerous, you may wish to dispose of it. To do this, you can either bring it into The Australian Museum or, if you prefer, place it in a jar in your freezer for 30 minutes.

—Mike Gray &
Christine Horseman
Australian Museum

MIKE GRAY / AUSTRALIAN MUSEUM

Sydney Funnel-web Spider.

Frogmouth or Owl

Q. Are Tawny Frogmouths members of the owl family?

—L. Barton
Mona Vale, NSW

A. Frogmouths are sometimes called 'frogmouth owls' but, although they have a superficial similarity to owls, they are only remotely related to them. The confusion probably arises from the fact that owls and frogmouths do share several characteristics that contribute to the outward appearance of a close relationship. Both groups are nocturnal, feed on prey that is captured by being pounced on from a perch or on the wing, and have large forward-facing eyes to assist in searching for food in dark conditions. Upright postures when perched, further contribute to their apparent likeness.

However, a closer examination reveals numerous differences. Many of these are features of the skeleton or soft anatomy and so are not readily obvious to the casual observer. Two striking external differences between owls and frogmouths are the feet and the bill. The feet of owls are strong and armed with powerfully developed talons, serving as the primary weapon for capturing and killing prey. The feet of frogmouths, in contrast, are weak, with small blunt claws. They are useless for capturing prey and can do little more than assist with perching. An owl kills and tears apart its prey with its bill, which is narrow and hooked. The name frogmouth comes from its heavy broad bill. This bird uses the bill to grasp prey,

The Tawny Frogmouth.

killing it by crushing it against the hard bony palate.

Owls are placed in the order Strigiformes, whereas the frogmouths belong to the order Caprimulgiformes. Included in this order are the nightjars, owlet-nightjars, potoos and oilbirds. Frogmouths comprise the family Podargidae and there are three species in the genus *Podargus*, found only in Australia and New Guinea; the Tawny Frogmouth *P. strigoides* is the best known of these. Another genus *Batrachostomus*, the eared frogmouths, consists of 11 smaller and often poorly known species. However, recent research suggests that these should be placed in a separate family from our frogmouths.

Another area of confusion between frogmouths and owls is the use of the name 'mopoke'. This is applied to both the Tawny Frogmouth and Boobook Owl *(Ninox novaeseelandiae)*, but properly should be restricted to the latter. The name is derived from the Boobook's two-note call, commonly written as 'boobook', 'mopoke' or, in New Zealand, 'morepork'. The call of the frogmouth is a booming 'oom', repeated in series.

—Walter Boles
Australian Museum

Cat Food Creature

Q. I recently found a strange-shaped creature in a can of cat food. It was identified as a parasitic isopod. Can you please tell me what an isopod is and would it be harmful to a cat or dog?

—J. Sommerfield
Bowraville, NSW

A. An isopod is a small crustacean that has seven pairs of similar walking legs and lacks a carapace attached to the head. Many isopods also have a broad flat body and five pairs of broad swimming legs on the rear of the body. Isopods are a widespread group that include such different things as the woodlice in your garden, bizarre little monsters that dominate the deep-sea floor, and the small parasites that you found in the tin. Assuming your cat was eating something like canned tuna or mackerel, the specimen in your cat food may be a member of the isopod family Cymothoidae, which includes only external parasites on fish. Some species of cymothoids, for example the genus *Nerocilia*, can attach themselves to fast-swimming hosts like mackerel. Referring to the old adage "you are what you eat", the isopod is likely to have the same nutritional value as the rest of the cat food, so I doubt whether it would cause any harm to your pet be it cat or dog if eaten. However, if your cat is finicky like mine, it will probably smear the odd bit over the kitchen floor and then leave the mess as a way of asserting cathood's dominance over us mortal humans.

—George (Buz) Wilson
Australian Museum

ROGER SPRINGTHORPE / AUSTRALIAN MUSEUM

Isopods vary greatly in appearance. This one was found parasitising a marine reef fish.

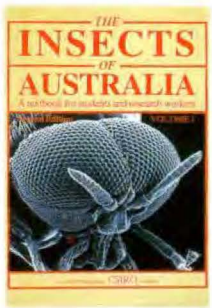
Answers to Quiz in Quips, Quotes & Curios (page 10)

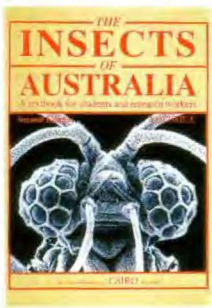
1. Australia's Fierce Snake (also known as the Inland Taipan or Small-scaled Snake)
2. 1859
3. North–South
4. Gondwana and Laurasia
5. Twenty
6. Desmond Griffin
7. Volcanic glass
8. *Seismosaurus halli*
9. Edible sea-cucumber or holothurian
10. Biosphere II

Questions for this column may be sent to Jennifer Saunders, Australian Natural History, P.O. Box A285, Sydney South NSW 2000.

REVIEWS

COMPILED BY
JENNIFER SAUNDERS





The Insects of Australia: A Textbook for Students and Research Workers*.
Ed. by I. Naumann et al. *Melbourne University Press, 2nd Edition, Vic., 1991. Volumes 1 & 2, 560 and 600pp. $250.00.*

The first edition of *Insects of Australia*, which appeared in 1970, was a landmark in Australian scientific publishing. It was widely hailed and quickly became a standard entomological reference worldwide. For many diverse insect orders, it provided the only comprehensive overview then available. (It must be remembered that most major insect families are cosmopolitan in distribution, and therefore, the good keys, figures, and morphological and biological information provided in this book was of interest to all entomologists, not just Australian-based workers.) I have heard North American entomologists complain, "How come we don't have a book like this?" Well, they still don't, and *The Insects of Australia* has just appeared in a magnificent new second edition. (Melbourne University Press has shipped one thousand copies for distribution in North America alone!)

The production of both editions was carried out under the guidance of the CSIRO, Division of Entomology, Canberra. The illustrations are of a uniformly high quality and many new figures have been added to the second edition. The book comprises ten introductory and 32 taxonomic chapters, with one chapter per order, and all written by specialists from both Australia and overseas.

The second edition does, however, invite comparison with the first. The new book is larger and bound in two volumes, making it easier to handle (the first edition was 1,029 pages in a single volume, placing considerable strain on the binding). All chapters have been thoroughly revised or rewritten, and a number of entirely new chapters have also been included.

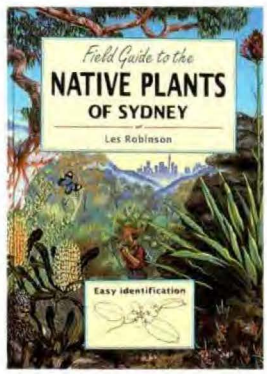
Of the taxonomic treatments, the revised chapters on Coleoptera by Lawrence and Britton, and Hymenoptera by Naumann *et al.*, are particularly impressive. The key to the 113 Australian beetle families alone comprises 255 couplets for adults and 266 couplets for larvae: welcome to biodiveristy!

In the introductory chapters, a brand new survey of fossil insects by Kukalova-Peck contains some fascinating information on insect evolution. Other chapters of note include a history of Australian entomology and entomologists by Marks; a comprehensive survey of insect biology by Norris *et al.*; a good review of biogeography by Cranston and Naumann; and a new key to all insect orders, both larvae and adults, including other terrestrial arthropods that might be confused with insects.

This book is a must for all entomologists and those even marginally interested in insects. Just looking at the figures is a pleasure.

I have only one obvious criticism, the price. The first edition cost $20.00 in 1970, whereas the new edition is $250.00. Even with inflation and real increases in publishing costs, the price seems excessive. The subtitle *A textbook for students and research workers* should now be changed: few students can afford it.

—Daniel J. Bickel
Australian Museum



Field Guide to the Native Plants of Sydney*
By Les Robinson. Kangaroo Press, NSW, 1991, 448pp. $29.95.

This book has partially filled a gap in the literature concerned with identifying Sydney's native plants. In the past, identification guides have either relied upon photographs—as is the case with Fairley and Moore's *Native plants of the Sydney district* (1989)—or on lengthy and involved botanical descriptions such as those in Beadle, Evans and Caroline's *Flora of the Sydney region* (1991). Both of those books have their place. The first provides quick and easy identification for the relatively untrained reader, while the second is regarded as a black hole to the untrained but a bible to those who are familiar with botanical language.

Les Robinson's book sits nicely between the two. He has adopted a very practical approach—using a key identification system, which allows the reader to quickly isolate a group of plants.

Most native plant enthusiasts recognise plants by their form and growth habit. These basic traits allow the reader to make clear and simple choices about which section of the book to turn to. For example, climbers, coastal or estuarine plants can be referenced.

Robinson's use of simple line drawings to distinguish between flowers, fruit, stems, form and dimension are very helpful. The scale and careful arrangement of the drawings allow many plants to be displayed on a single page, making comparison between relevant features easy.

The plant descriptions are adequate and the author is consistent in the information he has chosen to provide. The book is easy to read and dotted with anecdotes, which helps in remembering plants and their names. It appears comprehensive, it is compact and sturdy, and its quick-find index makes it suitable for field work.

I only have a couple of misgivings about the book; not every plant is linked to the keying system (for example, *Banksia serrata)* and there were many weed species included. Their inclusion is, in my opinion, unnecessary in a native plant book.

Knowing plant names is a preoccupation with many enthusiasts and professional people. This seems a futile exercise to me, as the real value of knowing plants is to understand the environments in which they can live and the variations in the communities they help to comprise. This book is partially organised around these parameters and takes a positive step toward teaching amateurs and professionals the subtleties of Sydney's bushland. Some botanical knowledge is helpful when using the book but is not essential. All in all, it is inexpensive for the information it provides.

—Andrew McGahey
The Total Earth Care Company, Sydney

Biomedical and Surgical Aspects of Captive Reptile Husbandry
By F.L. Frye. R.E. Kreiger Publishing Co., USA, 2nd edition, 1991. $US289.50.

This is a greatly enlarged and updated edition of Frye's 1981 text. It is a hefty two-volume production weighing over six kilograms and includes more than 1,800

colour plates and 180 radiographs. The quality of the printing is excellent and the text is interspersed with many useful tables.

Dr Frye is an internationally recognised authority on reptile medicine, surgery and husbandry, having spent over 20 years teaching in this field, and is currently Associate Professor at the University of California at Davis, USA.

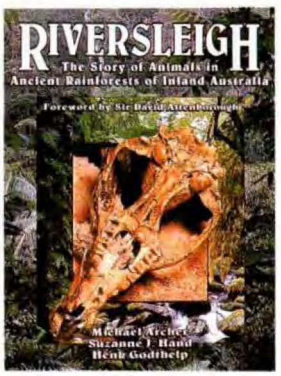
The chapters on captive husbandry and practical feeding should prove very useful as they contain many tables of recommended diets for assorted species and provide up-to-date information on these subjects. The chapter on antibiotic therapy is also of particular interest. It is written by Dr D. Mader who has extensive knowledge of the pharmacodynamics of antibiotic use in reptiles. He includes a description of the methods of drug administration and provides lists of drug dosages based on pharmacokinetic research as well as empirically derived dosages. A discussion of the use of metabolic scaling to determine drug dosage concludes the chapter.

The extensive use of superior-quality full-colour plates serves well to reinforce points made throughout the text. This is particularly so for the parasitology and haematology chapters. Each chapter also contains an extensive bibliography for further reading, and a cross-referenced index, together with a species list and glossary, complete the volumes.

It must be noted that Dr Frye has included many anecdotal case reports. He makes no apology for this; rather suggesting that these illustrate particular items of interest and enables the most up-to-date cases to be discussed. Nevertheless, care must be taken when interpreting these anecdotal reports and caution should be exercised in reaching conclusions based on such reports.

Dr Frye is to be congratulated for this lavishly presented two-volume text, which is destined to become a standard reference. The cost, however, will no doubt preclude it from reaching the shelves of many amateur herpetologists.

—Brendan Carmel
Healesville Sanctuary



Riversleigh: The Story of Animals in Ancient Rainforests of Inland Australia*
By Michael Archer, Suzanne J. Hand and Henk Godthelp. Reed Books, NSW, 1991, 264pp. $39.95.

By now, everybody with an interest in Australia's natural history has heard of Riversleigh—the fossil bonanza of northwestern Queenslan ..ersleigh was not recognised as a significant fossil locality until 1983. Today it is pre-eminent, not only as an Australian palaeontological site, but as a site of international scientific importance. Mike Archer's enthusiastic accounts of Riversleigh's treasures have created an interest in the wider community, paralleling that amongst palaeontologists. However, until now, access to information on the finds and theories associated with Riversleigh have been restricted to the scientific literature and a few popular articles. The Riversleigh Society (PO Box 281, Gordon 2072) has been successful in popularising Riversleigh research but, generally, popular accounts have been few, incomplete and limited in distribution.

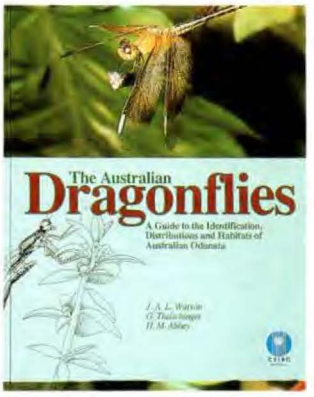
Riversleigh enables the uninitiated to amble through the science that has recreated 25-million-year-old rainforests.

Riversleigh is ideal for the interested layperson who wants to know more about this fascinating area of research. It is beautifully presented and self-contained, enabling the uninitiated to amble through the science that has recreated 25-million-year-old rainforests. In this task, the authors have done a magnificent job—it is not easy to convert scientific theory into an interesting narrative accessible to all readers. The layout, design, illustrations and photography are faultless.

This book is not simply a step-by-step description of the work at Riversleigh and a list of the animals so far discovered. It is a masterfully synthetic volume that takes this raw data and translates it into reconstructions of Australia as it was. It then proceeds to interpret the implications of this research for Australia, today and tomorrow. In this objective, the authors have succeeded in producing a book of immediate interest and appeal for all Australians concerned for our environment.

In a nutshell, buy it. There is no comparable publication on Riversleigh in particular, and few that translate the science of palaeontology as effectively.

—Paul Willis
Macleay Museum



The Australian Dragonflies*
By J.A.L. Watson, A. Theischinger and H.M. Abbey. CSIRO, Canberra and Melbourne, 1991, 278 pp. $60.00.

Although there has been considerable interest in Australian dragonflies in past years, it has been difficult for the non-specialist to obtain identifications. *Australian dragonflies* more than adequately resolves this problem as well as providing much background information.

The text can be divided into two main sections—the introductory chapters providing an overview of the biology, morphology and affinities of dragonflies (87 pages), and the identification keys to families, subfamilies, genera and species (145 pages).

The first of the introductory chapters concerns the biology of dragonflies. There is a special emphasis here on dragonfly larvae and their habitats, plus a short account of the conservation of dragonflies in Australia.

The next chapter is titled "The Australian dragonfly fauna" and includes a checklist of the known Australian species and their major synonyms. Much of this chapter is occupied by the descriptions of three new genera and 12 new species and subspecies. I feel these descriptions are somewhat misplaced in this book as they do not really add to its value—they would have been better published elsewhere before publication of this book.

A short chapter on terminology includes a glossary of terms and abbreviations, supplemented by 20 labelled figures. The last two chapters of the introductory section concern the distributions and habitats of Australian dragonflies.

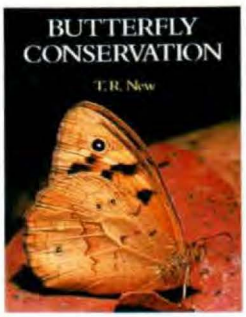
The real purpose of this book is to provide a means for identifying dragonflies. They are not easy insects to identify; colour and markings alone are often far from adequate and it is usually necessary to look at other structures such as wing venation. This book relies on illustrated keys for identifications. I tested the keys on several specimens and had no difficulties in arriving at correct answers. I also asked a friend, completely unfamiliar with dragonflies, to key a damselfly and again a correct identification was obtained. The numerous illustrations accompanying the keys are undoubtedly responsible for this success. Once identified, supplementary

information on species distribution and habitat is given.

Dividing the introductory chapters from the keys are 24 pages of colour photographs of live adult dragonflies. I was somewhat disappointed in the quality of several of these and suspect that the printing could have been of higher quality. Nevertheless, the majority are quite acceptable and play an important role in illustrating examples from all families.

I strongly recommend this book to anyone wishing to identify dragonflies, including naturalists, dragonfly specialists and museum curators alike.

—Max Moulds
Australian Museum



Butterfly Conservation*
By T.R. New. Oxford University Press, Melbourne, 1992, 224pp. $24.95.

This important book is a broad treatment of all subjects relating to the conservation of butterflies and is strongly recommended to the general naturalist as well as the ecologist, entomologist and collector. The trained entomologist may think himself talked down to in the early part of the book where detailed explanations are given for some elementary concepts, but this approach enables the book to be read by the generalist or politician who, except for Barry Jones, may know very little of the subject.

A significant point raised is the public's notion as to which animals are desirable and which are undesirable. The book concludes that great public sympathy can be found for conserving the humble butterfly. A recent experience of my own supports this view–a few days ago I was phoned by a person about a caterpillar in her garden. She asked "Is it a butterfly or a moth? Because if it's a moth, I'm going to kill it".

A chapter on classification, biology and diversity of butterflies tells us there are about 17,280 species of butterflies and explains the complex reasons why this number is quite rubbery. We are not told why Australia's slice of the butterfly cake is only about 400 species, as there is no special focus on regional faunas. There is, however, a summary of reasons for variation within a species.

The reader is also introduced to the serious problem of deciding which insects and other invertebrates are on, or near, the critical point where urgent measures are needed to ensure survival. Dr New also reveals something of the complex information required for each species or subspecies in order to understand the causes of decline and therefore enable effective measures for management. The most serious cause of diminishing butterfly numbers is habitat disturbance or destruction by such human activities as urban sprawl, clearing vegetation, overgrazing, applying herbicides and insecticides, replacement of native vegetation by exotic garden plants, draining marshes and introducing predators. Decimating butterfly habitats by these means can drastically increase the effects of fluctuating natural factors. Activities of butterfly collectors may sometimes effect vulnerable populations, particularly when there is large-scale commercial trading, but are generally far less important than habitat change. This is an indictment against governments that are ready enough to list protected species, but do little to prevent habitat degradation, particularly if it results from an operation for short-term profit.

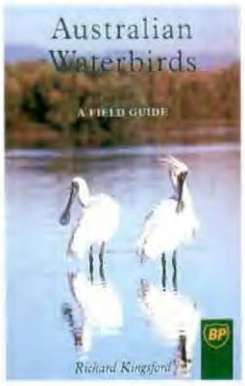
In the chapter on "Awarness and concern", we are shown that the individual naturalist and organised groups can all play roles. Both international and local laws are discussed, ranging from the absurd and counterproductive bans on collecting and the carrying of butterfly nets, to protection of rare or localised species. A chapter on "Studying butterflies for conservation" covers investigation of almost every attribute of target species in relation to their environment. The section on "Management" concerns putting into practice findings from ecological studies by a variety of techniques, including captive rearing, reintroduction, reenforcement, translocation and, especially, site management.

She asked "Is it a butterfly or a moth? Because if it's a moth, I'm going to kill it."

The "Case histories" of 18 butterfly species and subspecies make more interesting reading, with two Australian subspecies included–the Altona Skipper and the Eltham Copper. I was surprised that the Bathurst Copper *(Paralucia spinifera)* of central-western New South Wales does not even appear in the index, as this is probably one of Australia's most narrowly localised butterfly species and current studies have received much publicity. It seems that, despite the publication date, New's text must have been written some time before this insect gained prominence.

Following the very practical chapter on "Butterflies in towns and gardens", the final chapter considers "The future". In view of the enormous pressures on natural habitats, particularly in the tropics with their burgeoning human populations, we can only share the author's view that future prospects for a great many butterfly species are 'not good'.

—David McAlpine
Australian Museum



Australian Waterbirds: A Field Guide*
By Richard Kingsford. Kangaroo Press, NSW, 1991. 128pp. $14.95.
Birds of Lord Howe Island: Past and Present*
By Ian Hutton. Author, NSW, 1990. 154pp. $28.00.

When I heard that *Australian waterbirds* was the third prize in a raffle for which second prize was a magpie's nest, I was expecting something rather flimsy. However, my reservations were sidelined after a quick perusal. Instant information is the book's forte. Graphics are used innovatively to illustrate the size, distribution, habitat, diet, breeding season and nesting biology of 88 species of waterbird. Photographs are also provided for identification. Those who can read will not be disappointed either as the species descriptions, while not pretending to be comprehensive, contain the most interesting features of the biology of each species, whetting the appetite for further knowledge.

The introduction provides general information for the beginner, including an explanation of those elusive terms 'waterbird' and 'wetland', and what '8x40' means when you're choosing your binoculars. Australian waterbirds also contains

informative appendices including locations of good birding wetlands around Australia. To satisfy your growing interest it lists books, journals, bird clubs and hints on how to conduct systematic studies. Although identification of birds using photographs can often be more difficult than identification from artists' impressions, the photographs are generally unambiguous. However, I think it was ambitious to include even the small group of waders as their photographs will not do a lot to help the beginners to whom the book is targeted. I would also have liked a key to the pictorial representations of diet, and a quick way of telling which sex is pictured when the sexes are dimorphic. Field use of this book would have been made easier if similar species were sequential, rather than being listed in ascending order of water dependence. This problem can be solved to some extent by referring to the handy silhouettes in the front of the book in association with the index. Overall, the wealth of information provided by this user-friendly pocket guide will surely be

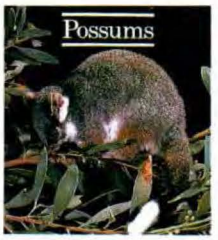
Being third prize in a raffle for which the second prize was a magpie's nest, I expected something flimsy.

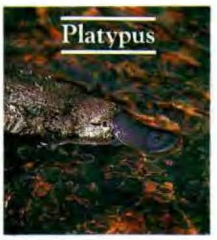
a catalyst converting people from a stable state of ignorance to the dynamic world of birds and their conservation.

Conciseness is not a word that springs to mind when describing *The birds of Lord Howe Island*. The book claims to be comprehensive, reviewing the works of early ornithologists and building upon this with more recent scientific research and the experiences of the author. However, it is more a book of interesting historical and biological anecdotes than an ornithological text. Ian Hutton has collected a wealth of information on behaviour, diet, breeding seasons and nesting details of Lord Howe's birds, assembling them in a very readable, narrative account. The book, however, does take a rather anthropocentric view, and and my chief criticism is that it oversimplifies the ecological component to the point of falsehood. The doctrine that individuals behave for the good of the species has been dead for 25 years and it would be educative for the human species if popular texts conveyed this change in scientific thinking.

Like the fauna of many islands, that of Lord Howe has suffered since the arrival of humans, with only six of the original 15 species of land birds surviving today. *Birds of Lord Howe Island* documents their decline, discusses the probable causes of extinction and also describes one of the most dramatic conservation success stories–the rehabilitation of the Lord Howe Island Woodhen. This book should prove particularly useful to visitors of the island as it provides a complete pictorial guide to all resident birds along with intimate local knowledge of where they will be and what they will be doing at any time of the year! I just hope it will not be left to the birds to write the same about us.

—Richard Major
Australian Museum





Possums*
By Barbara Triggs. Houghton Mifflin, Vic., 1991, 40pp. $13.00.
Platypus*
By Dominic Fanning. Houghton Mifflin, Vic., 1991, 32pp. $13.00.

Both these titles appear to have been produced with the primary-school child in mind. Extensive use is made of some excellent colour photographs and the obvious illustrative ability of Dominic Fanning is well demonstrated in *Platypus*.

Although similar in style and layout, each book might appeal to a slightly different audience, purely by force of the subjects covered. *Platypus* deals with one species and can therefore cover virtually all aspects of this amazing animal's life history. The detail presented will suit anyone seeking school project material.

Possums must cover over 18 species in 40 pages. A daunting task, but one that is helped by some well-chosen action 'shots' of some of Australia's most appealing marsupials. These photographs, combined with the text, highlight the most important facts about each animal and should make this book attractive to overseas visitors. However, photographs cannot say it all and both authors quite rightly send a strong conservation message. The threats to these mammals are real and let's hope that, when the children reading these books are adults, they will still be able to see these unique mammals in the Australian bush.

—Linda Gibson
Australian Museum

All books marked* are available from the Australian Museum Shop, which operates a full mailing service — call (02) 339 8150.

TRAVEL REVIEWS

Short Trips From Sydney

Jenolan Caves House

Jenolan Caves, NSW 2790.
Phone (063) 59 3304; fax (063) 59 3227.

Awakening to the sounds of whipbirds, I threw open my window to feel a gentle, crisp breeze wafting over the lichen-covered tiles. The scene was utterly relaxing; far removed from the city traffic of the previous night. A short stay (2–5 days) at Jenolan Caves House is an idyllic retreat from Sydney. It is a traditional Edwardian country guesthouse, with no phones, televisions, radios or mini-bars.

Caves House was built from local limestone quarried on site. Even the reception desk is constructed from the timber of a walnut tree that fell outside the front door. Since the hotel was taken over by Peppers in 1990, it is gradually being restored.

A comfortable, elegant loungeroom features a huge open fire, and the dining room is grand, complete with damask tablecloths and silverware. The food is on par with any international restaurant in Sydney and the most exquisite fresh bread is baked daily.

The caves are controlled by the Jenolan Caves Reserve Trust and tours go daily to nine of the 300-or-so caves. All are spectacular and well worth visiting but, if you have limited time, the office can advise on which to visit to get the most out of your stay. Weekends and school holidays are especially busy, so my advice is to take a midweek package or make your own long weekend, using the weekday to visit the most popular caves.

All limestone cave formations are present at Jenolan, most in spectacular form—huge columns, delicate shawls and enormous flowstones. My favourite are the helictites, small but curious formations that grow every which way, some almost spirals.

There is no breeze in the caves and they are a constant 15°C, making any time of year ideal for a visit—a long-sleeved shirt is sufficient attire.

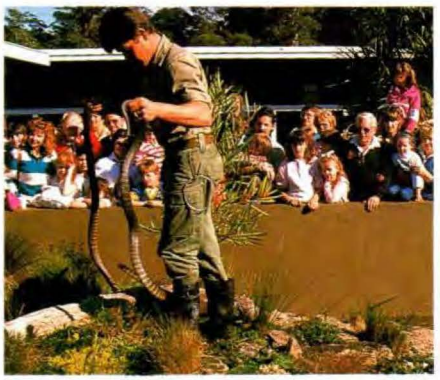
There is far more to Jenolan than just caves. Many bushwalks start directly outside the caves (half-hour to two-to-three days). A diversity of wildlife inhabits the area. I saw numerous Crimson Rosellas, honeyeaters and robins, and also a rare Brush-tailed Rock-wallaby *(Petrogale penicillata)*. The Trust established a captive-breeding program to help restore rock-wallaby numbers. Sadly, their greatest threat is the motor vehicle.

For the intrepid, adventure caving as well as early morning and late afternoon wildlife safaris with rangers are available. Take the 30-kilometre drive to Oberon for trout and salmon fishing or horse riding, or venture past the Oberon turn-off to the spectacular Kanangra Walls, the start of many excellent bushwalks.

Coach and rail/coach services are available; accommodation costs from $71 per person per day (economy room) including breakfast and dinner to $222 for weekend (room with en suite) including five meals. Children 2–12 years ($28 overnight; $36 for weekend package; under two years, free). Facilities include a children's playground, coffee shop, board games, complimentary tennis, 24-hour reception, barbecues, kiosk, live entertainment in the evenings, conference room and disabled facilities. Cave prices are $10 adults and children, with some cave tours reduced to $4 for children.

JENOLAN CAVES HOUSE

Jenolan Caves House.



JOHN WEIGEL / GOSFORD REPTILE PARK

Park keeper with mainland Tiger Snakes during a public talk.

Gosford Reptile Park

Pacific Highway, Gosford, NSW 2250.
Phone (043) 28 4311; fax (043) 29 1233.

"Leave funnel-webs here after hours" instructs a sign on a letterbox at the entrance, indicating that Gosford Reptile Park is no ordinary animal park. This park serves a vital community function that even the most fearless among us would shun: milking venomous snakes and spiders. It has been supplying toxins to the Commonwealth Serum Laboratories for the production of antivenene since 1950. This service has contributed to saving many lives.

While there is a representative collection of snakes, lizards and crocodiles, Gosford Reptile Park is more than just a place you can cuddle a python or learn about goannas. They have regular milking demonstrations and an education centre, and researchers and students are encouraged to use these facilities for carrying out their reptile studies.

Besides reptiles, the grounds are also ringed by other wildlife enclosures, including cassowaries, Emus, kangaroos, wallabies, Koalas, wombats, a noctarium, a Platypus tank and large crocodile and alligator enclosures. All this surrounds a huge, central lawn picnic area.

Give yourself at least half a day to get a good coverage and you will avoid the crowds if you arrive early. This will allow a good long morning's amble before settling on the lawns among the kangaroos for lunch.

Entrance fees are $8.00 adults; $6.00 pensioners (with card); $3.50 children over four; under fours, free. Park is open daily (except Christmas) 9am–5pm and to 6pm in summer. Facilities include a kiosk and gas barbecues.

Blue Mountains Trips
Australian Academic Tours
4/111 Darley St, Mona Vale, NSW 2103.
Phone (02) 979 5540, 008 249 762;
fax (02) 979 5561.

You will never feel the same about geology after one of David Root's trips–it will certainly fascinate you even if you weren't interested to start. In a single day in the Blue Mountains he explained why the solar system is the way it is, what makes some elements more abundant than others, that there is a geological reason for where all rocks and minerals end up, why Bilpin apples taste so good, and Brer Rabbit's vital role in bringing continental drift theory to light. None of this was necessarily part of the trip–David has a happy knack of being able to answer all your silly questions with great authority, yet simply enough to understand.

Much of this came out in the general conversation while on a Blue Mountains trip. An academic of some repute, David has a talent for field trips, which he has turned into a full-time business, Australian Academic Tours. Vastly knowledgeable about the geological history of the Sydney basin and the surrounding area, he draws together long past events to explain more recent history. He talked about the problems poor old George Cayley (an early explorer and botanist) encountered in his attempts to cross the Blue Mountains, and we stood at the spot where Cayley finally gave up, imagining what thoughts crossed his mind.

He also gave us a good overview of the formation of the Blue Mountains, combining his general Blue Mountains trips with a day-trip to the glow-worm tunnel near Newnes. After a delicious picnic lunch, we ventured through the now-defunct railway tunnel, which is home to the *Arachnocampa richardsae* glow-worms. These glow-worms emit a soft blue light to lure prey into their web nests, which are woven into the nooks in the rock face. Once completely inside the dark tunnel, a fairyland of miniature blue lights was revealed. A nice surprise at the end of the tunnel was the magnificent tree fern grove.

While the Blue Mountains is an easy place to get to under your own steam, you will never get such a broad understanding of this area going solo. David's enthusiasm for the ongoing processes of mountain building is contagious and will enliven even the dullest mind. He offers a number of fascinating short trips from Sydney, including Jenolan, Kanangra Farm Stay (October 9–11, Nov 6–8, $215); Glow Worm Tunnel Adventure (Oct 31, $75); Why They Couldn't Cross the Blue Mountains (November 21, $70); Yerranderie–Ghost Town and Volcano (3–5 Oct, 14–15 Nov, $360) and Wollongambe Canyon (5 Dec, $70). As most of these trips comprise small groups (in comfortable 10-seater four-wheel drive buses), dates are subject to change, so ring David for his latest program, which includes everything from single day outings to Antarctic cruises.

David has a happy knack of being able to answer all your silly questions with great authority.

Askania Park–Forest of Tranquillity
Rainforest Flora and Bird Sanctuary
Ourimbah Creek Road, Ourimbah, NSW 2258.
Phone (043) 62 1855; fax (043) 62 1595.

No sooner do you venture down the driveway that you realise this is no ordinary tourist-park complex. It's a breath of fresh air right from the start.

Privately owned and operated, Cathy and Ed Manners' rainforest restoration originally began as a hobby. But after a constant battle with invasive weeds, dumped cars and floods–and due to demand–it became apparent that they would have to open their private paradise to paying visitors in order to sustain their dream.

Inspired by similar parks overseas, the Manners believe their canopy rainforest is one of the best examples in the Sydney region. Many of the more than 160 identified and labelled plants are rare or unusual in a temperate rainforest. Being at the edge of the region where Sydney sandstone starts, Askania is home to many plants at their southernmost limit. One particularly rare plant is the Cut Mint Bush, which has a pleasant sweet minty scent, and only grows in this region. Another rarity is the Cream Bottlebrush.

Thanks to the tireless efforts of the Manners' friend Gwen Harden, a botanist from Sydney's Royal Botanic Gardens. the different species are well marked and there are many informative signs along the way. There are also some lovely bird paintings along the track, making identification easy.

The entire circuit can be completed in less than two hours; shorter walks within this are possible. However, I recommend taking longer and spending some time resting on the many seats along the way and just absorbing the sights and smells of the rainforest and the wonderful birdsong that echoes through the trees–the park is full of King Parrots, Galahs, Brush-turkeys and Satin Bowerbirds.

Don't bypass the Bangalow Palm track–it's quite heavenly sitting under massive circular palm fronds with the sunlight dappling through. The rainforest is also home to many Cabbage-tree Palms and bird-nest ferns.

A small colony of wallabies lives in the picnic area, most of which are being rehabilitated before their return to the rainforest. The park includes picnic tables and barbecues, and the picnic grounds are near the entrance so as not to disturb the tranquillity of the rainforest. It works.

There is a firefly festival coming up from 13 November to 6 December from 6pm to 9pm (depending on the weather), and the park is open late during most of January for evening walks.

Entrance fees: adults $5.50; pensioners $5.00; children 5–16 years $2.50; under fives, free. Group costs and facilities on application. Opening times: 10am–5pm, Wed–Sun (every day during school holidays or by arrangement for large groups). Beverages available; sandwich or barbecue lunches for groups by prior arrangement. Nursery-grown rainforest plants are also for sale.

—F.D.

The beautiful Blue Mountains is less than a days' drive from Sydney.

FARRSIGHT PHOTOGRAPHY

There is no point in making a decision based on conclusions of low power; you might just as well toss a coin.

THE DILEMMA OF POWER

BY JEFFREY M. LEIS

SCIENTISTS ARE INCREASINGLY embroiled in conflicts over use of the environment from Coronation Hill to the third runway at Sydney's airport. The Environmental Impact Statement (EIS) based on scientific research, is supposed to examine all the issues involved and lead to an informed, rational decision, but frequently it merely leads to more conflict. One reason for this may lie in the dilemma of power, but an understanding of why requires a look at how science and the EIS system work.

Science proceeds by testing an idea to see if it accords with observed facts. For example, a developer may argue that sewage effluent has no effect on the growth of kelp. The researcher testing the developer's idea makes a series of observations, and reaches a conclusion, usually expressed in the following way: the observations allow (or do not allow) rejection of the idea of no effect. Pretty straightforward.

The problem is, how do policy-makers or the public at large interpret this? The researcher is never 100 per cent sure of the rejection (or acceptance) of an idea because the natural world is variable. The more variable something is and the fewer the resources put into studying it, the more difficult it is to adequately test an idea and the less sure one is of the answer. The researcher testing the kelp and sewage idea may have measured growth of 100 kelp plants exposed to sewage and another 100 not exposed to sewage. On average, the growth of exposed plants is less than the unexposed plants, but some exposed plants grow faster than the slowest-growing unexposed plants. So, our researcher is uncertain about whether there is a real difference between the two lots of plants, and he uses statistics for help. Statistics have a bad name but, properly used, can tell our researcher how confident he can be of the difference in averages. This is expressed in the form of a percentage: for example, five per cent means that, if the researcher says the difference in averages is real, there is a five per cent chance of being wrong.

However, this is only half the story, for while you can be right two ways (correctly accepting the idea, or correctly rejecting it), you can also be wrong two ways: wrongly rejecting the idea (a Type I error), or wrongly accepting the idea (a Type II error). The power of a statistical test is 100 minus the probability of a Type II error (expressed as a percentage), so the higher the power, the higher the confidence in the conclusion. By convention, researchers only report the probability of their being wrong when *rejecting* an idea. This means that the power of the test, or the confidence one can have in the *acceptance* of an idea, is unknown.

This can have far-reaching implications. Suppose our researcher accepts the idea that sewage has no effect, but determines that the probability of a Type II error is 50 per cent. That doesn't necessarily mean his conclusion was wrong; just that his test of the idea has little power. And who would have any real confidence in the idea knowing the large chance of error? Unfortunately, the decision-makers probably don't know this, and they might decide not to treat the sewage—after all, the EIS said sewage had no effect. The correct decision is to regard the study as inconclusive (of low power) and order more research. Sound expensive? Perhaps, but there is no point in making a decision based on conclusions of low power; you might just as well toss a coin.

For the Environmental Impact Statement to be credible, we have to use power properly.

Another type of power involved in environmental studies is the power of control. In Australia, EIS preparation is controlled by the people who propose to use the environment for something, whether it be for airport runways or sewage disposal. These proponents hire and fire the EIS researcher. To a very large extent they decide what and how much research is to be done because, although government has EIS requirements, they tend to be of the vague 'assess the impact of the proposal' variety. This creates the appearance, if not the fact, of a conflict of interest. Because we all want to use the environment at the minimum short-term cost to ourselves, a built-in incentive for research of low power exists. Low-power research is usually cheaper; it is obviously more expensive to measure 100 kelp plants than to measure 10, and fewer plants measured means a less powerful test. In a situation of vague requirements, cost control, and competitive bidding for contracts to conduct EIS research, cost alone is often the deciding factor. Low-power research has a low probability of rejecting the idea of no effect, so the use of the environment is more likely to be approved and, furthermore, approved without expensive environmental safeguards. Because the EIS rarely reports the probability of being wrong when concluding there is no effect, no-one knows how much confidence to place in the EIS. This is one reason why such reports are often so hotly contested.

For the EIS to be really meaningful and credible, we have to use power properly. Statistical power must be as high as possible, and must be specified in reports. The power of control of the study must be removed from whomever is proposing to use the environment and vested in a body with nothing to be gained or lost on the decision. Obviously, those proposing the use must still pay the bill for the EIS research.

Politicians have a third type of power: they make the final decisions on the use of the environment. Exercise of this power must be based on scientific advice with a clearly stated level of confidence untainted by conflict of interest and, just as important, this power must be applied with a long-term view. The EIS process will not be credible or objective until everyone involved has the intelligence to use all three types of power in an open and far-sighted way.■

Dr Jeffrey Leis is a Senior Research Scientist in the Fish Section of the Australian Museum. He formerly worked as an environmental impact consultant.

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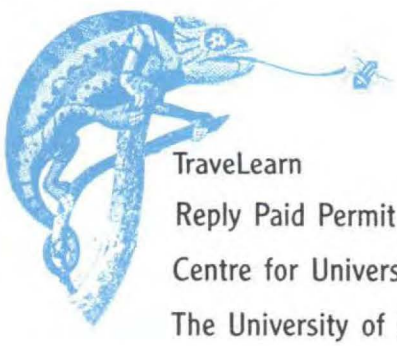

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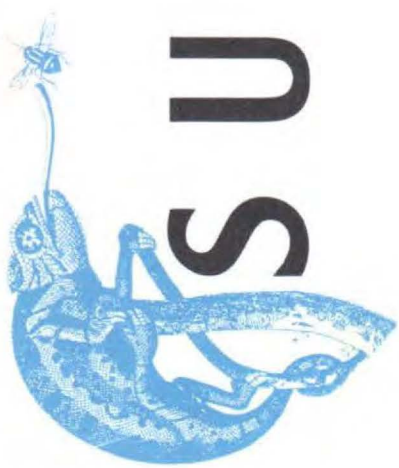

The brilliantly plumed Regent Bowerbird *(Sericulus chrysocephalus)* lives in littoral rainforests, featured in ANH's Spring 1992 issue. Photo by Wesley Tolhurst.

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The Mahogany Glider *(Petaurus gracilis)* is an elusive animal with extraordinary eating habits. It is featured in ANH's Spring 1992 issue. Photo by Bruce Cowell.

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The Spectacular or Leichhardt Grasshopper *(Petasida ephippigera)*. Photo from the Australian National Insect Collection, CSIRO.

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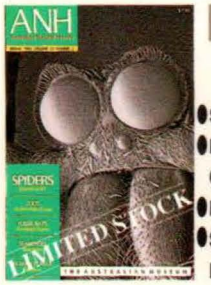

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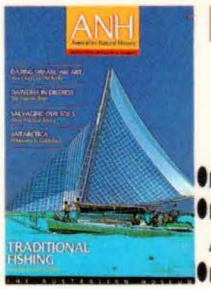

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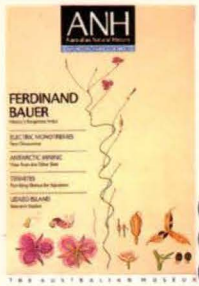

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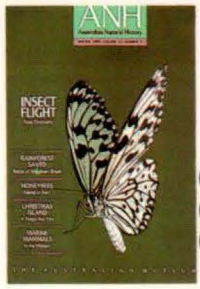

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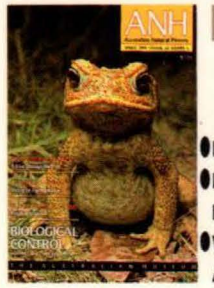

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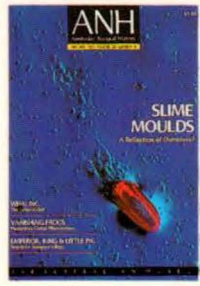
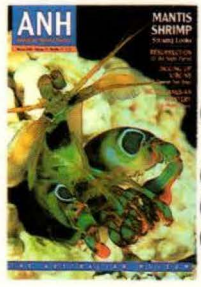
- INSECT ORIGAMI
- TASMANIAN TIGER'S SISTER



23/8

- SLIME MOULDS
- WHALING
- VANISHING FROGS
- SOLOMON'S RATS

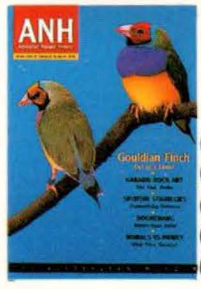


23/9

- NIGHT PARROT RESURRECTION
- DIGGING UP VIRGINS
- MANTIS SHRIMP
- MEGANESIAN MYSTERY

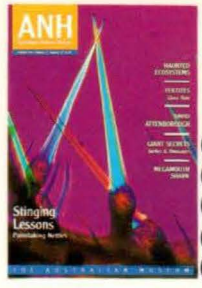
23/10

- IS AUSTRALIA OVERPOPULATED?
- MAGPIE GEESE & MANGOES
- LE VAILLANT'S PARROTS
- CHARLES DARWIN IN TASMANIA



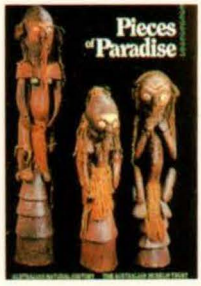
23/11

- GOULDIAN FINCH
- ROCK PAINTERS
- MITES
- CORAL REEFS
- SPITFIRE DEFENCE



23/12

- MEGAMOUTH SHARK
- TUATARA
- LEATHERBACK TURTLES
- TEKTITES
- TRAVEL REVIEWS



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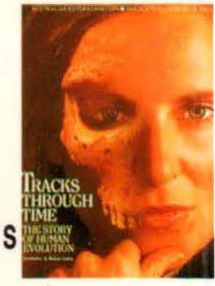

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