SUMMER 1993-94

Australia's Leading Nature Magazine

ANH

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BULMER'S FRUIT-BAT Back From the Dead

KILLER KANGAROOS

The Land of PARROTS

FREE PARROT POSTER

We're making sure Eric doesn't become bone idle.

Having been around for 110 million years it would seem only fair to let Eric take it easy. However, before this takes place we do feel that everyone should have a chance to see him. That's why at Akubra we are extremely proud to be the sponsors of his nationwide tour.

So who and what is Eric? Eric is a Pliosaur, a long extinct marine reptile predator that lived during the Age of Dinosaurs, 110 to 120 million years ago. This magnificent specimen was found by a miner, Joe Vida, in Coober Pedy in 1987. Interestingly all the original bones in Eric's skeleton had become opalised with white opal, a preservation unique to Australia.

The many fragments that went to make up this fascinating skeleton were carefully put together with over 450 hours of patient work. This reconstruction was entrusted to the Paleontology department of the Australian Museum under the supervision of Dr. Alex Ritchie.

To keep this wonderful and probably unique specimen in Australia, we were delighted to be able to assist the Museum financially together with the many thousands who responded to the recent Quantum appeal, to save Eric from possible sale overseas.

Over the years of course, our truly Australian family owned Company, that is now in its fourth generation, have proudly sponsored many Australians well known to us all. Also since 1956 we have been supplying hats for our Olympians and from well before that, the famous Slouch Hat that clearly identifies our Army. It's no wonder Akubra is known as Australia's most famous hat.

Our latest introduction has more than one great connection with Eric. The very aptly named Coober Pedy hat. It is quite suitable for either town or the country and features an opal in pride of place on the band. It is also a very fitting tribute to the adoption of the famous Opal as the National stone of Australia. The Coober Pedy and our many other Akubra hats are available from leading department stores, hat shops and saddleries nationwide.

So instead of idling his time away, Eric began his national tour in late September in Perth and from there will travel around Australia for about two years. Details will be advised in your local press.

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ANH NEWS

Win a fabulous holiday!

"At times I felt like I was in another world" is how ANH subscription competition winner Ian Robinson described his holiday prize tour through the exotic spice islands with Discovery Ecotours on the tall ship 'One & All' last August. "Highlights included sailing in the midst of a school of around two hundred dolphins, a jungle trek to a freshwater lake and almost daily snorkelling over fantastic coral reefs. It was one new experience after another, the Islanders were really friendly, and the food excellent."

In 1994 you could enjoy the same kind of exciting experiences that made Ian so enthusiastic. Our last subscriber competition proved so popular that we have teamed up again with Discovery Ecotours to offer one subscriber the holiday of a lifetime.

Imagine sailing the island-studded tropical waters of the fabled spice islands, Maluku, in the Eastern Indonesian Archipelago, and landing on some of the most remote and beautiful beaches in the world. You could be travelling in a motorised, dug-out canoe; walking in rainforests with scientists in pursuit of rarely seen wildlife; snorkelling or just lazing in the sun. At the end of each day you'll return to the comfort of your own ship and a gourmet meal. These tours are without equal. For a chance to be on one all you have to do is **ensure that your subscription is current on 15 April 1994** when our draw takes place.

Discovery Ecotours were recently awarded first prize in the prestigious Environmental Tourism category of the 1993 Australian Tourism Awards. This was in recognition of their success in creating unusual and exclusive holidays which combine extraordinary encounters with wildlife and rewarding cultural experiences. All tours are led by qualified science communicators. But they don't just come to look. Discovery Ecotours also funds research into some of the rarest fauna and flora in the world. For more information about their innovative holidays, simply complete the form at the bottom of this page.

Back Numbers sell out

We no longer hold any copies of Vol 22 Nos 8 & 10, and Vol 23 Nos 1,3 & 4. Stocks of Vol 22 Nos 5,6,7 & 9 and Vol 23 No 2 are now very low so if you would like a copy of any of these, please contact us sooner rather than later!

The Australian Museum Society

ANH is published by the Australian Museum in Sydney, widely regarded as one of the finest natural history museums in the world. The Australian Museum Society (TAMS) is an extension of the Museum. TAMS also provides invaluable financial support for the museum's research, exhibition and education projects. Membership of TAMS gives you the opportunity of being closely involved in advancing the work of the museum, while offering you and your family lots of fun.

As an ANH subscriber, you can enjoy all the benefits of being a TAMS member for only a small additional fee. These include:

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- Discounts at the Museum shops and much more . . .

Next TAMS event: 18 December: a special members only evening preview of the Shark! exhibition with food, a guided tour and a talk. For more information call Christine on (02) 339 8225 or use the form.

Spring Winner

The Spring *Pic Teaser* was a really tricky one that even stumped a few of the Museum scientists. Congratulations to Simon Wilkinson of Ipswich, Qld who was our only reader to correctly identify it as an assassin bug.

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Australia's Leading Nature Magazine
ANH

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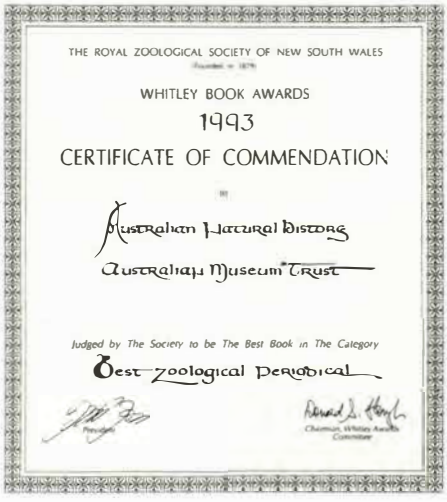
Up Front

CYRIL WEBSTER / NPIAW

Scaly-breasted Lorikeet.

In response to substantial correspondence from ornithological societies and birdwatching clubs from around Australia, we decided to mark the return of summer with a photo feature on Australia's magnificent parrots. Compared to the inherent difficulty of locating a good photograph for our Rare & Endangered feature, we assumed that finding breathtaking shots of Australia's colourful parrot population would be a relatively simple exercise. Not so! Our photo researcher, Kate Lowe, spent some 11 months eyeballing hundreds of slides in search of those elusive parrot pics. It seems that parrots, when not in cages, have no sympathy for the persevering nature photographer. After much angst, hard work and strange nightmares involving parrots, Kate found the images that burst from our cover and poster, and fill our Photoart section.



THE ROYAL ZOOLOGICAL SOCIETY OF NEW SOUTH WALES

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1993

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Best Zoological Periodical

ANH's seventh Whitley Award.

ANH has long had a commitment to provide its readers with interesting, accurate and accessible science, written by some of our foremost scientists and natural history experts. We then combine these stories with the best and most spectacular photographs available. We'd like to think it is this continuing commitment that has been recognised again this year, for an unprecedented seventh time, with the Royal Zoological Society's Whitley Award for Best Zoological Periodical in Australia. We are proud to have received it and proud to have beaten our very vocal competitors. We will, of course, continue to strive to provide you with Australia's very best nature magazine. Thankyou for all your comments and support. We hope that you enjoy this parrot-filled issue.

DAVE WATTS

Orange-bellied Parrot.

—Jennifer Saunders

ANH

Summer 1993–94
Volume 24 Number 7

Published by
The Australian Museum Trust
6-8 College Street,
Sydney, NSW 2000
Phone: (02) 339 8111
Fax: (02) 339 8313
Trust President: Robyn Williams
Museum Director: Desmond Griffin

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PRINTING
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Mary Pollinger
Phone: (02) 339 8119
Toll-free (008) 028 558
Fax: (02) 339 8313
Annual subscription (4 issues)
Within Australia $A30
Other Countries $A42
Two-year subscription (8 issues)
Within Australia $A58
Other Countries $A78
Three-year subscription (12 issues)
Within Australia $A81.00
Other Countries $A108.00
New subscriptions can be made by credit card on the ANH toll-free hotline 008-028 558 or use the form in this magazine. If it has been removed, send cheque, money order or credit card authorisation to the address above, made payable to the 'Australian Museum' in Australian currency.

ANH is printed on archival quality paper suitable for library collections.
Published 1993
ISSN-0004-9840

Australian Natural History is proud winner of the 1987, '88, '89, '90, '91, '92 & '93 Whitley Awards for Best Periodical.

Front Cover
The Sulphur-crested Cockatoo *(Cacatua galerita)* is one of Australia's most striking parrots. Common throughout their range, these large parrots are probably best known for their harsh, raucous call. Sulphur-crested Cockatoos feed on seed and grain, and usually occur in pairs or small family groups, although flocks comprising hundreds of birds are not uncommon. Other Australian parrots are featured in this issue's Photoart. Photo by Gerry Whitmont.

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LOUIE'S LAMENT

Television advertising may have been able to create in many of us a feeling of affection towards Louie the Fly, but the real House Fly should not be welcomed into our living rooms.

BY STEVE VAN DYCK

RARE & ENDANGERED

ECLECTUS PARROT

The lucrative captive-bird market, a scarcity of nest sites, marijuana cultivation and traditional hunting by Aboriginal people have all combined to place one of Australia's most spectacular parrots out on a limb. But things may not be quite as bad as they seem.

BY STEPHEN GARNETT & GABRIEL CROWLEY

WILD FOODS

LEAVES THAT STING

One of Australia's most dangerous inhabitants is the Gympie—a plant that carries an armoury of stinging hairs that can inflict the sort of pain that nightmares are made of!

BY TIM LOW

TRENDS IN SCIENCE

BEFORE GREENHOUSE

Way back in 1876 we were told of the importance of our forests; we were warned not to destroy them. And what happened to areas such as Persia and Lesser Asia confirmed those warnings. But did we listen?

BY ROBYN WILLIAMS

PHOTOART

TERRA PSITTACORUM

Dubbed the Land of Parrots by early European explorers, Australia is home to one sixth of all the world's parrot species ranging from the rare Paradise Parrot to the familiar Budgerigar.

VIEWSFROM THE FOURTH DIMENSION

A RUTHLESS ROO THAT CRAVED FLESH TO CHEW

Kangaroos: cute, furry plant-munchers we all know and love, or blood-besmirched killers of the Australian bush? Mike Archer reveals all was not as we thought . . .

BY MICHAEL ARCHER

THE LAST WORD

STONEAGE MUTANT TURTLE IDOLS

How do we investigate the evolutionary origins of behaviour? How can we tell if a certain behaviour is a uniquely human attribute? Tim Flannery tries to shed some light on these difficult questions via a tale of chimps, turtles and Stone Age idols.

BY TIM FLANNERY

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LETTERS

The forum for readers to air their views about their concerns, past articles and interesting personal events.

Weipa Shell Mounds

The comment in the QQC article "Middens or Nests?" (ANH Summer 1992–93) on the role of scrubfowl in creating the Weipa shell mounds promotes a hypothesis surrounded in controversy and supported by little field evidence, while neglecting the archaeological alternative.

A midden of human origin typically has the following characteristics: a greater occurrence of certain molluscan species compared to those that are locally available; a favouring of particular sizes of mollusc shells compared to those that occur naturally in the area; the presence of artefacts and food remains of vertebrate fauna; and significant quantities of ash and charcoal dispersed throughout the deposit.

The Kwamter shell mound at Weipa that I excavated in 1972 (and Richard Wright before me in 1963) has all of these characteristics. So do other shell mounds in the Weipa area subsequently sampled by John Beaton.

A chenier ridge, however, is a churned up mass of shells and sediments that typically has none of these features. It is as different from a midden deposit as chalk from cheese. At Weipa in 1972 I observed a two-metre-high scrubfowl mound built on a chenier ridge that contained large numbers of shells but in which sand and beach gravel were the dominant constituents. In the nearby midden deposits, shells were the dominant constituent. I do not believe that it is easy to confuse these different types of deposits.

The majority of the Weipa shell mounds are not on shelly cheniers. They are discrete deposits located on sand ridges or silt substrates in which shells are rare or absent. There was no pre-existing surface of shells from which the scrub-fowl could have created these mounds.

Radiocarbon dating has no power to differentiate scrubfowl accumulation from human. The margins of error are too large. In any case, middens can accumulate rapidly and are notoriously susceptible to reworking in the course of human occupation.

Shell middens are a fragile part of the Australian archaeological inheritance. Many have been destroyed in the past through local ignorance. Many more are under threat from commercial development. To suggest that well-established archaeological criteria are in doubt, simply because an alternative hypothesis has been proposed, is at best premature and at worst irresponsible. Few competent archaeologists are unaware of the potentially complex interactions between human activities and natural processes. New field investigations currently under way at Weipa and in other parts of northern Australia should soon resolve these issues.

—Geoff Bailey
Australian National University, ACT

Controlling the Ibis

Roger Burgess (ANH Winter 1993) asks if anyone is researching the scavenging behaviour of Sacred Ibis. At Healesville Sanctuary, various aspects of Sacred Ibis biology have been studied since 1978, with the Sanctuary's own colony being intensively studied between 1980 and 1990.

The history of the Healesville colony dates back to around 1957, when 24 Sacred Ibis nestlings were collected from wetlands in northern Victoria and placed upon open ponds within the park. By 1984 the population had grown to around 1,600, with school children visiting the Sanctuary being harassed by ibis for the contents of their lunch bags. The scavenging behaviour adopted by this species was not limited to the stealing of food from our visitors; the food supplied to captive animals was also being raided, as well as scraps of food from rubbish bins and refuse heaps. Nor was scavenging confined to the Sanctuary; local school grounds, Healesville's tip and even the local chicken processing works were all providing a free feed.

The Sacred Ibis colony at Healesville Sanctuary had reached overwhelming proportions and a management program was required. Ibis-proof feeders were constructed, allowing our captive animals to feed whilst excluding ibis, and open sources of food and refuse were covered. These measures have led to the Healesville Sanctuary Sacred Ibis population being reduced to the current level of around 300. Healesville Sanctuary now advises other zoos and wildlife agencies on the management of problem Sacred Ibis colonies throughout Australia.

Although this native species

The Sacred Ibis appears to have no trouble adapting to life in the urban environment.

LEO MEIER/AUSTRALIAN PICTURE LIBRARY

may reach 'plague' proportions in urban areas, in rural districts they are looked upon as a 'friend' of the farmer for the valuable role they play in controlling insect pests in pastures. Sacred Ibis have secured themselves a place in the future, irrespective of what human society does to the environment.

—Geoff Underwood
Healesville Sanctuary

Froggie Blues

In relation to the FROGWATCH article (ANH Winter 1993) I'd like to point out that, apart from the demise of suitable frog breeding areas, a big problem is people's attitudes to frogs. It's like the 'all snakes are bad and should be killed' syndrome. Believe me, there are lots of frog haters around. At our local golf club the ladies insist on dousing them with Harpic, Toilet Duck, Blue Loo and the like when they regularly occur in the toilets. If I'm not around to save them, it's 'goodbye froggie'! Try to reason with these supposedly mature adults and they laugh at you. Sometimes it's a sad world!

—Sue Pittarino
Kununurra, WA

Life can be tough for Green Tree Frogs.

Human Dwarfing

Tim Flannery's article "Time Dwarfs" (ANH Autumn 1993) provides an interesting discussion of the dwarfing of some Australian mammal lineages during the late Pleistocene. His claim, however, that humans are one of the exceptions to this dwarfing trend, is incorrect. One of the best documented events in recent human evolution is the reduction in body size that occurred between 30,000 and 6,000 years before present. This global reduction in skeletal and dental mass is particularly well documented for the Old World and south-eastern Australia. Prehistoric human skeletal remains from late Pleistocene Australian sites like Coobool Creek, Nancurrie and Kow Swamp belonged to people who were seven to nine per cent larger in body and tooth size than their mid-Holocene counterparts.

Explanations for this body size reduction in humans are often connected with the cultural developments accompanying the 'Neolithic revolution'. Everything from increasing population density, changes in food preparation technology and more sedentary lifestyles have been argued to select for smaller body size. These causative models miss the point that at a global scale not everyone entered the Neolithic revolution at the same time. Some populations never did. However, all human populations for which there are data appear to dwarf over the same period. A variety of mammal groups, carnivores in the Middle-East for example, began to dwarf in the late Pleistocene and continued until around 5,000 years before present. It seems unlikely to me that the dwarfing of humans and some other land animals, over the same time period and on a global scale, is not in response to a similar global phenomenon like climatic change.

—Peter Brown
University of New England
Armidale, NSW

Unfortunately, when I was writing "Time Dwarfs", I was unaware of the excellent work by Dr Brown on the size change in humans from south-eastern Australia. I had accepted the earlier hypothesis that there were both gracile and robust Aborigines in the Pleistocene, and that therefore no trend in size reduction was clear. Dr Brown's work raises the fascinating possibility that other factors were involved in dwarfing mammal lineages. A few points are worth making in regard to this. First, the size reduction shown by humans in Australia is slight compared with that shown by other Australian mammals of similar body size. Second, it is possible to test the hypothesis that other factors have been causing dwarfing on a global basis for the last 30,000 years. The Americas were peopled only 11,000 years ago. Does the American fauna begin dwarfing at 30,000 years ago or 11,000 years ago? A third point is that understanding of these complex issues is only enhanced by interaction between the diverse branches of science, including zoology and anthropology, which would not be possible were it not for forums like ANH.

—Tim Flannery
Australian Museum

A Case of the Blues

Katie Flanagan's question (ANH Winter 1993) on why the the male Satin Bowerbird uses blue as the predominant colour when decorating his bower raises some interesting speculation.

As Walter Boles points out in his answer, Satin Bowerbirds also use yellow, green, brown and grey in lesser amounts but will remove certain colours, such as red, from the bower. My observations have led me to conclude that the only colours the Satin Bowerbird will allow in or near his mating pad are the colours he wears as an immature male (yellow, green, grey and brown) or as an adult male (violet blue). Makes sense!

—Kevan Hardacre
Environment Artist
Cremorne, NSW

ANH welcomes letters for publication and requests that they be limited to 250 words and typed if possible. Please supply a daytime telephone number and type or print your name and address clearly on the letter. The best letter in each issue will receive a $20 gift voucher from the Museum Shop catalogue. The winner this issue is Peter Brown.

FRITHFOTO / ANT PHOTO LIBRARY

QUOTES & CURIOS

QUIPS

COMPILED BY GEORGINA HICKEY

Dasyurids and the Ultimate Sacrifice

Life for male members of the dasyurid (carnivorous and insectivorous marsupial) genera *Antechinus* and *Phascogale* can be little more than a brief and frenetic reproductive liaison. It has been known for some time, for example, that males of Brown and Yellow-footed Antechinuses (*A. stuartii* and *A. flavipes*) die shortly after their first breeding season from internal organ damage resulting from elevated levels of free corticosteroids in their blood. Females, by contrast, have been known to breed in two and occasionally three seasons. A consequence of the male die-off may be reduced pressure on scarce food resources, thus helping to ensure the survival of progeny.

Post-mating male mortality in mammals has, until recently, been thought to be peculiar to *Antechinus* and *Phascogale* species (see article in this issue). But a recent study by zoologists Chris Dickman and Richard Braithwaite has found the phenomenon to be more widespread among the dasyurids than previously thought. Dickman and Braithwaite have documented "abrupt and complete" male mortality among wild populations representing at least two other genera, *Dasyurus* and *Parantechinus*.

The zoologists' observations came from extensive field investigations of a population of Dibblers (*P. apicalis*) on Boullanger Island, north of Perth, Western Australia, and a population of Northern Quolls (*D. hallucatus*) in Kakadu National Park, Northern Territory. However, past studies by other researchers have revealed no indication in these two species of the sort of post-mating male mortality observed by Dickman and Braithwaite. It appears that the life histories within dasyurid species and genera are more variable than previously thought.

Males die shortly after their first breeding season.

—K.McG.

Female Northern Quoll and her young. Males of the species may succumb to post-mating mortality.

WADE HUGHES / LOCHMAN TRANSPARENCIES

Eggstraordinary Finds from Western Australia

A large fossil bird's egg, recently discovered by children in Western Australia, is believed to be from an extinct elephant bird *(Aepyornis* sp.) that once lived on Madagascar. It was found in a sand-dune near the town of Cervantes, midway between Perth and Geraldton, about 300 metres inland. The egg measures about 31 centimetres in length and, surprisingly, is actually the second such find to come from Western Australia. The first giant fossil egg was found in dunes south of the Scott River, near Augusta, in 1930 by a Mr Vic Roberts, and is now on permanent loan to the Western Australian Museum.

Aepyornis maximus, the largest of the seven known species, reached sizes of up to 2.5 metres high and would have weighed about half a tonne. *Aepyornis* eggs are the largest known of any creature, five times larger than the biggest known dinosaur egg. One full *Aepyornis* egg could have made an omelette equivalent to 135 hen's eggs, feeding some 70 people! *Aepyornis* became extinct in recent historical times, about 300–400 years ago, hunted out by humans as an easy food source. The Western Australian eggs are of uncertain age, but their encasing dune sediments and their discovery inland on ancient shorelines suggest they may be several thousand years old.

The discovery of the Scott River egg caused quite a stir. Doubt was immediately cast on its authenticity. After all, how could a large egg float across the Indian Ocean and be washed up onto a beach intact? Despite this incredible scenario, the identification of the egg as from an *Aepyornis*, based on its surface texture and overall size, appears the most likely explanation. The recent discovery of the second

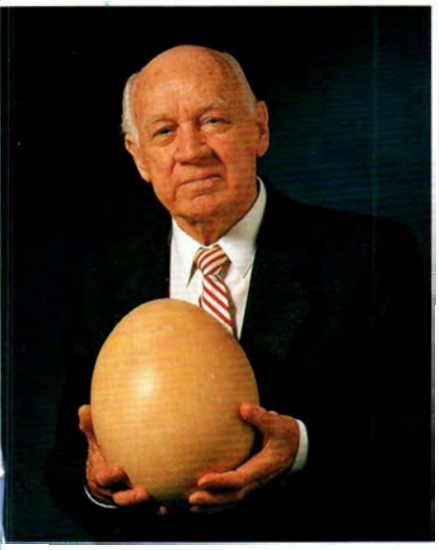
intact egg, near Cervantes, lends support to the drifting egg hypothesis. However, the most convincing piece of evidence is the fact that two fresh King Penguin *(Aptenodytes patagonicus)* eggs, which are most likely to have come from the Kerguelen Islands some 2,000 kilometres away, were found on Western Australian beaches. Both eggs had some barnacle growth on them, which was easily removed without damage to the shell, and both contained addled contents. Furthermore, glass floats washed up onto eastern Australian beaches that have barnacles on them are soon sand-blasted clean and end up with a polished clean surface. This may well have happened to the *Aepyornis* eggs after reaching Western Australia.

But what of our giant extinct Australian birds? The dromornithids or 'mihirungs' were the largest birds that ever lived. Some species were even bigger than *Aepyornis*, and certainly capable of laying gigantic eggs, but these died out several million years ago. The last of the dromornithids (such as *Genyornis)* became extinct in Australia about 30,000 years ago. Their eggs are known only from shell fragments and have a distinctive structure and surface texture, quite different from those of living Emus. While it remains possible that the two gigantic eggs from Western Australia were laid by local birds, it now seems improbable in the light of the evidence from the King Penguin eggs, which demonstrate that eggs can survive intact after long journeys on the Indian Ocean currents.

The fate of the Cervantes egg is currently uncertain because the owners plan to put it up for auction. Although the Protection of Movable Cultural Heritage Act should stop the egg being exported overseas, there is no legislation protecting it from harm if sold to an Australian buyer who doesn't know how to conserve the specimen. It would be a tragedy if the largest fossil egg of any kind ever found in Australia were to be lost or damaged. It belongs in a public museum where all can see it and marvel at its huge dimensions. Furthermore, these eggs may provide clues as to how other animals or plants may have reached Australia, rafting across the Indian Ocean in distant geological times. There is still much scientific study of the eggs to be done, if either can be permanently acquired by a museum. The Cervantes egg has recently been subjected to carbon-14 dating and scanning electron microscopy of its shell structure, and results from these tests are imminent. Only then may the truth about its strange journey from Madagascar be revealed.

—John Long
Western Australian Museum

Malagasy Consul General with the giant fossilised egg from Cervantes.



CARL BENTO/AUSTRALIAN MUSEUM

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WHY DO FLYING FISH FLY?

Since early this century, scientists have known how flying fish launch themselves into the air, but why do they do it? Is it to avoid predators, or is it part of an energy-saving strategy akin to that used by penguins and dolphins that repeatedly jump out of the water when on long cruises? Muscle in the fishes' tails gives the answer.

Flying fish are easy to study by virtue of their habit of flying onto the decks of boats, including research vessels. This is how Professor John Davenport (University Marine Biological Station in Scotland) collected specimens from the sea near West Africa. Part of his work involved making cross-sections of the tails to assess the proportion of white and red muscle.

Red muscle requires less energy than white muscle. So, if the tails are relatively rich in red muscle, it would suggest that flying is for saving energy. If the tail has a more even distribution of white and red muscle, flight is energetically more costly and thus more likely to be a way of avoiding predators. Davenport's studies of tail cross-sections revealed less than ten per cent of the muscle to be red, supporting the long-held assumption that flying fish fly to avoid being eaten.

—C.A.

ERIC ANDERSON, CHRIS ECROYD / NZ FOREST RESEARCH INSTITUTE

Caught in the act: a Short-tailed Bat visiting the flowers of a Wood Rose.

Video Beasties

Sophisticated video surveillance equipment developed for the security industry has revealed a biological relationship peculiar to New Zealand and helped uncover one reason why that country's only fully parasitic flowering plant, the Wood Rose *(Dactylanthus taylorii)*, is in decline.

The 'rose' that gives this plant its popular name is not really a flower but an attractive growth that forms where the tissues of the parasite fuse with the roots of its host, usually a small tree. It has been known for some time that the popularity of these 'roses' as ornaments among human collectors has contributed to the species' decline.

But it was the real flowers of the Wood Rose upon which Chris Ecroyd, of the New Zealand Forest Research Institute, focused a recent study to identify further factors behind its decline. The plant's true flowers are not particularly attractive but they have a strange musky scent and produce large quantities of nectar. In an attempt to identify the flower's major pollinator, Ecroyd began a nightly surveillance of field specimens using a time-lapse video camera that relied on infra-red lighting, invisible to most animals.

Initially it seemed that only introduced rats and possums visited the flowers, often destroying them in their haste to get to the nectar. But the camera eventually revealed the plant's specialist pollinator to be the terrestrial Short-tailed Bat *(Mysticina tuberculata)*, one of New Zealand's two native land mammals. Habitat destruction, and competition and predation from introduced mammals have reduced that bat's numbers. Ecroyd believes that, in turn, the decline of the Wood Rose may be linked to the decline of the Short-tailed Bat.

—K.McG.

Mouse Plagues: Food for Worms?

Mouse plagues are a major problem in rural Australia. Not only do mice damage crops, machinery and stored grain but they can also contaminate food, gnaw clothes and even run over people's faces while they're asleep.

Work being done by the CSIRO may soon put an end to House Mouse *(Mus domesticus)* plagues by stopping them before they've got out of hand. A group headed by Dr Grant Singleton of the CSIRO Division of Wildlife and Ecology in Canberra is trialing a biological control method that uses a roundworm parasite *(Capillaria hepatica)* to limit mouse populations. If this technique works, it will be only the second successful use of biological control on mammals anywhere in the world. (The first was the myxoma virus used to control rabbit populations in Australia in the 1950s.)

The roundworm infects the mouse's liver and, in the low doses that are being used, reduces the reproductive output of female mice by delaying subsequent litters and reducing litter size. This reduced productivity prevents the

A new biological control method on trial might mean the end to mouse plagues.

J. FRAZIER / ANT PHOTO LIBRARY

population reaching plague proportions.

For successful transmission of the parasite, eggs in the infected mouse liver must be eaten, passed out with the consumer's faeces, allowed to develop for about 40 days in humid oxygen-rich conditions, and then eaten again. Eggs deposited onto the soil surface quickly dry out and die. Only those that are deposited underground in a crowded mouse burrow are likely to survive. (Mice often indulge in cannibalism and even necrophagy, and the infected eggs are passed from contaminated soil to the mice by grooming behaviour.) This nature of the roundworm's life cycle makes it unlikely for native rodents and predators to become infected.

The mouse population must reach a certain density before the roundworm's life cycle can be sustained. The worm thus needs to be introduced just when mouse populations are building up at the beginning of a plague. The researchers have developed computer models to allow them to predict mouse plagues so they know when and where it is best to introduce the parasite. By contrast, chemical control methods are traditionally used at the peak of a plague when it is already too late.

—C.A.

Hot Ants

Most desert animals avoid the midday sun—but not Saharan Silver Ants (*Cataglyphis bombycina*). Like clockwork, these tiny ants burst out of their underground burrows when temperatures at the surface reach 46°C. They scavenge frantically for other arthropods that succumbed earlier in the day to heat stress, and retreat to their burrows, only a few minutes later, when their body temperatures reach nearly 54°C—the highest recorded temperature for any terrestrial animal. Any ants that fail to return to their burrow before this critical temperature are literally baked on the spot.

In an effort to understand just what triggers the ants' outbursts, zoologist Rüdiger Wehner from the University of Zurich and his colleagues noticed, just before the ants emerged, that a few individual ants would regularly appear at the surface. The researchers believe these ants are monitoring temperatures and, when the temperature (and hence time) is right, they call on the rest of the colony by secreting stimulants from special glands in their jaws.

But why do these ants restrict their foraging activity to such high temperatures? Further observations suggest that predatory pressure from the desert lizard *Acanthodactylus dumerili* is to blame. This lizard, which frequently burrows close to the ant colonies, retreats underground shortly before the ants' explosive outbursts. Experiments showed that ants released before this time were invariably eaten within five minutes. It is therefore a combination of heat stress and predatory pressure that has forced the Saharan Silver Ant to exploit such a narrow thermal (and temporal) window.

—G.H.

COURTESY RÜDIGER WEHNER

A Saharan Silver Ant in the midday sun.

Largest Living Organism

Publishers are scrambling to amend 'largest living organism' entries in encyclopaedias and books of records, following recent reports of massive subterranean fungi.

For years, the Blue Whale (*Balaenoptera musculus*)—reaching up to 30 metres in length and 200 tonnes in weight—has borne the tag of 'largest living organism'. (Although the enormous North American evergreen sequoia trees can grow over 90 metres tall and weigh thousands of tonnes, most of their bulk is non-living wood.)

Previous 'largest living' records have now been eclipsed by at least two fungus specimens. In a forest in Michigan, USA, University of Ontario researcher Myron Smith and colleagues have identified an *Armillaria bulbosa* individual at least 1,500 years old with an estimated mass of about 100,000 kilo-

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HORSE SENSE

It is always best to avoid a fight. Fights are costly. They may damage one or both contenders. Thus it often pays to recognise the winner before a fight begins.

Daniel Rubenstein and Mace Hack from Princeton University have been investigating the interactions between feral stallions defending mares on the island of Shackleford Banks, off the coast of North Carolina. Most confrontations are settled when one horse runs away. But sometimes there is a period of squealing and sniffing that the researchers believe is a way of assessing fighting ability.

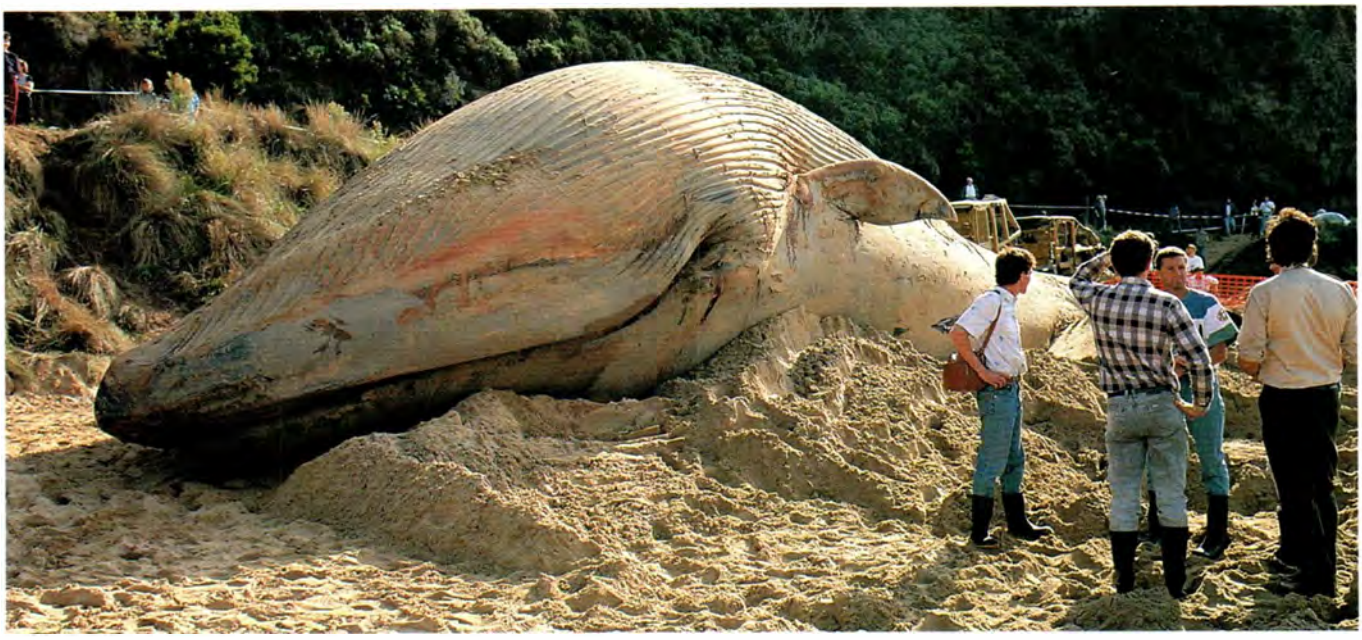
Signalling between rival animals usually indicates either status or identity. Rubenstein and Hack have shown that the feral horses are using both kinds of signals. Squeals indicate status, while sniffing, particularly sniffing dung, determines identity.

Dominant stallions squeal for longer than their subordinates. Their squeals start with a high-frequency sound and remain loud to the end. These characteristics are thought to reflect greater lung capacity and stronger thoracic muscles, which would enable the horse to last the distance in a drawn-out fight. Shorter, more shrill squeals that peter out characterise subordinate stallions.

The scent of a horse's dung is like its signature. A stallion can use this information to work out if he's met his rival before. He can associate his rival's identity with the outcome of the last encounter and work out whether or not to proceed.

About 79 per cent of encounters between stallions end after sniffing and squealing. Rarely does fighting follow.

—C.A.



GARY BELL / AUSTRALIAN PICTURE LIBRARY

The Blue Whale has lost its title as the world's largest living organism to a North American fungus.

grams spread over more than 15 hectares (over 600 metres across). Using genetic tests, they established that the huge fungal mass belonged to the one individual organism.

Armillaria bulbosa is a common wood-decay fungus in European and eastern North America mixed hardwood forests. It can also infect the roots of stressed living trees. Individuals begin life as fertilised spores and spread through the forest floor as a hidden network of branching cord-like rhizomorphs. The only readily visible evidence of this underground enterprise is a scattered, short-lived crop of mushrooms produced on the forest floor each autumn.

It's at least 1,500 years old and weighs about 100,000 kilograms.

Most recent but as yet unpublished reports lay claim to an even bigger fungal individual, a specimen of *Armillaria ostoyae*, also a root pathogen, covering 600 hectares beneath a western conifer forest near Mount Adams, in Washington State. Its age is estimated at between 500 and 1,000 years.

—K.McG.

Making Scents of Blind Snakes

Two Sydney herpetologists have identified how a virtually blind Australian snake locates its favourite food. *Ramphotyphlops nigrescens*, a small primitive snake that looks like a black worm, is commonly found in wet sclerophyll forests throughout the Sydney region. It has a diet made up almost exclusively from the brood (pupae and larvae) of ants. Because its eyes are little more than pigment spots beneath its scaled skin, it has been thought for many years that it must rely on chemoreception to locate the ant nests that contain its prey.

Jonathan Webb and Richard Shine, of the University of Sydney, put the theory to the test with a series of laboratory experiments. For use as potential prey, they collected six species of ants with brood known to appeal to the snake along with species of termites, isopods and earthworms that occurred around Sydney. Using controlled chambers in glass aquaria the snakes were given the opportunity to follow trails left by each prey type.

Webb and Shine found that the snakes ignored the trails of the earthworms, isopods and termites but followed the trails of the four ant species thought to leave detectable pheromone trails in the wild. The snakes would, momentarily, place their snouts on the trails before following them, sometimes flicking their tongues and arching their necks to bring their nostrils in contact with the chemicals. They followed the trails just as well when they were a week old as when they were fresh.

The snakes did not follow the trails of the other two ant species, although they were known to consume their brood in the wild if they found them. The reason appeared to be that these ant species were solitary foragers, rarely laying chemical scents on their trails. The researchers concluded that trail-following was important to *R. nigrescens* in locating potential prey.

—K.McG.

The blind snake *Ramphotyphlops nigrescens*. How does it locate its food?

JEAN-PAUL FERRERO / AUSCAPE INTERNATIONAL

ICBP / E.F.G. SMITH

After recognition as a new species, this rare and lucky shrike from Somalia was set free.

Shrike me Lucky

When a new animal species is discovered, an individual of the species is collected for study. This is the 'type specimen' used to describe the species. Museums keep hundreds of thousands of type specimens for scientists to analyse and compare.

At least that's what usually happens. But it didn't happen when a new species of shrike was identified in 1988. The bird was seen in the grounds of a hospital near the town of Bulo Burti in Somalia. An entomologist and amateur bird watcher, Edmund Smith, recognised that it didn't belong to any of the known shrike species in the region. He only ever saw one individual and so was reluctant to catch it and kill it for a type specimen. The International Council for Bird Preservation advised him to catch the bird, take a blood sample for DNA analysis and then return it to the wild.

Blood traces on the ends of shed feathers were used for DNA analysis. By comparing this DNA with DNA from the blood and skins of other shrike species, scientists were able to confirm that this was indeed a new species.

The lucky shrike was later released in a nature reserve 60 kilometres to the south of the small habitat from which it was collected. It is the first new species ever to be recognised solely on the basis of DNA analysis and then to be set free. It was aptly named *Laniarius liberatus*. Time will tell whether or not this action was the most appropriate way to help conserve the species.

—C.A.

COURTESY YVES POIRIER

Carrie Arkinstall (science communicator for the CSIRO) and Karen McGhee (freelance science writer living in Newcastle) are regular contributors to QQC.

Laughter Breeds Laughter

Laughter is infectious. Poet Ella Wilcox noted it when she penned the phrase "laugh and the world laughs with you". And, for decades, the entertainment industry has successfully exploited the phenomenon with laugh boxes and recorded laugh tracks to stimulate audience response to comics and comedies.

One of the most powerful examples of the contagious nature of laughter was seen in Africa in 1963 when an epidemic of giggles and guffaws spread from a Tanganyikan boarding school through an entire district, forcing school closures.

Now, University of Maryland psychologist Robert Provine believes he has identified the stimulus behind contagious laughter. It is simply laughter itself. Provine came to the conclusion following a series of trials in which he observed the responses of a group of students to laughter recordings.

Provine believes that laughter is more than just an outpouring of hilarity, and that its infectious nature is not simply a curiosity but crucial to understanding the role of laughter.

Laughter, argues Provine, may be a relic mode of communication that pre-dates speech. Like yawning (see ANH Winter 1989), it is an example of a social process that synchronises the biological and behavioural state of a group, and this may have been an important mechanism in prelingual humans. It is possible there may be some neurological detector in the human auditory system designed specifically to recognise laughter.

—K.McG.

Plastic Plants

Most plastic is made from petroleum products tapped deep below the Earth's surface. Recently though, researchers have made plastic from a radically different source—genetically engineered plants.

The plastic is polyhydroxybutyrate or PHB. It is made naturally by many species of bacteria including *Alcaligenes eutrophus*, which makes PHB as a form of carbon (food) reserve. When these bacteria are grown in large fermenters, PHB is made commercially as a biodegradable plastic under

Granules of biodegradable plastic fluoresce as red dots in a genetically engineered mustard seedling.

the trade name 'Biopol'. But making PHB like this is quite expensive.

A cheaper alternative could be to transfer the two genes necessary to make PHB into plants. This was done by introducing the genes separately into mustard plants, and then interbreeding the plants containing the single introduced genes to produce plants with both genes. The genetically engineered plants produced 20 to 100 micrograms of PHB for every gram of plant tissue. Although this is quite a low yield, these experiments demonstrate that it is at least possible to produce this biodegradable plastic in plants.

There is one problem that is hindering attempts to improve the PHB yield—genetically engineered mustard plants become unhealthy. It is possible that, in the process of PHB production, important chemicals are being diverted away from the pathways needed to make life-sustaining compounds. Scientists are therefore thinking about using other kinds of plants that make and store compounds not necessary for survival. Potatoes, for example, could be engineered to make PHB instead of starch, which is not a compound they need to survive. If successful, plastic spuds may well become the crop of the future.

—C.A.

Suggested Reading

Davenport, J., 1992. Wingloading, stability and morphometric relationships in flying fish (Exocoetidae) from the north-eastern Atlantic. *J. Mar. Biol. Assoc. U.K.* 72: 25–39.

Dickman, C.R. & Braithwaite, R.W., 1992. Postmating mortality of males in the dasyurid marsupials, *Dasyurus* and *Parantechinus*. *J. Mamm.* 73: 143–147.

Ecroyd, C., 1993. In search of the wood rose. *Forest & Bird* Feb. '93: 24–28.

Poirier, Y., Dennis, D.E., Klomparens, K. & Somerville, C., 1992. Polyhydroxybutyrate, a biodegradable thermoplastic, produced in transgenic plants. *Science* 256: 520–523.

Provine, R.R., 1992. Contagious laughter: laughter is a sufficient stimulus for laughs and smiles. *Bull. Psychonomic Soc.* 30: 1–4.

Rubenstein, D.I. & Hack, M.A., 1992. Horse signals: the sounds and scents of fury. *Evol. Ecol.* 6: 254–260.

Singleton, G. & van Wensveen, M., 1992. 'Mouseomatosis' may spell the end of mouse plagues. *Aust. Grain* Aug.–Sept. 1992: 14–15.

Singleton, G.R., Spratt, D.M., Barker, S.C. & Hodgson, P.F., 1991. The geographic distribution and host range of *Capillaria hepatica* (Bancroft) (Nematoda) in Australia. *Internatl J. Parasitol.* 21: 945–957.

Smith, E.F.G., Arctander, P., Fjeldsa, J. & Amir, O.G., 1991. A new species of shrike (Laniidae: *Laniarius*) from Somalia, verified by DNA sequence data from the only known individual. *Ibis* 133: 227–235.

Smith, M.L., Bruhn, J.N. & Anderson, J.B., 1992. The fungus *Armillaria bulbosa* is among the largest and oldest living organisms. *Nature* 356: 428–431.

Webb, J.K. & Shine, R., 1992. To find an ant: trail-following in Australian blind snakes (Typhlopidae). *Anim. Behav.* 43: 941–948.

Wehner, R., Marsh, A.C. & Wehner, S., 1992. Desert ants on a thermal tightrope. *Nature* 357: 586–587.

QUICK QUIZ

1. **Name the floral emblem of New South Wales.**
2. **What is the nickname of the opalised pliosaur purchased by the Australian Museum in May 1993?**
3. **How many legs does a crab have?**
4. **What Earth-shattering event happened in Australia on 28 December 1989?**
5. **Who was appointed Federal Minister for Science and Small Business after the 1993 Federal election?**
6. **What is a coprolite?**
7. **Where in Victoria would you expect to find the Giant Earthworm?**
8. **Name the three main islands of New Zealand.**
9. **What does WWFN stand for?**
10. **Which other continent, apart from Australia, has native marsupials?**

(Answers in the Questions & Answers Section)

The House Fly is one of the most feared potential vectors of human disease.

LOUIE'S LAMENT

BY STEVE VAN DYCK

Despite the affection many people may feel for Louie the Fly, House Flies are capable of transporting more than 60 kinds of disease-carrying organisms and should definitely be kept at arms length.

HAVING FAT BANJO FROGS is not all beer and skittles. Those rubbery plunketting throats and bullfrog bellies rumble for more than just the occasional insect that goes for a sixer into their tank. Night after night, while sensible people sleep in bed, muggins here has to lurk in the roses with a torch and an empty peanut-butter jar, snapping at grasshoppers, katydids and Dorothy Perkins' thorns, all for the sake of eight Northern Banjo Frogs *(Limnodynastes terraereginae)* raised from the day they were but crotchets.

But on a steamy hot morning a month or so ago I thought I'd struck it rich—Lassiter's Lost Larder—an untapped pantry to fill my bullfrogs' bread-baskets. I could kiss the roses and barking dogs goodnight, for there outside the garage, the old garbage bin was erupting. Like lemmings on the brink of Nirvana, they were abandoning ship in a sheet—maggots—a boiling sea of miniature concertinas pumping themselves off into the long grass. Here was tripey tucker fit for a frog prince.

So I swept up a million or two and put them in an ice-cream container half filled with flour. When I was a boy we used to purge maggots this way for a day or so before feeding them to young birds. The reason for this is that the maggots, having profoundly unprejudiced stomachs, suck every imaginable form of bacteria out of the fruity muck they wallow in. This goes firstly into a crop, a halfway house from where it is then drawn on to be digested in the maggot's gut. Feeding fresh maggots to animals is thus like having them swallow hand grenades of concentrated bacteria and virtually guaranteeing them a tummy ache at the least or acute diarrhoea and death at the worst. (Even in humans the accidental swallowing of live maggots can lead to an uncomfortable condition known as myiasis in which the larvae continue to feed on the living tissue of the gut.) But after a day in flour the crop contents are digested and the gut is left 'clean' and empty. So with great expectation on all fronts, the next night saw the bullfrogs gather around the pulsating dish of lily-white *hors d'ouvres*.

None of them could hold their tongues for long and with great gusto they golloped down the animated macaroni.

For Steve and his frogs, this delicious plate of animated macaroni turned out to be a meal not soon forgotten.

PHOTOS: STUART HUMPHREYS / AUSTRALIAN MUSEUM

Adult flies do not eat solids; they feed by turning their food into a suckable bouillon.

Fifteen minutes later, while I was still slapping myself on the back for the gastronomic discovery of the year, the frogs started to look terrible.

An unforgettable thing was happening and I had to fight hard to hold down my dinner. Just as surely as the maggots had gone in end A of the frogs' alimentary tract, they were now emerging one by one from end B, larger than life, no worse for wear and slinking off into the soil.

To think that as a child I used to wonder why a generous slurp of Pine-O-Clean splashed into the old thunderbox made no difference to the frenetic churning going on below!

Maggots, there is no doubt, are tough. They have no eyes, legs or antennae but are covered with an impervious skin called a cuticle. This baggy outer layer is shed twice during the maggot's life . . . the second time, though, it toughens up to form a hard brown case in which the larva develops and finally emerges as an adult fly. It breaks out by filling its head with fluid and pumping this against the case until it ruptures.

Maggots, like flies, eat no solids. They salivate freely and excrete the enzyme tripsin, which quickly turns solid, non-fatty food into a suckable bouillon. The two grappling hooks on a maggot's head help it to hook its way along when moving, but the hooks are not used for feeding.

Although it's hard to imagine how they can bear to do it, maggots actually breathe through two holes . . . where else but at their tail end, and they will drown if the broth they are working their way through becomes too thin.

When a new House Fly *(Musca domestica)* emerges from its pupal case it is virtually disease free, having shed its gut lining inside the pupal case. However, in a short period of time it becomes one of the most feared potential vectors of human disease, capable of transporting more than 60 kinds of disease-causing organisms, including those responsible for typhoid, cholera, tuberculosis, dysentery, trachoma and food poisoning.

In one experiment, House Flies caught in a city slum were found to have an average of 3,683,000 bacteria adhering to the outside of their bodies. Not only are these bacteria spread to human food on the sticky taste-sensing hairs of the fly's feet, but the process of eating fly-style involves it regurgitating a grisly mix of digestive juices and incidental bacteria onto the food particle, thereby dissolving it to a liquid that can be sucked up.

And so prolific are flies at reproducing themselves that, according to the calculation of one entomologist with some spare time on his hands, if none of the flies died during a single summer breeding season, the descendants of one pair of House Flies would cover an area the size of Germany to a depth of 16 metres.

But where would Australian culture be without plastic-strip fly-doors outside greasy cafes, and streamers of spotty flypaper decorating the kitchen? And where would early TV advertising be without poor dead Louie?

Nostalgia aside, the introduced House Fly should be regarded with the suspicion it richly deserves. Given its potential as a disease carrier, the only buzz we should get out of its life is its last. ■

Suggested Reading

Dethier, V.G., 1962. *To know a fly.* Holden-Day: San Francisco.

Oldroyd, H., 1965. *The natural history of flies.* Wiedenfeld S. Nicholson: London.

Steve Van Dyck is in charge of the Mammal Section of the Queensland Museum where he has worked since 1975.

Despite the threats, there is room for optimism about the parrot's future.

ECLECTUS PARROT

BY STEPHEN GARNETT & GABRIEL CROWLEY

ABOUT 7,000 YEARS AGO the rising sea divided New Guinea from Australia and formed a barrier to many of the animals and plants that once moved freely between both landmasses. Over the ensuing millennia differences have evolved between the divided populations. Among them was a population of Eclectus Parrots *(Eclectus roratus)*, and today the subspecies *macgillivrayi* is confined to the rainforests on the Iron and McIlwraith Ranges on eastern Cape York Peninsula. The Australian subspecies is slightly larger and less glossy than its closest relative in southern New Guinea.

At present Eclectus Parrots are not uncommon within their restricted range. Most visitors to the area soon hear their coarse calls and see birds flying overhead, their stiff shallow wing beats and dumpy silhouettes looking more like cockatoos than the slender forms typical of Australian parrots. They feed primarily on fruit taken from both the rainforest and the surrounding woodland, and often occur in flocks, over 80 individuals having been seen roosting together.

Breeding appears to be communal. This means that, instead of a single pair attending a nest, there may be several birds of each sex helping to feed and protect the young. Such communal breeding, which is unusual among parrots, often evolves when there is a shortage of high-quality breeding habitat. In the case of the Eclectus Parrot, this shortage appears to be suitable hollows for nesting.

The Eclectus Parrot prefers hollows in trees that emerge above the rainforest canopy or that grow along the rainforest's edge. Presumably these sites give a good view from which to see birds of prey and other potential predators. Such nest sites are scarce and, once found, are used year after year. Interestingly the only two tree-nesting parrots in Australia to excavate their own hollows, the Red-cheeked Parrot *(Geoffroyus geoffroyi)* and the Double-eyed Fig-parrot *(Psittaculirostris diophthalma)*, also live in the McIlwraith and Iron Ranges.

Unfortunately for Eclectus Parrots, reliance on a few nest trees has left them vulnerable to people wanting to take them for the captive bird trade. Before the species was protected by law, ladders of iron pegs hammered into nest trees by trappers were a common sight at Iron Range. Now such theft is clandestine but nonetheless still occurs—a few years ago a film crew found evidence that 35 nests they had under observation were also being visited by trappers. Such predation is probably less frequent away from the few roads in the region but, because the area of habitat occupied by the parrots is so small, about that of the Blue Mountains in New South Wales, bird trapping is considered a real threat to the survival of the subspecies.

The problem is compounded by the suitability of the area for drug (marijuana) cultivation. Not only do the drug and bird smuggling industries have much in common but, because the area is so remote, attempts to contain them can only be conducted by the occasional police patrol. In fact, tracks into some parrot habitat are followed with trepidation for fear of finding something one shouldn't!

Nest trees at the edge of rainforest have also been affected by changes in fire regime. With an absence of fire, the rainforest moves into the woodland, rendering the marooned nest trees unsuitable. However, too many hot fires late in the dry season eat into the edge of the rainforest, destroying in particular the hollow trees Eclectus Parrots prefer. Both processes are occurring at Iron Range, although there is no research to say whether they represent a genuine threat to the parrots.

There is a third factor considered by some to be a threat to Eclectus Parrots—that of hunting by local Aboriginal people. However, while it occurs, the issue is more complex than at first it might appear. Parrot is probably a traditional food for local people, who would have been as adept as any trapper at climbing nest trees. Nowadays most hunting is likely to be along main roads so it probably affects only a small proportion of the population. The issue of hunting, particularly of threatened species, will be canvassed in the management plans that will be prepared for the Iron Range and other nearby national parks as part of the process of handing this land back to traditional owners. In the case of the Eclectus Parrot, it will be necessary to work out in cooperation with local Aboriginal people what is a suitable level of hunting.

Despite these threats, there is room for negotiation, and for optimism about the parrot's future. For a start the principal rainforest habitat is secure and there are no plans to exploit it for forestry or agriculture. Also, both the threats and their solutions are readily identified. Advances in genetics will soon make it possible to take DNA fingerprints of all Eclectus Parrots held in captivity in Australia, and so detect any trapped illegally from the wild. Fire research, too, is helping promote better fire management on the Cape, particularly in the national parks. There is work to be done, certainly, but there is every reason to believe that this large and spectacular parrot will still be surviving in 100 years time. ■

Advances in genetics will soon make it possible to take DNA fingerprints of all Eclectus Parrots held in captivity.

Suggested Reading

Forshaw, J.M. & Cooper, W.T., 1982. *Australian parrots.* 2nd ed. Lansdowne Editions: Sydney.

Garnett, S.T., 1992. Eclectus Parrot. *RAOU Report* 82: 79–80.

Drs Stephen Garnett and Gabriel Crowley were recently involved in a review of the status of Australian birds for the Australian National Parks and Wildlife Service. They are currently working on Cape York Peninsula on another threatened bird, the Golden-shouldered Parrot.

JOHN CANCALOSI / AUSCAPE INTERNATIONAL

A particularly irksome property of the sting is its habit of returning weeks and even months later.

LEAVES THAT STING

BY TIM LOW

THE MOST DANGEROUS LIVING thing in the rainforests of tropical Queensland is not a snake or spider but a shrub. The Gympie or Stinging Bush *(Dendrocnide moroides)* carries an armoury of stinging hairs that can inflict debilitating pain.

Gympie was the scourge of early pioneers, sprouting prolifically wherever tracks and clearings were forged into the rainforest. Edmund Kennedy declared in 1870 (with some exaggeration) that "if a certain proportion of any one's body is burnt by the *stinging-tree* death will be the result. I would as soon pass through fire". He also claimed: "I have known a horse so completely mad, after getting into a grove of these trees, that he rushed open mouthed at every one who approached him, and had, at last, to be shot in the scrub . . . Dogs when stung will rush about whining piteously, biting pieces from the affected part".

A particularly irksome property of the sting is its habit of returning weeks and even months later, especially when the site of the sting comes in contact with water. Gympie sprouts bunches of a raspberry-like 'berry', which looks enticing until you peer closely and see its scatter of stinging hairs. But as Robert Johnstone noted in 1903: "The fruit is edible after being rubbed in the grass or passed through the fire, to deprive it of its poisonous spines, and is often used for this purpose by the blacks, as it is often found where no water is". He praised the berry as "juicy, and always cold".

Australia has five species of stinging tree, all restricted to rainforests in Queensland and New South Wales. They are placed in the same plant family (Urticaceae) as the stinging nettles, of which Australia has one native species, the Scrub Nettle *(Urtica incisa)*. Its leaves can be safely boiled as a vegetable, and their sting is much milder, as noted by Johnstone when commenting on Gympie: "a bunch of common nettle condensed into one sting would hardly rival the keen time this innocent-looking plant is capable of inflicting".

To assuage the sting of stinging trees, many bushmen swear by the sap of the Cunjevoi *(Alocasia brisbanensis,* previously known in Australia as *A. macrorrhizos)*, a large-leaved lily often found beneath stinging trees. The honourable W. Pettigrew, MLC, exhibited Cunjevoi before the Royal Society of Queensland in 1885 with the following comments: "It is a well ascertained fact amongst residents in the Parishes of Mooloolah and Maroochi, to the north of Brisbane, that if a person is stung by contact with the leaf of the 'stinging tree' . . . and the affected part afterwards rubbed at intervals during an hour or so, with the leaf of the Cunjevoi, the pain will cease and not return again; whereas, should no such application be made, the pain will return for a considerable time after, whenever the injured part is made wet". Johnstone reports the same remedy from northern Queensland Aborigines, although it appears to be unknown among such communities today. Medical consensus is that this treatment does not work, except

The Shiny-leaved Stinging Tree has tasty fruits and carries only a few stinging hairs on its fruits and leaf undersides. It occurs in eastern Australia south to Newcastle.

PHOTOS: TIM LOW

Gympie is common in Queensland rainforests where its berries are eaten by the Southern Cassowary and other birds.

perhaps by wiping away some of the stinging hairs.

Aborigines made string for fishing nets from the bark of stinging trees. They also made creative use of the sting. Early this century a Mr Crawford of Walcha told of New South Wales Aborigines curing a man so stricken with rheumatism he could not walk: "The blacks took him in hand, stripped him, laid him out on a sheet of bark, rubbing him with the young leaves and bark of the [Giant Stinging Tree, *D. excelsa*] pounded up and boiled until it was of the consistency of treacle. It is said that they almost rubbed the man's skin off, but they cured the patient". This treatment has parallels with urtication, or flogging with nettles, a traditional European remedy for rheumatism. Aborigines in New South Wales also practised urtication using native nettles. The treatment may assist by drawing blood to the afflicted site.

Perhaps the most bizarre use to which a stinging tree has been put was recorded by ethnographer Walter Roth in 1901: "At certain corroborees on the lower Tully River some of the blacks will chew, and spit out again, the leaves of the 'stinging tree' . . . The immediate effect is apparently a condition of frenzy, in which the individual may take violent action on his mates, or perhaps more commonly produce in himself a grossly disgusting perversion of the alimentary functions which enables him to eat human excreta".

I doubt that I will ever try chewing a stinging tree leaf, but I have mustered enough courage to sample the berries of the three more common species, after rubbing them in a handkerchief to remove the hairs, and found them to be pleasant eating. The Giant Stinging Tree has a pink or white fruit which, like that of Gympie, tastes a bit watery, while the Shiny-leaved or Mulberry-leaved Stinging Tree *(D. photinophylla)* has a tangy, creamy white fruit well worth trying (and its stinging hairs are few).

If you do happen to be stung on the skin by a stinging tree, Paxyl spray may provide relief; it is commended in a recent newsletter of the Queensland Naturalist's Club. A depilatory wax treatment will also help by removing the stinging hairs. I was told of this latter treatment on a recent trip to Mackay, where farmers call Gympie 'Moonlighter' because it "lights up at night". This charming illusion is attributed to moonlight reflecting off the fine stinging hairs. ■

Scrub Nettle can be boiled and served as a tasty vegetable. Its leaves were baked on hot stones and eaten by Murray River Aborigines.

Suggested Reading

Johnstone, A.R., 1984. *Reminiscences of pioneering in north Queensland.* J.W. Johnstone-Need: Cairns.

Kennedy, E., 1870. *Four years in Queensland.* Edward Stanford: London.

Tim Low is a Brisbane-based environmental consultant and the author of four books about edible and medicinal plants, all published by Angus & Robertson.

Scientific skills applied with local knowledge would make all the difference.

BEFORE GREENHOUSE

BY ROBYN WILLIAMS

ARE WE THE VERY FIRST folk to be worried about trees and climate? Is it suddenly our generation that has been galvanised by environmental concerns, made green by the urgings of Davids Bellamy and Suzuki?

I suspect you know the answer to that, but you may not be aware of how much was known popularly over a century ago. A Radio National listener was kind enough to send me a copy of Chambers' *Journal of Popular Literature, Science and Art*. Its price was a penny-halfpenny and was "conducted" by William and Robert Chambers in the 1870s.

These were their prescient words on forests: "Forests have uses in nature not usually thought of. They furnish wood—that we know. They shelter the lands against piercing winds. They are generally beautiful to the eye—at least a relief to bareness. But that is not all.

"They modify, or rather avert, destructive torrents of rain. The evil effects of the wholesale cutting down of extensive tracts of timber are, it may be said, only beginning to be felt. Direful results have ensued, and now it is to be hoped we are taking warning."

So much is good, sensible land management—wisdom acquired by observing the changing terrain and using common sense. But it's in the next passage that one sees solid scientific insight, including a startlingly accurate appreciation of what we now call the Greenhouse Effect.

"Forests, it seems, have a fourfold effect on climate and rainfall. There is the chemical action of their leaves, which decompose the carbonic acid of the air, fixing the carbon in their woody tissue and liberating the oxygen. There is their physical action in hindering evaporation and stopping currents of air, and in covering the ground with a vegetable mould which holds water like a sponge. And there is the organic action of the leaves, which, in breathing, restore to the air a part of the water which the roots have drained from the soil. Lastly, there is the mechanical action of the roots, which, at once, prevent the earth from being washed away by rain and also enable the water to filter deep into the ground.

ESTHER BEATON

Despite century-old concerns about deforestation in Australia, the clearing still continues.

"Forests, then, ought to make a country cooler, by withdrawing the carbon from the air; the heat that is set free when wood is burned is the very heat that was being absorbed when it was growing. A forest may be looked on as a condensing apparatus for storing up the atmosphere. That is what theory says, and experiment confirms it."

Not bad for 9 September 1876! And the authors did not fall for that common misconception that forests act as lungs—providing the oxygen we need. They certainly yield oxygen, as a result of photosynthesis, but then take it up again when respiring. The bulk of the oxygen in the air may well come from huge reserves in the ocean built up over the millennia by action of algae and plankton.

However, the Chambers' sensitivity to the importance of forests coincides with the heyday of their being felled in Australia. Little was known by the perpetrators of the mischief that the penalties in the shape of salination, erosion and temperature rise would often make farming impossible in but a few generations on. Climate too would be affected, in Australia, India and America, by the clearing of forests.

All this is superbly demonstrated at the Australian Museum's Discovery Room, where you can be in charge of a forest of your own—housed in a computer program. I've seen many a youngster staring at the green trees on the screen, wondering whether it's safe to chop ten per cent of the trees for logging purposes only to discover that, as a result, the temperature rises by 8°C, the wind becomes twice as fierce, and half the wombats die!

If only they'd had computer terminals for a trial run in the 19th century! Trouble is that, even now, clearing continues apace, despite the evidence that it is counterproductive. And, when I attended the First World Conference of Science Journalists held by UNESCO in November 1992, a majority of us agreed that felling would continue and that there would be few reserves of rainforest in 50 years time.

I believe the answer is to provide technology to the 'Third World' that will enable them to be independent of the plundering of their primary resources. They are as aware as Australians, in many of these poorer countries, of the penalties attached to losing their forests. A combination of international debts, shortsightedness and desperation seem to leave them little choice. We could help. Scientific skills applied with local knowledge would make all the difference.

This is how the Chambers put it 117 years ago. "These, then, are the two great uses of forests—to increase the rainfall, and to prevent it from coming in devastating floods, instead of in fertile showers. The first is most valuable in hot countries. It is sad to think what mischief has been wrought in the fairest countries of the world by reckless destruction of forests.

"Persia, the whole Indus valley, the valley of Euphrates; and, above all, Lesser Asia, have each of them suffered grievously from this waste. Lesser Asia, the Greeks looked on as the Garden of the World, it is now subject to droughts like that which not long ago spread death through whole provinces. The same everywhere. The millions of mulberry trees planted in Egypt since Mehemet Ali's time have actually brought rain to the hitherto rainless land, the plantations here and there along the Suez Canal are doing the same."

We were warned. And advised of the alternatives. Nowadays there should be no excuse. ■

Robyn Williams is Presenter of Radio National's Science Show. His work brings him constantly in contact with the changing trends in science.

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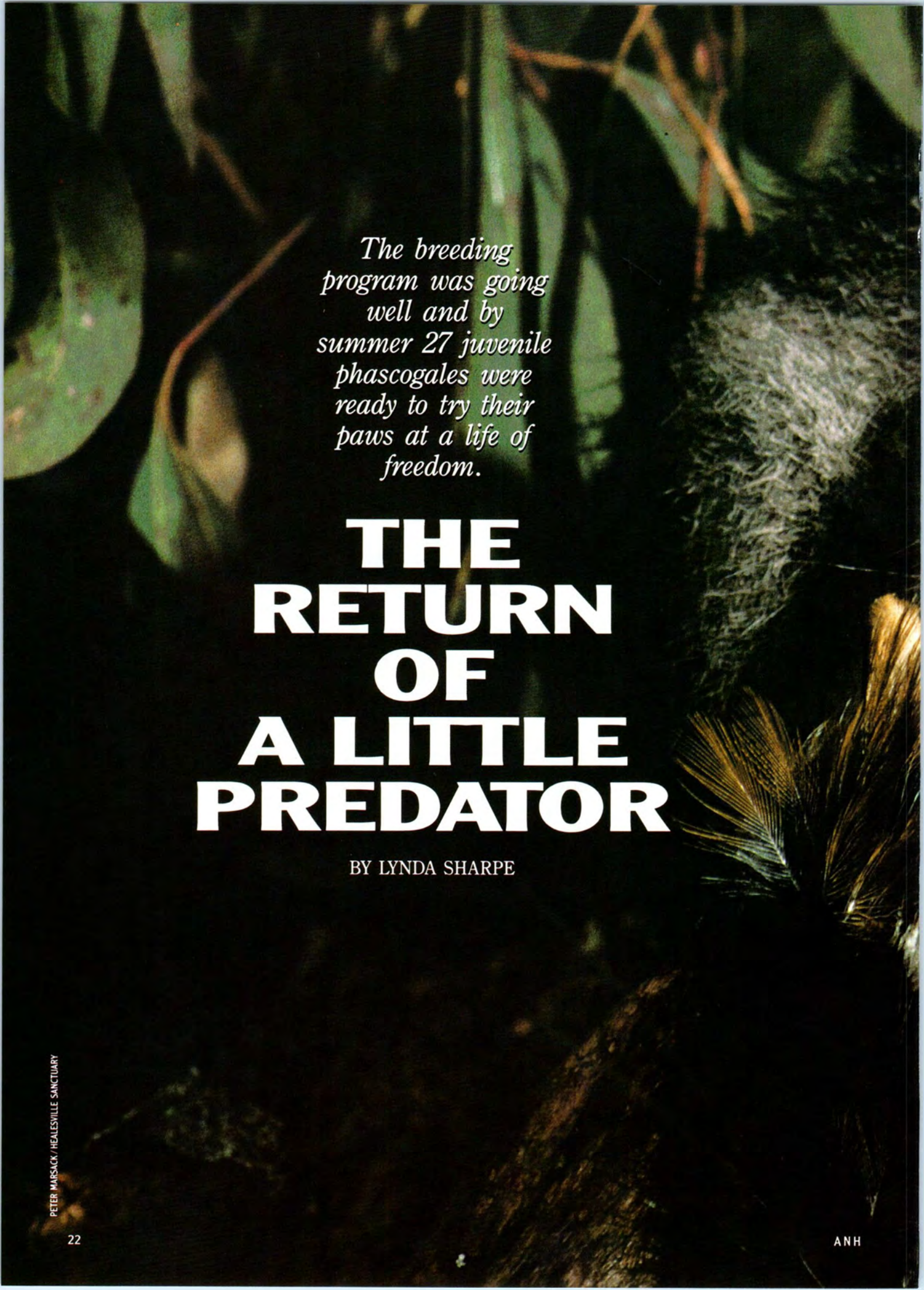


The breeding program was going well and by summer 27 juvenile phascogales were ready to try their paws at a life of freedom.

THE RETURN OF A LITTLE PREDATOR

BY LYNDA SHARPE

PETER MARSACK / HEALESVILLE SANCTUARY

Although once known as 'vampire marsupials' and accused of the blood-thirsty slaughter of chickens, Brush-tailed Phascogales usually stick to a diet of insects and spiders. They will, however, dine on nectar and small vertebrates, like this robin, if available.

PETER MARSACK / HEALESVILLE SANCTUARY

Remarkably agile climbers, Brush-tailed Phascogales spend most of their lives in the trees.

THE PIECE OF CARDBOARD QUIVERED and tore. Needle-like teeth gnawed at the broken edge, then a small paw pushed through the gap and pulled away the pieces that still blocked the nest box entrance. In the red glow of the spotlight I could see a long pointed nose, large dark eyes and delicate ears that flickered in response to a forest-full of sound.

This was the beginning. Not only for the Brush-tailed Phascogale *(Phascogale tapoatafa)* poised above me, but of an exciting experiment. What was to happen in the following months would have far-reaching effects.

Emerging from the box, the grey-furred phascogale revealed a fluffy black tail larger than her body. For a moment she paused, gazing out at an unfamiliar world, then jumping sideways she began to probe a crevice in the bark with eager paws. Even from where I sat I could hear the succulent crunching that marked the demise of her insect prey. She then darted up the tree trunk, raced along upside down beneath a branch and, leaping into the twigs of an adjacent tree, disappeared from view.

A light coming through the trees heralded the arrival of Todd Soderquist, a PhD student from Monash University who has been studying Brush-tailed Phascogales in the wild for almost four years. It was at his invitation that I was now standing in a forest in Central Gippsland, Victoria. He looked pleased. "Well the cardboard kept them in until dark", he said, as we pushed through a thicket of tea-tree that lay between us and the car. "And they certainly seem at home."

Brush-tailed Phascogales are a poorly known species, a fact that can be tiresome for Todd. With extraordinary perseverance he answers the queries of perplexed neighbours and petrol station attendants, explaining that phascogales are carnivorous marsupials that hunt insects in the trees at night. "Ah, they're possums!" is the inevitable reply. Todd's jaw clenches. Patiently he explains that phascogales are not possums but carnivorous marsupials, and draws from his wallet a photo of one dangling upside down on a tree trunk. Without fail, his audience turns the picture 90 degrees, reducing the phascogale's remarkable acrobatic skills to possum plausibility. "Oh yes," comes the knowing response, "a possum".

But the wearisome aspects of studying a little-known species are nothing to the problems created by studying a rare one. And Brush-tailed Phascogales are rare. Even in prime habitat, one individual every 35 hectares is the norm. To catch wild phascogales Todd must spread his traps over tens of square kilometres, and even then he's lucky to capture one in a week of trapping. But for a scientist interested

BRUSH-TAILED PHASCOGALE

Phascogale tapoatafa

Family
Dasyuridae (carnivorous marsupials). Closest relative is Western Australia's Red-tailed Phascogale *(P. calura)*.

Identification
Grey head and back; cream underneath. Distinctive black bottle-brush tail.

Range
Woodland and dry sclerophyll forest throughout mainland Australia.

Breeding Cycle
Mating occurs in June and July. Up to eight young born a month later, and carried in the pouch for seven weeks. Then deposited in nest, where they stay until 16 weeks old. Independent of mother by 20 weeks. Sexually mature at 10 months.

Status
Potentially vulnerable. Rare in Victoria and New South Wales. Probably extinct in South Australia.

PETER MARSACK / HEALESVILLE SANCTUARY

Healesville Sanctuary's phascogale colony was founded primarily with orphaned wild animals that were raised by hand.

in reproductive strategies, the phascogales' unusual breeding habits are a strong lure. At the same time each year, after the one short breeding season, all male phascogales living in the wild die. Like their small cousins the antechinuses, male phascogales invest so heavily in breeding that their immune systems fail and, just before their first birthday, they succumb to stress-related illnesses. By contrast the females can live until they are three, raising their young alone, free from competition with their mates.

But the Brush-tailed Phascogale's unusual 'one chance' mating system is now threatening its existence. If a localised population of phascogales fails to reproduce in any one year (due to heavy predation or adverse weather, for example), its extinction is guaranteed. Once, young phascogales dispersing from neighbouring populations would have recolonised the area, but today, much of their dry forest and woodland habitat has been cleared and the remainder fragmented. These small patches of forest, isolated by farmland, are almost impossible to recolonise so localised extinctions are now permanent and, bit by bit, the Brush-tailed Phascogale is disappearing. Since European settlement, the species' range has shrunk by 40 per cent in Victoria and New South Wales, and in South Australia it appears to be extinct.

Todd, well aware of the Brush-tailed Phascogale's plight, decided it was time to halt this decline. Surely it was possible to re-establish lost populations artificially. Unfortunately, wild phascogales are too rare for animals to be shifted from one site to another (called translocation). Todd's studies hadn't only revealed that the species is sparsely distributed, but that foxes, owls and cats kill two-thirds of the youngsters born each spring. None of Victoria's natural phascogale populations could withstand the removal of animals for translocation.

But what about animals bred in captivity? Couldn't they be released into vacant habitat? No-one knew. Would a captive-bred phascogale be able to catch its own food, find sheltered nest sites, elude hungry predators or even find its way around without becoming lost? These questions were an added stimulus to Todd. Discovering the answers wouldn't only benefit phascogales, but would generate information important for saving other endangered marsupial carnivores, like their closest relative the Red-tailed Phascogale *(P. calura)*, the Kowari *(Dasyuroides byrnei)* and quolls *(Dasyurus* spp.).

FOR HELP WITH HIS AMBITIOUS PLAN Todd turned to Healesville Sanctuary. Nestled in the foothills of the Great Dividing Range, 60 kilometres east of Melbourne, the Sanctuary is a special kind of native fauna park. Established in 1920 as a native animal research centre, the park became a sanctuary for wildlife in the 1930s, and today it not only maintains captive breeding colonies of 20 species of threatened fauna, but it displays, within a lush forest setting of tree ferns and manna gums, almost 200 species of wildlife. The Sanctuary, with its strong commitment to conservation, understands that captive breeding alone can't save species, and as a consequence the park is heavily involved in habitat regeneration and research into the needs of wildlife and habitat management techniques. The proposed reintroduction of Brush-tailed Phascogales was clearly of high conservation value, and the Sanctuary not only agreed to provide animals and assistance, but (in cooperation with Chicago Zoological Society) financial support as well.

But there was a problem. The Sanctuary's phascogale colony, although prolific due to innovative husbandry techniques, had been founded with individuals from New South Wales. Genetically, these animals would be different to the wild phascogales living in Victoria. If successfully released into the State, they might end up breeding with Victorian phascogales, altering—perhaps harmfully—the genetic make-up of the Victorian population. But couldn't Todd use the Sanctuary's stock to test the feasibility of reintroducing the species—provided they didn't breed? And in the meantime Healesville Sanctuary could breed Victorian phascogales.

Over the years Healesville Sanctuary has developed considerable expertise in the veterinary care of wildlife. With the public bringing in more than 1,000 sick or injured native animals each year, the Sanctuary's veterinary department has coped with almost every conceivable

Ten-week-old phascogales, born and bred at Healesville Sanctuary. In about another four weeks they will be taken from their nests and relocated into Gippsland forest.

MARK GRIFFIN / HEALESVILLE SANCTUARY

emergency. But never had the park's vets been asked to perform vasectomies on phascogales!

Watching as the vet fitted an anaesthetic mask over the little pointed nose, and the small grey form on the operating table went limp, I must admit I felt a twinge of apprehension. But, in this instance at least, my fears were groundless. The vets, with white-coated efficiency, performed the finicky operations without a hitch. The fitting of radio collars a few days before the animals' release was an uglier affair. Gazing appalled, as a blood-spattered phascogale writhed in Todd's grasp, I didn't realise for several shocked moments that the blood and whimpering cries were coming from Todd and not the needle-toothed marsupial!

After exhaustive health checks, 20 Sanctuary-bred animals were tucked up in their home nest boxes and relocated to the forests north of Heyfield. This area, like the rest of Gippsland, had lost its original phascogale population more than two decades before.

AS THE RAIN TRICKLED A LITTLE further down inside my collar and I stumbled over yet another log, I wondered why I'd ever agreed to help Todd. Striding ahead with the radio aerial thrust out before him like a divining rod, he seemed oblivious to everything but the radio receiver buckled at his waist. Todd was tracking a newly freed phascogale, but I, straggling behind, was dreading what we would find.

And there was good reason to be anxious. Although the animals had proven remarkably adept at catching insects (sometimes even scorning Todd's supplementary offerings of mealworms), and their innate navigational skills were my secret envy, there was one thing they couldn't do: avoid predators. One by one they fell victim to foxes and cats. Each morning we'd track the survivors—long, anxious minutes trudging through the bush—only to be confronted by a few tufts of grey fur, a silky black tail and a tooth-marked radio collar. Within five days, ten of the Sanctuary-bred phascogales had been lost, and by the end of a month only two survived.

Todd, used to the heavy losses suffered by wild phascogale populations, remained positive about this trial reintroduction. After all, it was identifying problems so they could be corrected for the real reintroduction attempt. One such problem was the tendency for males to disperse long distances, losing contact with the females and sacrificing their chance to breed. In a plane bewhiskered with radio aerials, we tracked one male to a tiny cluster of trees three kilometres from the nearest forest—quite a feat for a small tree-dwelling animal!

But back at Healesville Sanctuary the breeding program was going well. And by the following summer 27 juvenile phascogales were ready to try their paws at a life of freedom.

PETER MARSACK / HEALESVILLE SANCTUARY

Young phascogales are fitted with special radio collars that expand as the youngsters grow.

This time Todd chose Moondarra State Park, north of Moe. Unlike the fragmented forest near Heyfield, this site was far from farmland and should harbour fewer cats and foxes. In an attempt to eliminate these pests entirely, Todd, with assistance from the Department of Conservation and Natural Resources, embarked on an intensive control program, burying poisoned meat baits along roads and tracks, where keen-nosed foxes quickly plundered them. His efforts to capture feral cats, in live traps baited with dead rats, proved less successful. In fact, his only catch was a phascogale, found next morning snuggled up companionably with the bait!

Yet Todd's efforts paid off. Of the 27 phascogales released (and this time they were set free as soon as they were weaned, simulating wild dispersal patterns), only five fell prey to feral cats, and none to foxes. He also managed to curtail the wanderings of the males, by releasing them two weeks later than the females. The males, gearing up for the breeding season, were not so keen to desert a locality soaked with female scent!

But there were still problems. Although survival rates were substantially improved

LYNDA SHARPE

(three-quarters survived the first five days, compared with half in the trial release, and half survived the first month, compared with one-tenth previously), the phascogales were still dying. Todd tracked two radio collars to the bellies of replete goannas, and birds of prey were taking a heavy toll. One young male was even hit by a car on a quiet bush track that carried a maximum of two vehicles a night! These losses, although from diverse causes, suggested the captive-bred phascogales possessed a fearlessness unheard of in their wild counterparts.

Ultimately, two females survived to give birth (the last males died naturally after mating), and one mother successfully raised her seven young to independence. Clearly this budding wild population was going to need supplementing with more captive-bred animals. Surely there was some way of making them more wary.

After much racking of brains and sceptical assessment of US attempts to increase wariness in captive-bred Black-footed Ferrets by using dogs and mechanical badgers, Todd hit on a plan. If it was the time spent in captivity (prior to weaning) that dulled a phascogale's native caution, why not eliminate this phase entirely?

Cats, which end the lives of many juvenile phascogales (both wild and reintroduced), often leave the carcasses uneaten.

Todd achieved this in an ingenious way. Hidden deep in the bush near the Moondarra release site, he built three large cages, each of which carried several small holes. Although these portals would allow the juveniles to clamber in and out of the enclosure, they were too small to be used by a full-grown adult. Into the cages Todd transferred three of the Sanctuary's mother phascogales with their 19 Sanctuary-bred offspring which, at that stage, were still dependent on their mothers and had not yet ventured from the nest. Once the youngsters were old enough to creep out of their nest boxes, they took full advantage of the holes, squeezing out of the enclosures each night to climb and forage in nearby trees. Sometimes they'd venture hundreds of metres through the forest before racing back to the cages to suckle their mothers and nibble at the food Todd left there each day. Because Brush-tailed Phascogales are self-taught hunters, the youngsters were not affected by their mother's absence in the 'real world', and roaming the forest at night, they'd never really experienced captivity.

The results of this innovative release exceeded all expectations. The juvenile phascogales survived their early sallies out of the enclosures, even though cats and owls prowled close by. And ten weeks after first venturing into the forest, all 19 individuals, fully weaned and dispersing naturally, were doing just fine. ■

Habitat fragmentation, feral predators and an unusual breeding habit appear to have pushed the Brush-tailed Phascogale to the edge of extinction.

JIRI LOCHMAN / LOCHMAN TRANSPARENCIES

Suggested Reading

Cuttle, P., 1982. Life history strategy of the dasyurid marsupial *Phascogale tapoatafa*. Pp. 13–22 in *Carnivorous marsupials*, ed. by M. Archer. Royal Zoological Society of New South Wales: Sydney.

Halley, M., 1992. Maintenance and captive breeding of the Brush-tailed Phascogale *Phascogale tapoatafa* at Healesville Sanctuary. *International Zoo Yearbook* 31: 71–78.

Kleinman, D.G., 1989. Reintroduction of captive mammals for conservation. *Bioscience* 39: 152–161.

Sharpe, L.L., 1992. Fostering phascogales. *Wildl. Aust.* 29(3): 10–12.

Lynda Sharpe has a background in zoology, with a particular interest in the behaviour of carnivorous marsupials. After six years writing and producing publications on social and cultural issues, she is now fulfilling her interest in environmental education, working as Communications Officer at Healesville Sanctuary.

STEPHEN NICOL

It takes many thousands of Antarctic Krill per cubic metre of water to turn the ocean red (inset), and it is this aggregating nature that has attracted the interests of the fishing industry. But why they sometimes break their normal pattern and come to the surface during daylight hours remains a mystery.

Antarctic Krill would have to be one of the most abundant and successful animal species on the planet.

ANTARCTICA'S KRILLING FIELDS

BY STEPHEN NICOL

"ANTARCTIC KRILL ARE TINY SHRIMP-like crustaceans." This phrase has been repeated so often that many people are surprised when they actually see them for the first time. At six centimetres adult length and over a gram in weight, most people comment on how *big* krill are.

The constant underestimation of the size of krill is probably the result of a general lack of public awareness about them and their importance in the Antarctic ecosystem. The animals most commonly depicted in books and articles about the Antarctic are the whales, seals and penguins but seldom is much space given to the animals that are their prime food source. This is unfortunate because Antarctic Krill *(Euphausia superba)* would have to be one of the most abundant and successful animal species on the planet.

Most pictures of krill are either drawn or photographed from dead or dying specimens. Krill are difficult to keep in aquariums so most biologists have to be content with studying them pickled. Dead krill are opaque and their bodies are usually curled up. When they are alive, however, they present a much prettier picture. They are mostly transparent, although their shell is tinged a bright red by small pigment spots. They have large black eyes and a digestive system that is often vivid green from the pigments of the microscopic plants they have eaten. Their overall appearance is quite beautiful and very different to the evil-smelling specimens preserved in formalin in laboratory jars.

Krill is a general term used to describe about 85 species of open-ocean crustaceans known as euphausiids. They look like smaller versions of more familiar crustaceans such as prawns or lobsters, and range in size from small tropical species less than a centimetre in length to little-known deep-sea giants that can reach lengths of 14 centimetres. All species of krill have a recognisably crustacean shape; that is, they have an elongated head-trunk region (cephalothorax) and a muscular, segmented tail (abdomen) to which are attached five pairs of paddle-like swimming legs.

The head region houses up to 13 pairs of modified limbs that gather food, manipulate it, grind and ingest it. The last six pairs (the 'thoracic' limbs) form a specialised 'food basket', with fine bristles that project from them forming a net-like structure. During feeding, these limbs are thrown down and outwards enclosing a parcel of water, and the water is squeezed out through small flap valves in the 'basket' leaving particles trapped on the inside from where they are passed to the mouth. Antarctic Krill are mainly herbivorous, feeding on the phytoplankton (microscopic suspended plants) of the Southern Ocean, but planktonic animals (zooplankton) may also form part of their diet.

STEPHEN NICOL

Antarctic Krill are open-ocean crustaceans similar in appearance to prawns. Their behaviour and aspects of their biology are, however, far more mysterious.

In summer, female Antarctic Krill lay up to 10,000 eggs at a time, sometimes several times a season, into the surface waters of the Southern Ocean. The eggs are thought to sink, perhaps as deep as 2,000 metres, before hatching. They then begin their long (up to ten days) 'developmental ascent', during which the newly hatched larvae journey up towards the sunlit waters to feed.

Once krill have surmounted their first hurdle and have reached the surface waters, they begin to grow and change, becoming more like the adult as time progresses. Antarctic Krill larvae face a second great hurdle of their life with their first long, dark, ice-bound winter. No-one is quite sure how krill, young or old, survive the Antarctic winter. They do not seem to build up large fat reserves, so must either use some food available under the ice (such as the algae that grow on the underside of the pack ice, detritus on the sea-floor or the other animals in the water), or utilise some internal store other than fat. Evidence for the latter comes from laboratory studies in which Antarctic Krill were found to be able to withstand long periods (up to 200 days) of starvation. They do this by shrinking, using up the very material of their body to meet their metabolic needs. Krill, like all crustaceans, grow by moulting; that is, they cast off the old confining shell and expand in size while the new one is still soft. What seems to be unique in krill is the ability to use this process in reverse (in other words, to shrink) when food is absent. It certainly tends to confuse ecol-

The pink guano around these penguin colonies shows just how much these animals depend on Antarctic Krill as a food source.

ANTARCTIC KRILL

Euphausia superba

Classification
Phylum Arthropoda, class Crustacea, order Euphausiacea.

Identification
Look like small prawns, up to six centimetres long, can weigh over a gram as adults, five pairs of swimming legs, large black eyes, occur in vast swarms that can colour the water red.

Distribution
Circumpolar in Antarctic waters; approximate area of distribution 35 million square kilometres.

Population Size
At least 500 million tonnes (about 5 x 10^{14} individuals).

Life Cycle
Probably live for five to ten years in the wild, becoming mature after two years.

Food
Mainly planktonic plants.

Major Predators
Baleen whales (Blue, Fin, Minke), Crab-eater Seals, fur-seals, Adelie and Macaroni Penguins, petrels, fulmars and shearwaters, squid and fish.

Economic Uses
Have been harvested since mid-1970s, current catch just under 300,000 tonnes per year; major catching nations Russia, Ukraine and Japan; uses include fish farm feed, domestic animal feed and products for human consumption.

STEPHEN NICOL

JONATHAN CHESTER / EXTREME IMAGES

Adelie Penguins *(Pygoscelis adeliae)* are one of the major predators of Antarctic Krill.

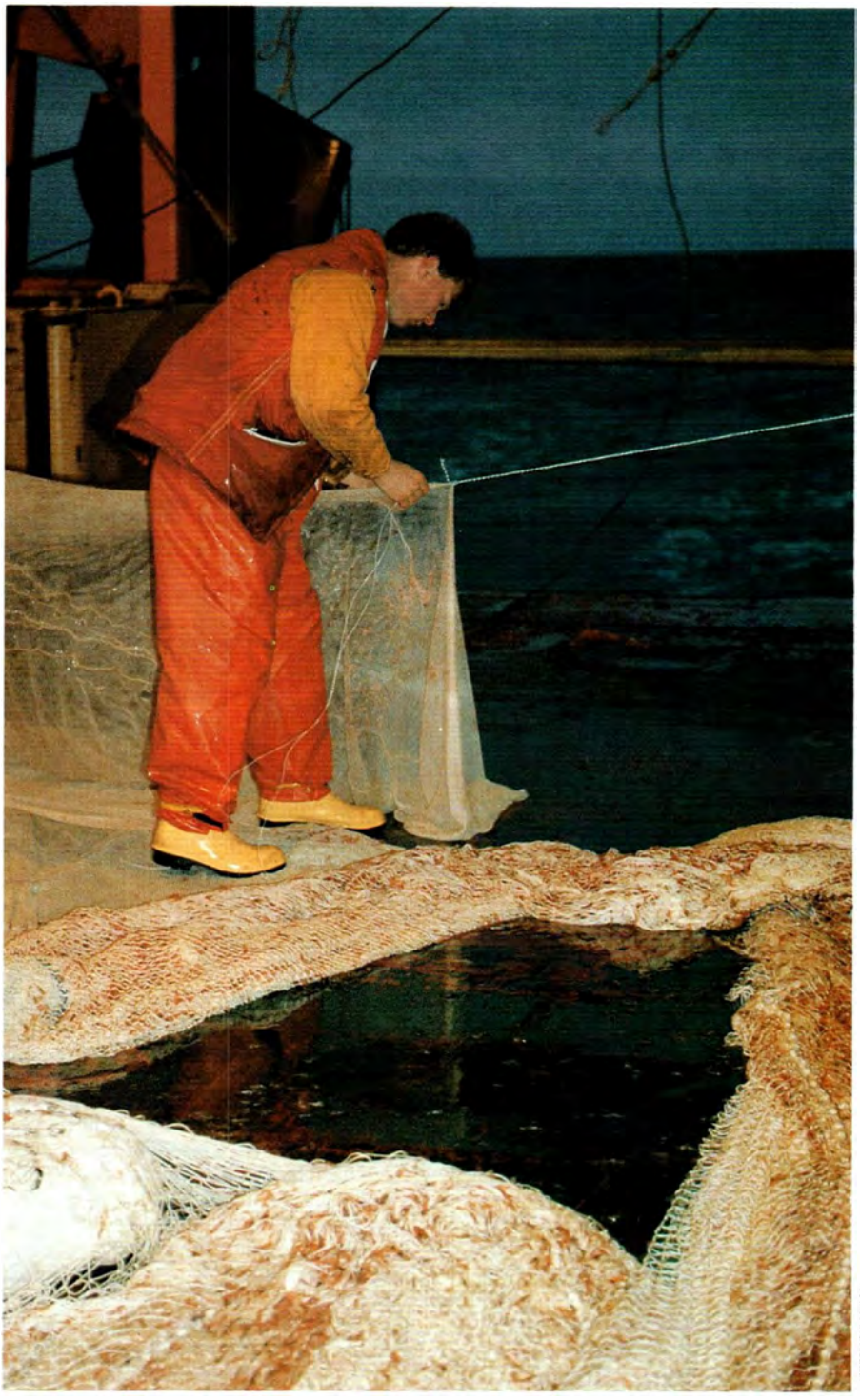
ogists when the individuals emerging from under the ice in spring are noticeably smaller than the ones that went in the previous autumn!

As krill come to resemble adults they begin to aggregate into huge schools or swarms, sometimes stretching for kilometres in every direction, with many thousands of krill packed into each cubic metre of water often turning the water red or orange. The first seamen who ventured into the waters around Antarctica were confused by discoloured patches on the surface of the water. Captain Cook may even have mistaken one of these patches for shallow water, leading him to suspect he was near land. Surface swarms of krill, however, are not a common sight. Most of the time schools remain unseen, at depth during daylight hours and only rising to the surface at night. This diurnal vertical migration is a behaviour adopted by a variety of aquatic animals but is perhaps exhibited in its most spectacular guise by Antarctic Krill. Just why krill occasionally break the rules and arrive at the water's surface during broad daylight is still unknown. In some species it is linked to reproduction but in others there seems to be no rhyme nor reason to it. One thing is certain, though, and that is, when they reach the surface, they immediately become prey for myriads of surface-feeding predators such as seabirds, squid, fish or whales. It is the aggregating nature of krill that has enabled the baleen whales to evolve their feeding habits; if krill were any less dense, great whales would not be able to filter enough water to strain out sufficient prey, and their great size attests to the abundance of krill.

THE OBVIOUS ABUNDANCE OF KRILL has not gone unnoticed by fishing fleets searching for new species as traditional ones are fished out. One small species of krill has been harvested off the coast of Japan for the last 40 years and is used mainly as food for farmed fish. Since the 1960s, however, attention has been turned to Antarctic Krill, mainly because of its huge range (around 35 million square kilometres or four and a half times

the area of Australia) and colossal abundance. Estimates of krill abundance made in the 1960s, based on the amount of krill freed up by the removal of the baleen whales from the Southern Ocean, suggested a sustainable krill harvest of around 150 million tonnes a year. This astronomical figure is put into perspective when one considers that less than 100 million tonnes of all species of fish and shellfish are currently harvested from the oceans of the world each year. Indeed, the biomass of this one species may be the largest of any multicellular animal species on the planet.

Right from their first scientific discovery, there has been speculation about using Antarctic Krill for food. In the reports of the German South Polar Expedition of 1901–1903, Von Drygalski noted catching



STEPHEN NICOL

Some quick repair work is required as a fishing net bursts under the weight of a large catch of Antarctic Krill. The impact that the removal of large quantities of krill will have on the Antarctic ecosystem is of concern to many scientists.

NICK GALES / LOCHMAN TRANSPARENCIES

If Antarctic Krill arrive at the ocean's surface during daylight they immediately become prey to birds such as this Southern Fulmar *(Fulmarus glacialoides)*.

"huge quantities of shrimps [krill]" close to the ice "in such quantities that we were able to eat them too; they tasted quite good, but they were rather small and tiresome to peel . . . ". In this they anticipated some of the problems later faced by the commercial fishery.

Commercial krill fishing began in the early 1970s and has continued unabated ever since. The current catch is a little under 300,000 tonnes a year which, although down on the peak years of the early 1980s, is still by far the largest catch in Antarctic waters. Krill are caught by large freezer trawlers and processed on board into products for human consumption, domestic animals (cattle, poultry, pigs and mink) and farmed fish.

There are a number of problems associated with the krill industry. For a start, Antarctic Krill are found in a remote location that is expensive to get to and operate in. And there are a number of biological obstacles too. They have extremely powerful digestive enzymes that tend to spoil the catch by breaking down the krill's body tissue soon after death. Krill shells are also rich in fluoride so they have to be removed before the meat is fit for human consumption. These processing problems all add to the cost of production and so the fishery has failed to grow as fast as some had initially predicted. Currently only six nations are actively involved in the fishery: South Korea, Chile, Poland, Japan, Russia and the Ukraine, with the last three accounting for 96 per cent of the catch.

The slow growth of the krill fishery has come as a relief to those concerned about the impact of krill harvesting on the Antarctic ecosystem. Most of the larger Antarctic animals–the seals, whales and seabirds, as well as the less well known fish and squid–depend directly or indirectly on Antarctic Krill. We have little idea what impact the removal of large quantities of krill from the ecosystem will have, although it is fairly safe to say that it is unlikely to be benign. To be sure, there is room for a large harvest of krill, especially if the areas fished are spread around the Southern Ocean to lessen the local impact, but the rate at which the fishery can grow and the maximal catches that are permissible should be determined in advance.

The prospect of a free-for-all fishery for Antarctic Krill led to the signing of a unique fishing treaty in 1981. This is the Convention on the Conservation of Antarctic Marine Living Resources, designed to protect the Antarctic ecosystem from the consequences of a rapidly expanding krill fishery, and to aid recovery of the great whales and some of the over exploited species of fish. The first step towards management of the krill fishery came in 1991 at the tenth meeting of the Commission for the Conservation

of Antarctic Marine Living Resources (CCAMLR)—the body set up to oversee the implementation of the Convention. The Commission set a limit of 1.5 million tonnes on the catch of krill in the South Atlantic (where almost all of the krill has been caught recently) and, in 1992, set a limit of 390,000 tonnes for part of the Indian Ocean. These precautionary catch limits are much higher than the current catch levels but this is a reflection of the huge size of the resource and of the pre-emptive approach to management that CCAMLR was designed to take.

SCIENTIFIC MANAGEMENT OF THE krill fishery requires that we know a great deal about the biology of krill. To date it has proved extremely difficult to study these oceanic animals, since they will not adapt well to laboratory conditions. Up until the 1970s almost everything known about Antarctic Krill came from studying krill pickled at sea and studied on shore, but many of the pressing questions about their biology could only be answered by studying live animals.

In the early 1980s a major international scientific program called BIOMASS (Biological Investigations of Marine Antarctic Systems and Stocks) began studying the role of krill in the Antarctic ecosystem. As part of the program, techniques had to be developed for keeping krill alive for experimental purposes. These were pioneered in Australia, first at the Australian Institute of Marine Science in Townsville and then at the Australian Antarctic Division in Kingston where a supply of live krill has been kept continuously since 1982. Experimental studies on krill made possible by the existence of captive populations led to an explosion of knowledge about their life processes: their growth rates, longevity, physiology and behaviour. There are, however, many aspects of the biology of krill that are still difficult to study and for which information is urgently needed for the management of the fishery.

We need to be able to accurately assess krill abundance: this is a pressing problem as current estimates vary widely. One of the achievements of the BIOMASS program was the first global estimates of krill abundance using hydroacoustic (sonar) techniques. The huge range of krill, their aggregating behaviour and the experimental nature of the hydroacoustic technique have all conspired to make these estimates of abundance subject to large uncertainties. It is still unclear whether krill populations drift with the currents or whether they are able to maintain self-sustaining populations in particular areas, and one of the major question marks hanging over their life history is what they do through the winter. We still don't know how long krill live for. While early estimates suggested two years, recent studies have shown they can survive in the laboratory for at least 11. Determining the age of krill is related to the problem of winter shrinkage. Crustacean age is usually measured by size but, if krill are growing and shrinking in response to a fluctuating food supply, it is unlikely there will be any simple relationship between size and age. This is a problem for fisheries management as estimates of production are based on how long we think the animals live for and the natural levels of mortality.

The Antarctic ecosystem is far from pristine; the marine living resources of the region have been exploited for nearly 200 years. The emergence of a krill fishery posed the greatest threat to the integrity of the Antarctic ecosystem but the fishery has operated far below its potential, despite its early rapid growth. If the fishery continues to expand only slowly, it gives scientists time to carry out the research necessary to answer critical questions concerning the biology of krill and their interactions with other species in the Antarctic ecosystem. This knowledge will, in turn, be fed back into the management process to provide further safeguards. If the fishery begins to expand more rapidly, then recent moves to set 'precautionary limits' on the catch and develop advanced management techniques should ensure that exploitation of this crucial resource remains within sustainable bounds.

Although the fishery for Antarctic Krill is not turning out to be the cornucopia that many had imagined, it is also not turning out to be the environmental scourge that it had the potential to be; in fact, it may end up being the agent for the restoration of the Antarctic ecosystem. Without the krill fishery there would have been no CCAMLR and it is likely the CCAMLR will be the forum within which the major decisions will be made to manage the whole Antarctic ecosystem, restoring the populations of depleted species as well as maintaining a sustainable harvest of krill. ■

Suggested Reading

Miller, D.G.M. & Hampton, I., 1989. *Biology and ecology of the Antarctic krill* (Euphausia superba): a review. BIOMASS Vol. 9. Scientific Committee on Antarctic Research: Cambridge, England.

Nicol, S., 1989. Who's counting on krill? *New Scientist* 1690: 38–41.

Nicol, S., 1991. The age-old problem of krill longevity. *Bioscience* 40(11): 833–836.

Nicol, S. & de la Mare, W.K., 1993. Ecosystem management and the Antarctic krill. *Amer. Sci.* 81: 36–47.

Ross, R.M. & Quetin, L.B., 1986. How productive are Antarctic krill? *Bioscience* 36: 264–269.

Dr Stephen Nicol is the Principal Research Scientist in charge of the krill research team at the Australian Antarctic Division in Kingston, Tasmania. He is a member of Australia's delegation to the Commission for the Conservation of Antarctic Marine Living Resources (CCAMLR) and has been an active participant in all of the meetings of the Commission's Krill Working Group.

We looked in amazement at the indignant face of a bat that was once thought to have become extinct at the end of the last Ice Age, and we hugged each other with joy.

RICHARD SMITH

Tim Flannery with some of the Bultem villagers.

THE FALL AND RISE OF BULMER'S FRUIT-BAT

BY TIM FLANNERY AND LESTER SERI

"DARKNESS HAD DESCENDED, AND clouds of mosquitoes surrounded us, crawling into our ears, nose and eyes. We were unable to slap them for fear of disturbing the bats. Then at last we heard their distinctive 'pok pok pok' wingbeat as they left the roost. The noise of one bat after another colliding with the net high above our heads sounded encouraging until we realised they were bouncing off again. The net had been set too tight, and we would have to climb high into the canopy of trees above the cave to loosen it. And it had to be done quickly. In ten minutes the skies would be empty of bats.

"The previous three hours had been pure terror. In order to set the net we had to climb two large trees that overhung the rim of this enormous cave, which plunges down vertically for several hundred metres. It was a 15-metre climb to the canopy, and we had first to cut a clearing for the net with bush-knives. Then we

TIM FLANNERY

The only practical way to reach the bats' roost site at Luplupwintem is by helicopter.

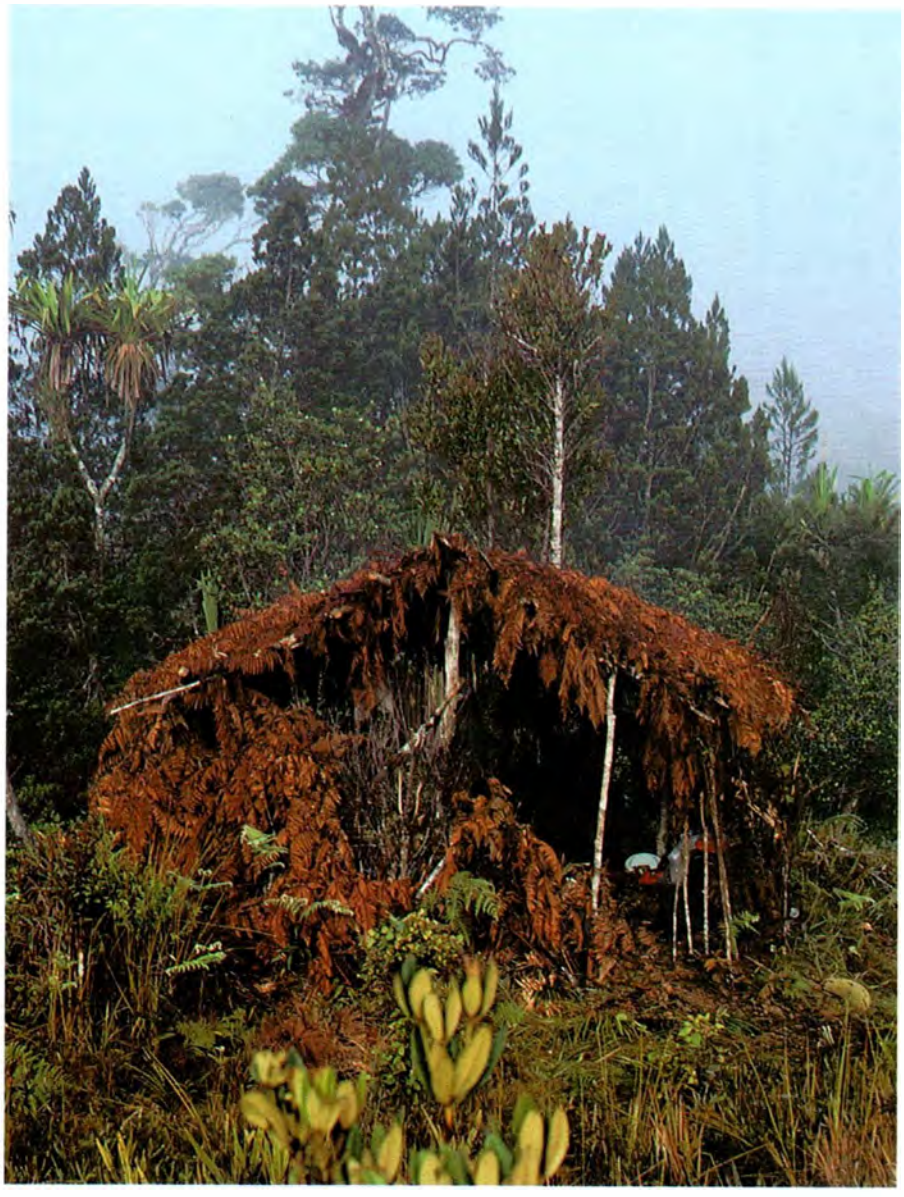
each had to manipulate a seven-metre pole, with mistnet attached, into place, and fasten it to the trees. All the while the light was fading, and the vines I had used to ascend were becoming smooth with wear. The thought of climbing the tree again filled me with dismay; then I realised from the sounds overhead that Lester was already halfway up his tree.

"The climb seemed easier in the darkness for I could not see the yawning chasm below, nor could I see the tree sway as I reached the thinner branches of the crown. Almost immediately upon loosening the net a bat struck and became firmly entangled. I held onto the tree with a crooked elbow, stuck the torch in the fork of a branch, and began to haul in the net. The bat was understandably furious, attempting to bite everything around it, and was much larger than I had expected. When I reached it I realised I'd have to cut the net, and carry down the section containing the violently struggling bat.

"Net cutting done, I began my descent in darkness, for in the struggle to pull in the net my torch had fallen. Suddenly I began to feel my centre of gravity shift, and I realised I was supporting myself on the mistnet pole that I had tied loosely to the tree. I grabbed wildly for further support and caught a liana. I climbed down the last few metres shaking, the furious fruit-bat struggling to be free.

"Lester was waiting with a calico bag. Carefully he placed the bat inside, then took up his torch and peered in. We looked in amazement at the indignant face of this bat that was once thought to have become extinct at the end of the last Ice Age, 10,000 years ago. We hugged each other with joy—after eight years field work together in rugged western Papua New Guinea we had rediscovered Bulmer's Fruit-bat."

This is how one of us (Tim) recorded his thoughts on the evening of 3 May 1992. It documents the end of a long



TIM FLANNERY

The hunting shelter that served as the author's headquarters. Birds of paradise displayed daily in the clump of southern pines at the back of the shelter.

search for one of New Guinea's most intriguing mammals: *Aproteles bulmerae*, commonly known as Bulmer's Fruit-bat, a species twice thought to be extinct.

THE STORY OF BULMER'S FRUIT-BAT began in the early 1970s when James Menzies of the University of Papua New Guinea tried to identify the fossilised bones of some bats found in a rock shelter in Chimbu Province, Papua New Guinea. He found that many of the bones, particularly those from the upper (more recent) layers, were those of the Bare-backed Fruit-bat *(Dobsonia moluccensis)*, which is the common large fruit-bat of the mountains of New Guinea today. In the lower levels of the site (those dated to 10,000–12,000 years old) however, he found abundant remains of a second species. It was somewhat larger than the Bare-backed Fruit-bat, and its teeth were very different. Surprisingly it lacked incisor teeth—a very unusual feature among fruit-bats. Realising that he had found an undescribed species, Menzies named it *Aproteles*, meaning 'incomplete at the front' in reference to its lack of incisor teeth, and *bulmerae*, for the archaeologist Susan Bulmer who had excavated the bones.

Menzies noted that, although remains of Bulmer's Fruit-bat were very common in layers dating to 10,000 years ago and older, it was not present in more recent levels. Considering that it had never been found as a living animal, Menzies quite reasonably deduced that it was now extinct, and had been so for around 10,000 years.

There matters lay until the anthropologist David Hyndman (University of Queensland) began working with the Wopkaimin people in far western Papua New Guinea in the mid 1970s. Hyndman was interested in Wopkaimin hunting methods and so one day accompanied a group of hunters to a large cave at Luplupwintem to obtain fruit-bats. With the aid of store-bought ropes they entered the cave and, using a shotgun, killed between 200 and 300 bats. Hyndman was unsure of the identity of the species they had caught, so he kept two skulls and even made up a study skin (a dried skin stuffed with cotton wool) to send to Jim Menzies for identification. Unfortunately the skin was lost before it reached the University; but the skulls arrived and, to Menzies' great surprise, they were from Bulmer's Fruit-bats.

In 1980 Hyndman and Menzies published their findings but reported that, although the cave sheltered "a great number" of bats in 1975 when Hyndman first entered it, by 1977 when he returned only two bats were roosting there. Evidently the colony had been exterminated by hunters. In 1985 Menzies returned to the site, only to find it entirely deserted, and enquiries by us in 1987 led to a similar conclusion. Between 1984 and 1990 we carried out an extensive mammal survey of the region, visiting almost every major cave we heard about, but found no sign of the bat. As a result of these fruitless searches, by 1990 it was thought again that Bulmer's Fruit-bat was extinct. Indeed it had the dubious honour of being considered the only New Guinean mammal to have become extinct in recent times.

In 1991 a most unexpected turn of events led to new hopes that Bulmer's Fruit-bat had survived the massacres of the mid 1970s. The Mammal Section of the Australian Museum was granted funds to deal with a backlog of nearly 2,000 unregistered specimens that had built up over the years. Alexandra Szalay was employed to carry out this work, and on 6 June 1992 she brought a dusty cardboard box containing several fruit-bat skulls to Tim for identification. One seemed unusual, for its shape was different and it lacked incisor teeth. For a moment they mused about the accident that might have deprived a common fruit-bat of its front teeth, but then Tim remembered the meaning of *Aproteles*. Astonished, he rushed for Hyndman and Menzies' paper. It took only a moment to determine that the skull was a third modern specimen of

TIM FLANNERY

Lester Seri (left) sets out on the long walk to Luplupwintem from the helicopter drop site with Wopkaimin landowners Freddie (right) and Frester.

Bulmer's Fruit-bat. But when and where had it been collected? The number it bore, "24/85", seemed to reveal no clues.

Thankfully Alex was by now familiar with all of the various numbering systems used by the Mammal Section through the years. She recognised the number as one assigned to the specimen during preparation. Examination of the preparation book for 1985 revealed that there had also been a skin, collected by Steve Van Dyck (Queensland Museum) at Ofektaman in the Telefomin Valley in February 1984. It had been identified as *Dobsonia moluccensis* (the Bare-backed Fruit-bat), and lodged in the collection. Examination of the skin soon revealed that, although superficially similar to that of the Bare-backed Fruit-bat, there were some significant differences. These included an extra claw on each wing, brown claws instead of white, and fur that was browner and much finer.

X-ray photography of the skin revealed even more important details. The ends of the bones of the wings were all unfused. This meant that the animal was young, probably less than a year old. As it had been collected in February 1984, it must have been born in the first part of 1983. At least some Bulmer's Fruit-bats must have survived the 1970s. But where were they roosting, and how many were left? Unfortunately the specimen was accompanied by only meagre data and a very general location. Steve Van Dyck was contacted and a critical piece of information was recovered from his diary. The bat had been sold to him by a hunter named Woflayo. Since Steve did not speak Telefol (Woflayo's language), and Woflayo had no

A perched lake in mossy forest near the only known roost of Bulmer's Fruit-bat.

RICHARD SMITH

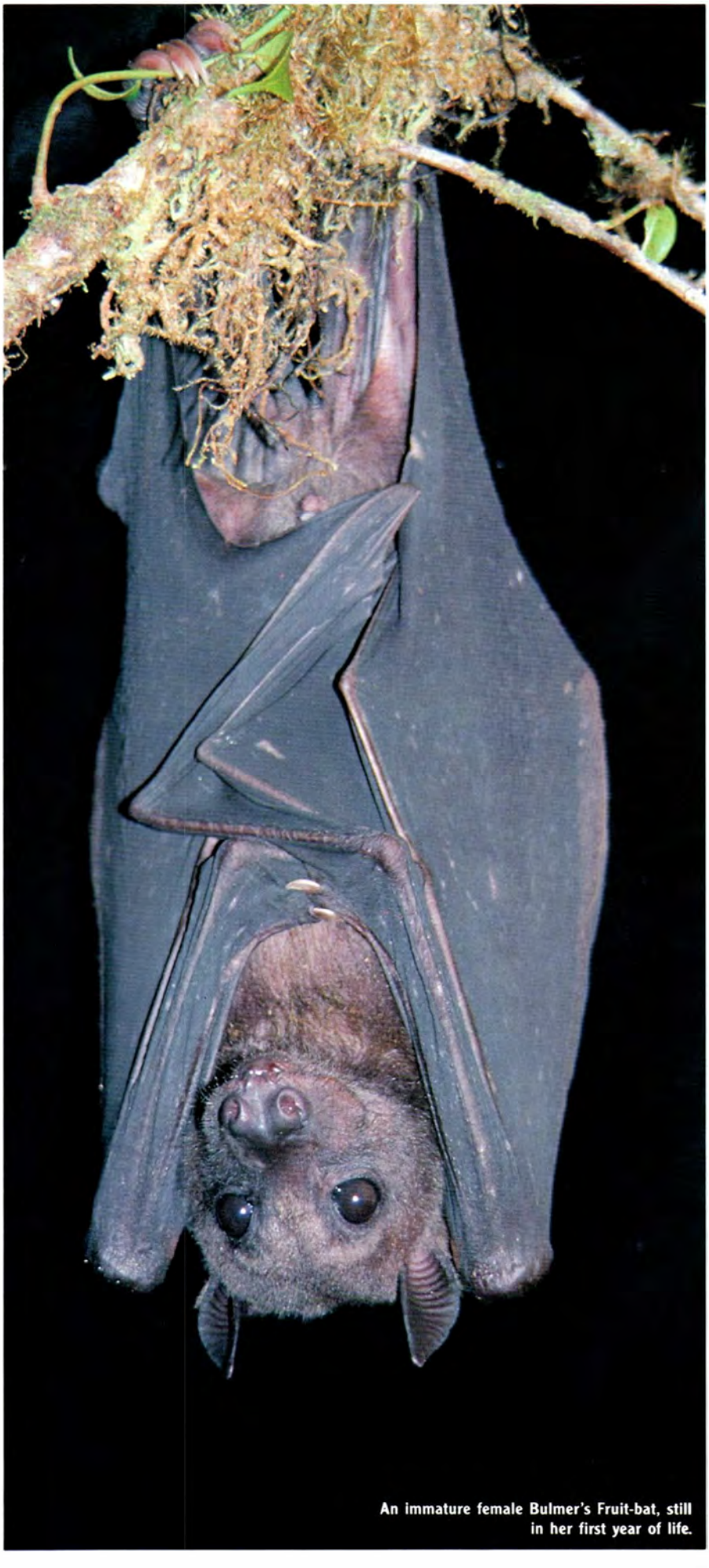
The authors (bottom left) sit and wait for Bulmer's Fruit-bats to make their nightly exodus from the cave. From late afternoon, the bats can be heard moving about in the cave.

English, this accounted for the paucity of information accompanying the specimen.

We now felt that we had enough clues to justify an expedition to the area to begin a new search for the bat. As is usual, however, we entirely lacked the necessary funds. Fortunately, Ok Tedi Mining Ltd had become interested in the bat and offered to finance the research. Our first objective was to re-examine the cave visited by Hyndman in the 1970s. Neither of us had seen the location before, and we both felt we could learn a lot by examining the old roost site, even if it had long been abandoned. The cave is perched on the edge of a limestone plateau that ends abruptly at the Hindenberg Wall, a huge limestone escarpment over a kilometre high. The only practical way for us and our equipment to reach the site was by helicopter. From Ok Tedi, the ride took just 20 minutes, during which time we enjoyed the breathtaking scenery.

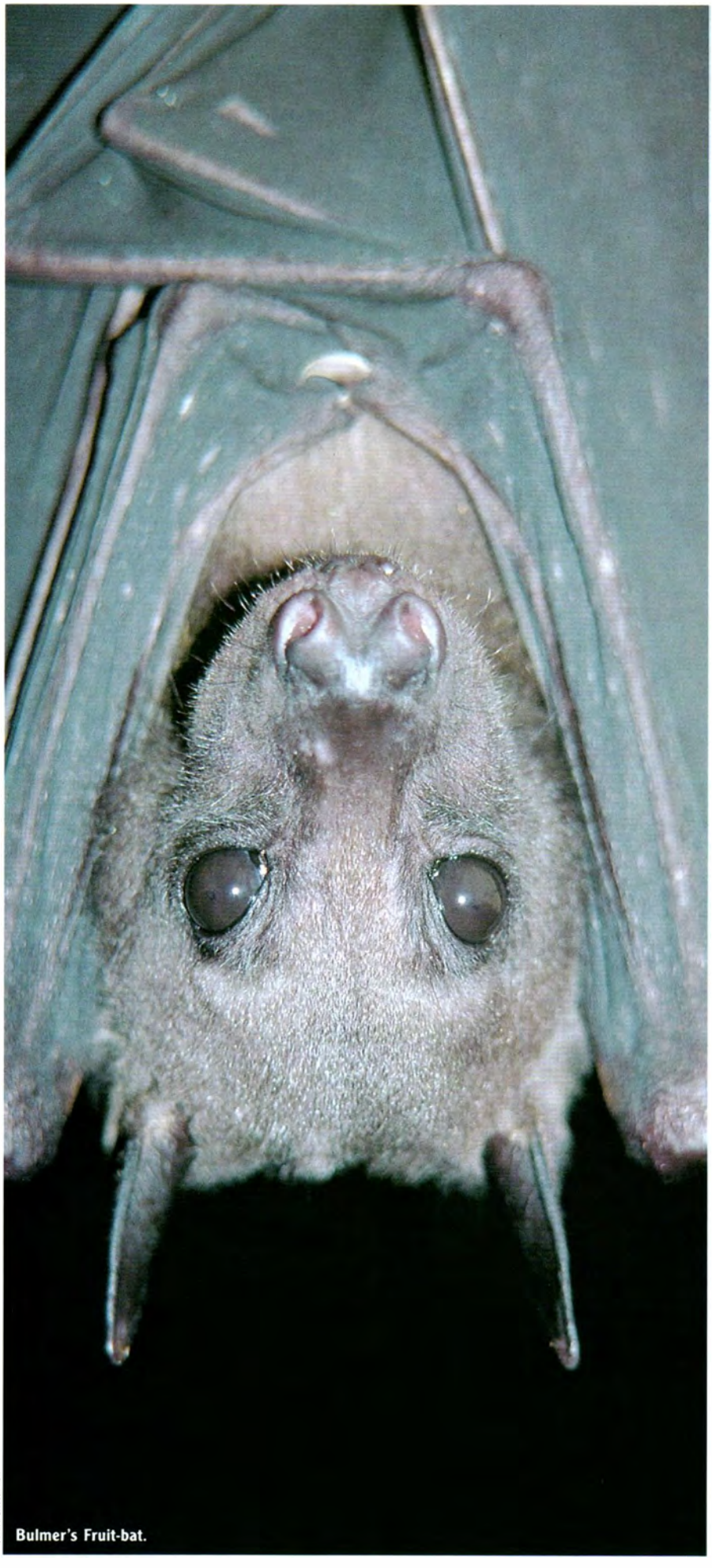
The helicopter could not land at the cave because of dense forest, so our small party was dropped into a grassland two or three minutes flight time to the north (a difficult three-hour walk away). The opening to the cave was a 400-metre-deep conical shaft, 200 metres wide at the top. Way below in the gloom a

Entrance to the roosting chamber used by Bulmer's Fruit-bat. This cathedral-like cavern opens from the southern wall of the Luplupwintem doline.



An immature female Bulmer's Fruit-bat, still in her first year of life.

TIM FLANNERY



TIM FLANNERY

Bulmer's Fruit-bat.

cathedral-like cavern opened up. Sounds, reminiscent of the cries of parakeets, but quite different from those of any bat we had ever heard, emanated from the hole. Then, quite suddenly, a dark shape swooped from the cavern into the gloom of the main shaft. It was a large fruit-bat.

We considered for some hours how we should proceed. The cave was clearly inaccessible to us, so we could not carry out a detailed study. The most pressing question was to establish the identity of the bats roosting in the cave. Were they the common Bare-backed Fruit-bat, or the superficially similar Bulmer's Fruit-bat? The only way to be sure was to get a bat in hand.

That evening as the light faded a few bats began to emerge from the cavern and circle in the gloom of the shaft. They uttered a continuous bird-like call as if signalling to those still inside. Before last light the entire colony had emerged and flown over the lowest part of the shaft opening. Lester counted 137 bats. As we walked three hours back to our camp site in the dark and rain, it was clear that if we were to examine a specimen we would have to hoist a mistnet above the canopy that grew on the edge of the opening. Over the next two days we examined the area, and planned our netting. It ended in the nerve-racking experience recounted at the start of this article.

WE ARE ONLY NOW BEGINNING TO investigate the natural history of Bulmer's Fruit-bat, but already we think we understand the reason for its precipitous decline. Its main problems seem to stem from the fact that it is a large bat and thus a prime hunting target. It also has quite specific roost requirements, and thus is very sensitive to human interference. Although we never entered the cave at Luplupwintem, the bats were clearly aware of our presence, for over the three nights we observed them they delayed their departure by almost an hour. Human disturbance appears to be a very real threat to Bulmer's Fruit-bat, and we suspect that its extinction in other parts of New Guinea 10,000 years ago was due to a human population increase associated with the development of agriculture at that time. Its survival in Luplupwintem is doubtless due to the unique topography of the cave, for it is large enough to accommodate a colony of thousands and is an almost invulnerable refuge for the bats.

By talking to Wopkaimin hunters we were able to reconstruct the events that led to its near extinction at Luplupwintem, its last stronghold. The 1970s were a time of enormous cultural upheaval for the Wopkaimin. Traditionally they had lived in small, isolated family groups dependent upon gardens cut out of the sodden rainforest of the southern Star Mountains. The Wopkaimin who live in Bultem Village (the village nearest the cave) were entirely forbidden by taboo to disturb the bats, although they occasion-

The Bare-backed Fruit-bat is superficially similar to Bulmer's Fruit-bat, although it is smaller. It has remained common in areas where Bulmer's Fruit-bat vanished over 10,000 years ago.

ally allowed other Wopkaimin to enter the roost. On these occasions one of the region's bravest men might descend on a long rattan rope carried to the entrance by many helpers. With bow and arrow he might secure two or three bats from the cathedral-like roof above before returning to the surface. But then outsiders began to arrive. Geologists and others began planning for the Ok Tedi mine, and the Papua New Guinean administration began to assert itself. New technologies, such as nylon rope and shotguns, had arrived in the Star Mountains, and local hunters were acquiring the purchasing power to obtain them. This technological change was accompanied by a breakdown in traditional lifestyles. The attention of the Wopkaimin was naturally focused on matters to do with the mine and Government, and traditional obligations often went unattended. When hunters from the neighbouring Tifalmin area entered the cave

The villagers were forbidden by taboo to disturb the bats.

three times between 1975 and 1977, killing thousands of bats, the Wopkaimin were too preoccupied with these other matters to retaliate for this breach of tradition and theft of resources. Indeed, Wopkaimin hunters themselves entered the cave and, with shotguns, killed hundreds of bats. By 1977 only a tiny remnant population remained.

We do not know what happened to that remnant. It is possible that a few bats always roosted in the cave but remained undetected; but it is also possible that the remnant colony fled and, for a decade or more, roosted in less suitable sites. The animal shot by Woflayo and sold to Steve Van Dyck in 1984 does not shed much light on this problem. It was shot while feeding in a fig tree just outside the village of Taman, some 30 kilometres north-east of Luplupwintem. A bat as large as Bulmer's Fruit-bat could easily cover that distance in a night, but it is just as likely that it had come from closer by. What it does reveal, however, is that Bulmer's Fruit-bat is vulnerable to predation not only in its cave, but also away from the roost. If enough bats are killed while foraging, then protection of the roost alone will be inadequate to conserve the tiny remnant population.

Fortunately Lester will be undertaking a long-term study of Bulmer's Fruit-bat. This study, funded by Ok Tedi Mining Ltd, will clarify much about the species. We hope to learn, for example, what it feeds upon and where it finds its food, and if any rainforest plants are dependent upon it for pollination or seed dispersal. We need to know when it breeds and how often, and what is special about its roost at Luplupwintem. If successful, the rise of Bulmer's Fruit-bat should continue. But these are perilous times, for we will be trying to preserve a tiny remnant of an Ice Age species in an environment of turbulent social and environmental change. Only with understanding and goodwill can we succeed. ■

PAVEL GERMAN

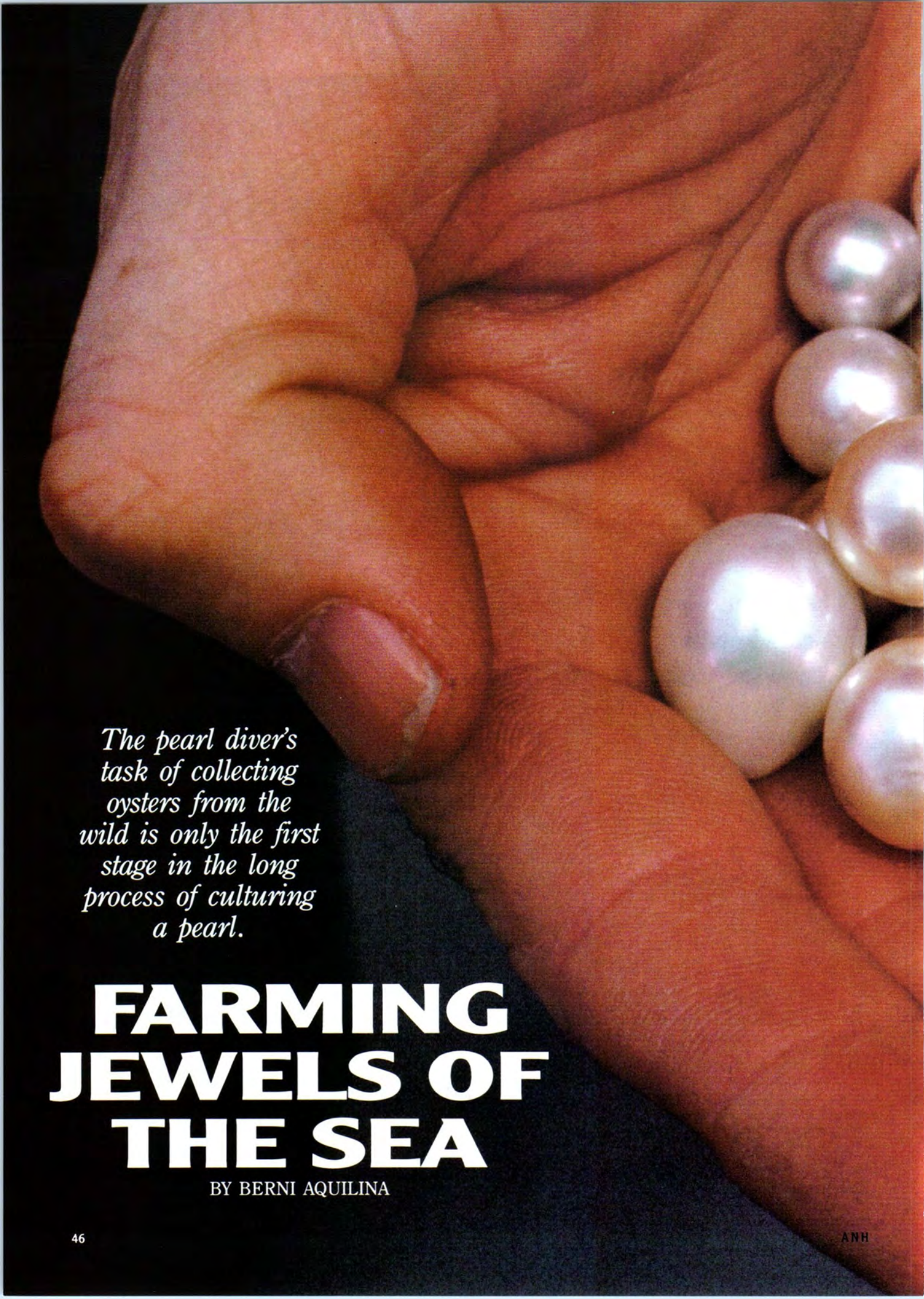
Suggested Reading

Flannery, T., 1990. *Mammals of New Guinea*. Robert Brown & Associates: Bathurst, NSW.

Hyndman, D. & Menzies, J.I., 1980. *Aproteles bulmerae* (Chiroptera: Pteropodidae) of New Guinea is not extinct. *J. Mamm.* 61: 159–160.

Menzies, J.I., 1975. Fossil and subfossil fruit bats from the mountains of New Guinea. *Aust. J. Zool.* 25: 329–336.

Dr Tim Flannery is Head of the Mammal Section of the Australian Museum. He is particularly interested in the mammals of New Guinea. Lester Seri is a scientist with the Nature Conservation Section of the PNG Department of Environment and Conservation.



The pearl diver's task of collecting oysters from the wild is only the first stage in the long process of culturing a pearl.

FARMING JEWELS OF THE SEA

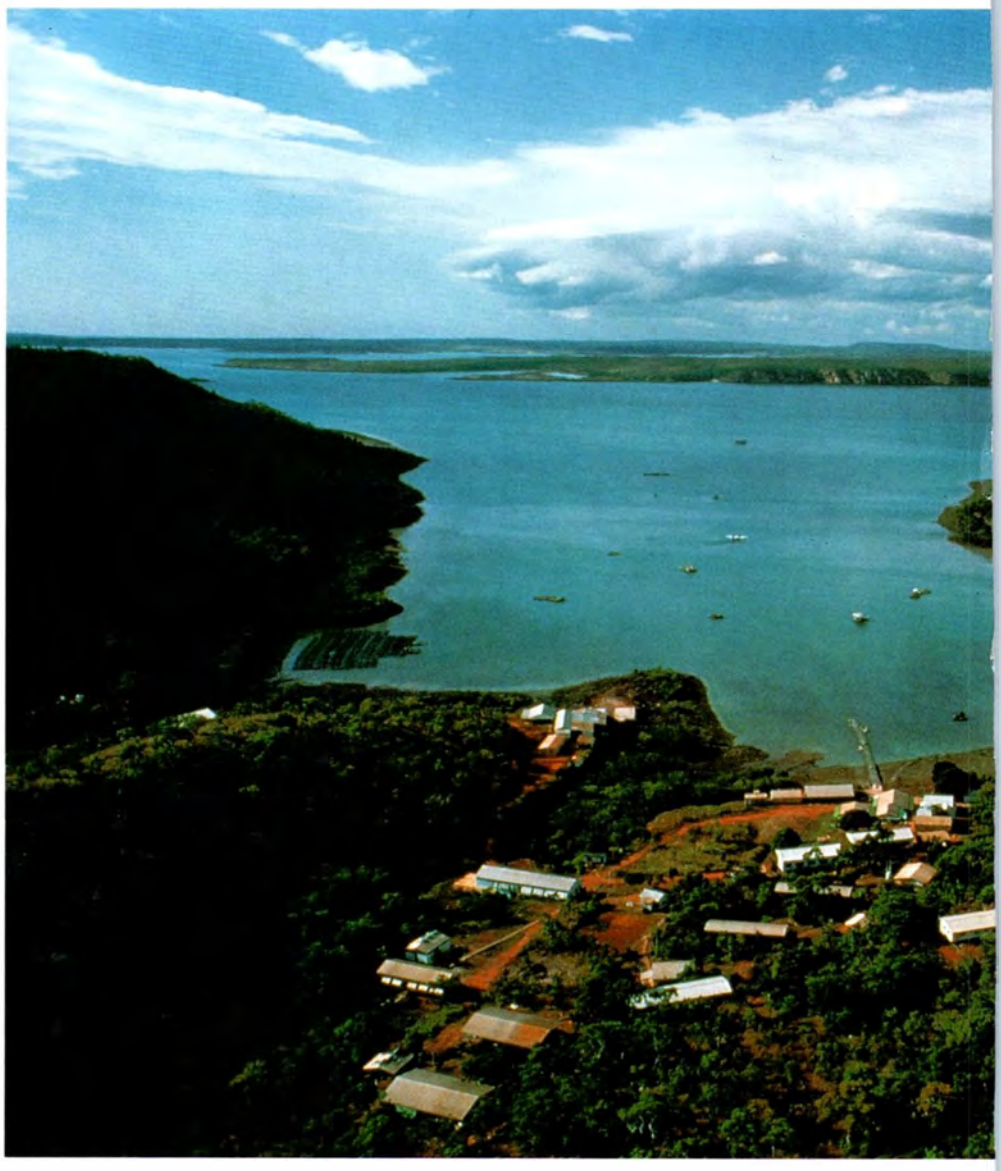
BY BERNI AQUILINA

Beautiful, rare and perfect—Australian pearls are some of the most sought after in the world.

DAVID DOUBILET

THINK OF PEARLS AND ROMANTIC notions are likely to spring to mind. The world's only 'living gems', produced through biological rather than physical processes, have been thought in past times to originate from tears and drops of dew or rain. Off the coast of northern Australia pearls are being formed in a far less ethereal, yet no less fascinating, way. Pearl oysters are being 'farmed' in the sea to produce large and lustrous pearls of world renown.

Pearls can occur in any of several varieties of mollusc but those of commercial importance, on account of their brilliant lustre, are usually from bivalve oysters of the family Pteriidae. Pearls, like the shells of the oysters in which they are found, are composed of nacrous layers secreted by the mantle (a thin layer of tissue that lies against the inside of the shell). The nacre, also known as mother-of-pearl, is formed of calcareous crystals arranged in sheets and separated by thin layers of an organic substance called conchiolin. A natural pearl is likely to occur when an irritant such as a piece of sand, particle of shell, or perhaps a parasite, intrudes into the soft body tissue of the oyster. As the irritant enters the oyster, some of the cells from the nacre-secreting mantle may become attached to it. Those cells may then grow and divide to form a 'pearl sac' enclosing the particle or 'nucleus'. Nacre is deposited from this sac to coat the irritant and thus a pearl is formed. Pearls formed around internal parasites are probably created by redifferentiation of visceral organ cells to nacre-secreting cells.



DAVID DOUBILET

SILVER-LIPPED PEARL OYSTER

Pinctada maxima

Family
Pteriidae

Distribution
Warm, tropical waters off Thailand, Burma, Indonesia, Philippines and Australia.

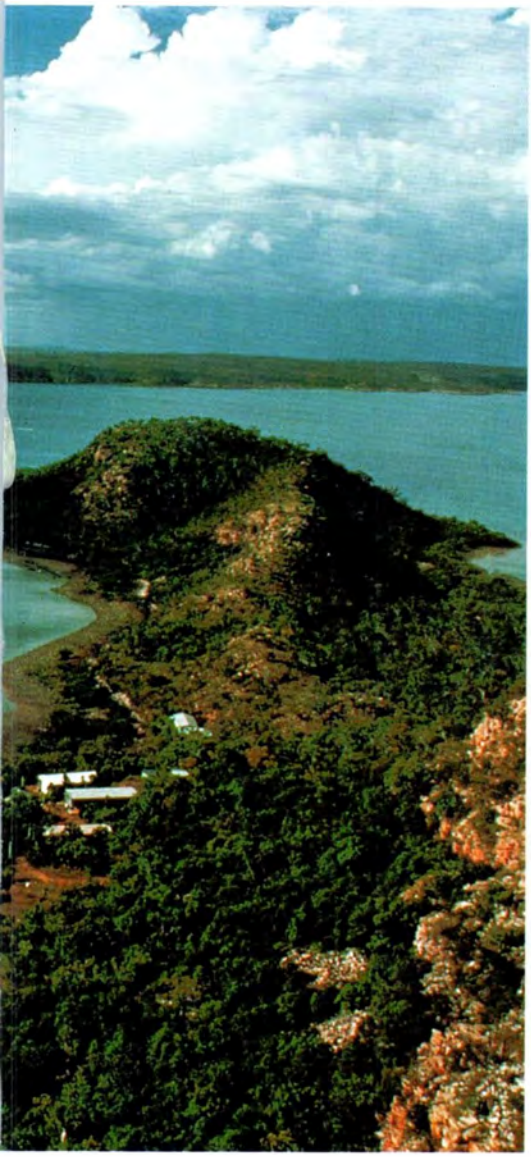
Life Cycle
External fertilisation, followed by a three-week planktonic larval stage. At the end of the planktonic period, the larvae settle onto a suitable surface, attaching themselves with thread-like tufts known as 'byssus'. The settled larvae are called 'spat'. The juvenile stage lasts two to three years, after which the pearl oysters mature as males. With increasing age, some change sex to become females, so that at sizes around 18–20 centimetres the sex ratio is approximately 1:1. They filter-feed on phytoplankton suspended in the water.

Natural Life Span
10^{+} years. Most common causes of natural death in older animals due to infestation by polychaete worms, boring sponges or molluscs. Young pearl oysters are eaten by crabs, fish and turtles.

A cultured pearl varies from a natural one only because a person instigates the process by inserting an artificial nucleus and a piece of graft mantle tissue. The process of laying down nacre remains the same for both natural and cultured pearls. Because cultured pearls are grown around a manufactured nucleus, they are usually far larger and have a more regular and rounder shape than natural ones. Since natural pearls are extremely rare, the pearl market is based on the cultured product which, except for size and nature of nucleus, is identical to a natural pearl.

Today the Australian pearling industry is based on cultured pearls grown by the Silver-lipped Pearl Oyster *(Pinctada maxima)*, a species that grows naturally in warm, tropical waters off Thailand, Burma, Indonesia and the Philippines as well as off the coast of northern Australia. This species is preferred on account of its large size and thick nacre. Shells can be at least the size of a saucer. One old and very large specimen measured 25 by 28 centimetres—the size of a dinner plate. In Japan the smaller Akoya Pearl Oyster *(Pinctada fucata)* forms the basis of a huge industry for pearls ranging in size from about three to ten millimetres. Although the Australian industry produces far fewer pearls, it is able to compete on the world market by producing pearls of a greater size. Australian cultured pearls begin at ten millimetres diameter and pearls as large as 15 millimetres are not unusual. The largest cultured pearl I have seen measured 20.8 millimetres across—about the size of a five cent piece!

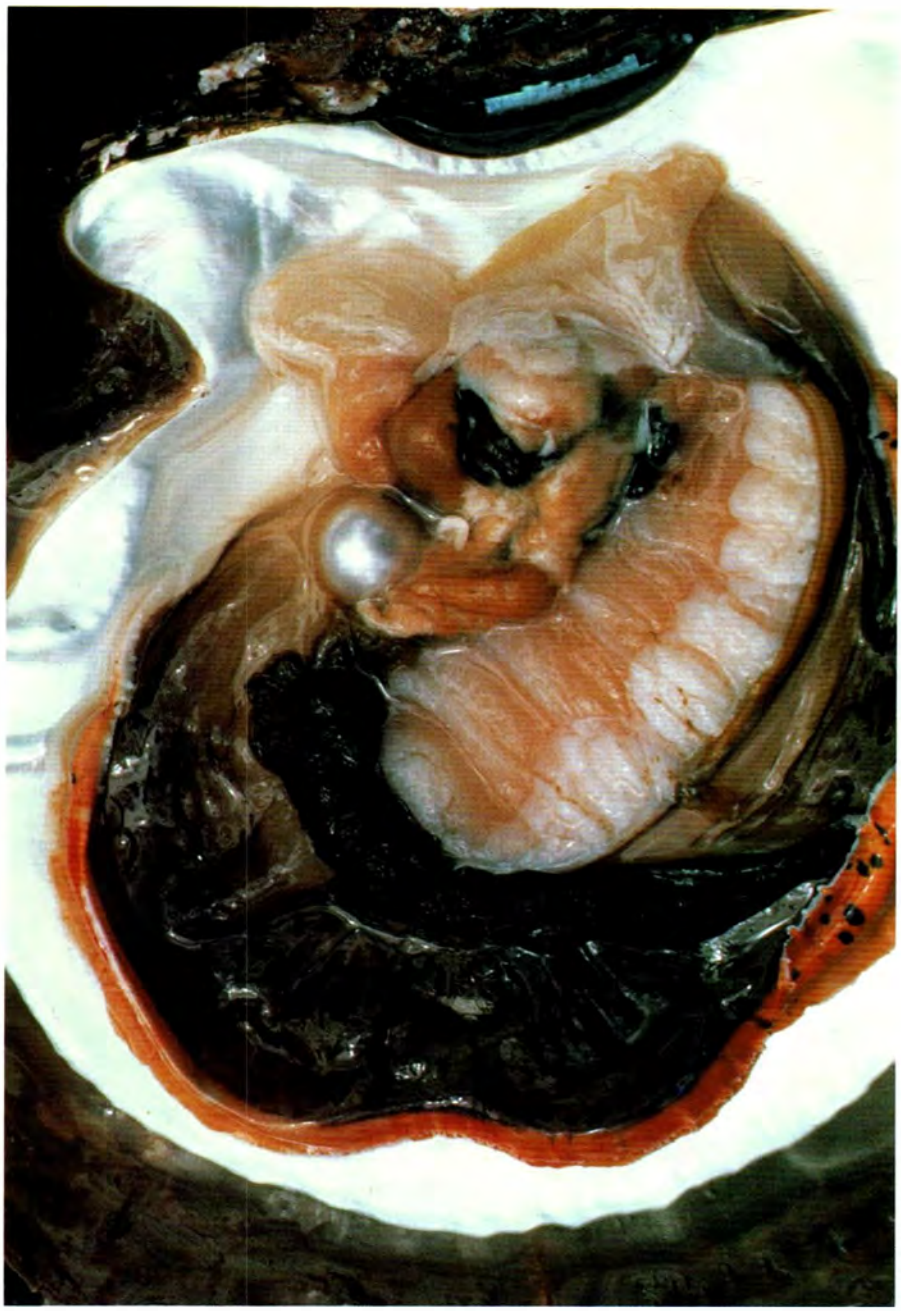
AUSTRALIA'S FIRST CULTURED PEARL farm was established in 1956 at Kuri Bay, north of Broome, Western Australia. But Australian pearling has a history dating back to the last century. The industry was then based upon the sale of mother-of-pearl, obtained from the same species of oyster and prized for the thickness of its nacre. It was primarily used for the manufacture of buttons and, to a lesser degree, for instrument dials, inlay work and the like. Pearls, when found, were considered a bonus rather than the mainstay of the industry.



Kuri Bay, Western Australia, was the site of Australia's first cultured pearl farm and today continues to produce magnificent pearls.

Off the coast of northern Australia pearl oysters are being 'farmed' to produce large and lustrous pearls of world renown.

By 1912 Broome was considered the pearling centre of the world, supplying 75 per cent of the world's output of mother-of-pearl. Much of the aura of adventure and romance surrounding the pearling industry is linked to that period when divers wore full diving dress and 'hard hat' helmets, rather than the wetsuits used today. In fact, for the most part, the divers and other crew members of the early pearling fleets led lives of monotonous hardship. They were often at sea for months at a time, working long hours and enduring little variation in their diets. Pearling was a hazardous occupation. Lugger crews were unable to forecast the approach of cyclones or other storms, although divers could sometimes predict them by sudden temperature changes under water and by the ground swell. A sudden drop in barometric pressure signalled the imminent arrival of a cyclone but often



DAVID DOUBILET

A pearl, shown here lying within the mantle tissue that created it, is the world's only 'living gem'.

PHOTO INDEX

Seeding an oyster involves wedging open the live shell and inserting graft tissue and a nucleus. This is a delicate operation and even the most skilled technicians rarely achieve more than a 70 per cent success rate.

the boats were far from any safe anchorage and were compelled to ride out the storm as best they could. Massive loss of life and equipment could result. In 1935, for example, what was described as a "very violent Willy Willy" devastated a pearling fleet working at the Lacepede Islands north of Broome, killing an estimated 141 people.

'The bends', a form of decompression sickness, was another frequent affliction of divers that often led to loss of life. The disorder is caused by nitrogen bubbles forming in the bloodstream or body tissues following too rapid an ascent. The most common symptom is joint pain, which tends to be relieved by holding the affected limb in a bent position—hence the colloquial name. The nervous system may also be affected causing headaches, loss of consciousness, paralysis and death. At the turn of the century, the Queensland pearling fleet alone incurred between 10 and 25 deaths each year, three-quarters of them due to paralysis and most of the others resulting from suffocation due largely to inexperience in use of equipment.

Today pearl divers are at far less risk. Advances in meteorological forecasting

Despite an aura of adventure and romance, pearling in earlier times was a demanding and hazardous occupation. This diver is wearing full diving dress and a hard hat helmet common earlier this century.

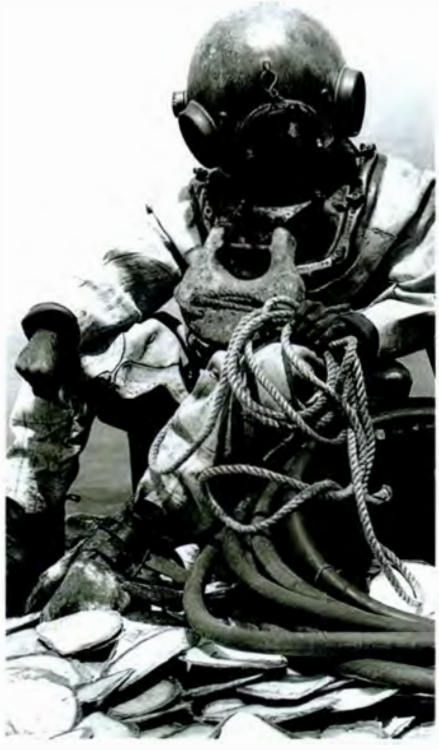
For several weeks after seeding, the Silver-lipped Pearl Oysters are kept in panels of net pockets on the sea-floor where they are regularly checked by divers.

DAVID DOUBILET

and communication systems have enormously reduced the risk of cyclone damage. Better understanding of the physiological impacts of diving and development of 'dive-tables' stipulating safe diving and recompression times have dramatically reduced the incidence of the bends. And, should an unlucky diver suffer decompression sickness, a recompression chamber and medical aid are just a short seaplane trip away.

A more common diving hazard is the sting of the Irukandji Jellyfish *(Carukia barnesi)*, named after a northern Queensland Aboriginal tribe. This seemingly insignificant creature has a body size of a thimble but with four almost invisible tentacles up to 65 centimetres in length and containing extremely toxic nematocysts (stinging cells) that affect the victim by producing acute abdominal pains, cramps, profuse sweating, vomiting, respiratory stress and increased blood pressure. While a sting is not likely to cause loss of life, extreme pain can result. In order to protect themselves from such stings, most divers wear hoods, protective flaps around their regulator mouthpieces and long gloves in addition to their wetsuits.

THE PEARL DIVER'S TASK OF COLLECting oysters from the wild is only the first stage in the long process of culturing a pearl. A Silver-lipped Pearl Oyster is usually about two to three years old and 13 centimetres long when it is picked up by a diver. It is taken up to the catching boat and cleaned of fouling growth before being placed with other oysters into



AUSTRALIAN MUSEUM

Nature can be fickle and, like farming wheat or other food crops, there can be bad seasons as well as good.

panels of net pockets stretched over a frame. The panels are returned to the ocean floor until the season's quota of oysters (issued by the Fisheries Department) has been caught. The total quota for the Western Australian industry is approximately 500,000 oysters per year, with individual companies having quotas of between 15,000 and 100,000 oysters. The 'fishing' period usually runs from April to July but is dependent upon seasonal factors such as weather conditions, underwater visibility and densities of wild oyster stocks.

When the fishing is completed the vessel is used as a floating work platform while the first part of the seeding operation is performed. This consists of wedging the oyster open and making an incision into the connective tissue between the epithelium (skin) and visceral mass (organs). The technician inserts a bead-like nucleus made of mussel shell, together with a small piece of graft mantle tissue from a sacrificial oyster. The graft tissue must be placed so that the nacre-secreting cells are in contact with the nucleus. Following the operation the oysters are again returned to the sea-floor in panels, where they are turned regularly from side to side by divers over a period of several weeks until the graft tissue grows evenly to form the pearl sac around the nucleus. The oysters are then transported by boat in large tanks containing circulating sea water to the pearl farms.

At the farms the panels of oysters are generally hung at about two metres depth from a system of ropes and buoys. There they remain for almost two years while the pearls grow. Each month the panels are passed through a machine like a miniature car wash that uses high-pressure water sprays to dislodge fouling organisms. More stubborn animals such as barnacles and flat oysters are chipped off by hand.

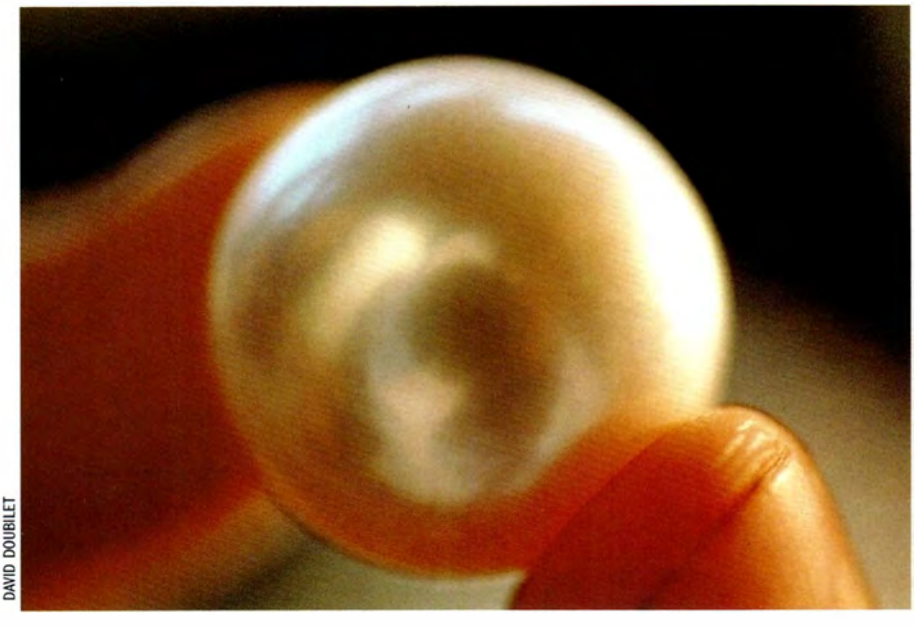
Not all seeded oysters will grow a pearl. Several reasons for failure are possible: the nucleus may be pushed out of the oyster's body by muscular activity; the cells of the graft tissue might die; or the graft tissue may not be correctly aligned against the nucleus. It is unlikely that even a highly skilled technician would have more than about a 70 per cent success rate. Some months after being seeded the oysters can be X-rayed to identify any that have rejected their nucleus. These can then be re-seeded.

On a pearl farm the highlight of the year is always the harvest. An air of excitement and anticipation abounds as everyone waits to see what the pearls will be like. Nature can be fickle and, like farming wheat or other food crops, there can be bad seasons as well as good. Of the pearls harvested, only about five per cent are likely to be the perfectly round ones most sought after for strands. The majority will still be marketable but will have flaws that lessen their value. Some will be worthless, having failed to grow a nacreous coating.

Lustre (the shininess caused by reflected light) is an essential characteristic of a gem-quality pearl. Good lustre occurs when the crystals of calcium carbonate in the nacre have a regular structure. If the crystals are irregular, the pearl will appear dull and without iridescence. Other sought-after features include a blemish-free skin and, of course, good size, shape and colour.

Australian pearls are most commonly silver-white in colour, although natural variations occur including pink, cream, gold and blue. The reasons for colour variation are not well known but may be related to the placement of crystals in the nacre or to mineral levels in the sea water. Other research also indicates that colour may be genetically derived.

The oyster does not have to be killed to harvest its pearl. If the harvested product is good, a second, larger nucleus can be placed in the pearl sac. The process can be repeated for a third or even fourth time. Alternatively an older oyster may be used to grow 'half-pearls'. Several flat-based plastic beads are glued onto the inside of the shell, under the mantle. As the mantle lays down nacre the beads are



DAVID DOUBILET

Australia is one of the leaders in the world pearl market, producing pearls that are not only beautiful but enormous as well. This pearl is a massive 20.8 millimetres in diameter.

PHOTO INDEX

The interior of a pearl-sorting shed in Broome, Western Australia. Despite the large numbers of oysters harvested only five per cent are likely to be the perfectly round ones. As a result, world demand for Australian pearls is rarely satisfied.

covered too, forming blister-like shapes on the shell. After nine to 12 months the oyster is killed and the nacreous blisters drilled out of the shell. These are used to create earrings, pendants and the like. Yet another type of pearl is produced when an oyster rejects its nucleus but retains its graft tissue, forming a small, often irregular pearl of solid nacre. These are called seed pearls or *keshi* (Japanese for 'poppy seed') in reference to their small size.

THE AUSTRALIAN PEARLING INDUSTRY has always had a strong input by the Japanese. In the early mother-of-pearl industry Japanese were found to be the most successful hard-hat divers. Later, Australians became dependent on the Japanese for their knowledge of the pearl culturing process. One reason for this is because, in Japan, early pearl culture experiments were encouraged by the government and led to successful techniques being developed early this century. In contrast, the Western Australian government prohibited the artificial culture of pearls from 1922 to 1949, in what was a misguided attempt to protect the mother-of-pearl industry (which was to collapse, anyway, after World War 2, following the development of plastics). Thus the Japanese were in a position to provide technical expertise and financial backing for the Australian pearl industry and they remain a strong force today. Indeed, nearly all technicians currently working in Australia are Japanese-born.

The future outlook for the Australian cultured pearl industry is one of development and change. Hatcheries are being established to breed oysters, reducing the need for divers to collect them from the wild. Indonesia already has several Silver-lipped Oyster hatcheries, and has the potential to influence the Australian market. In recent years the Australian government has sought greater skills transfer from the Japanese through the training of Australian pearl technicians. However, because of the close and long-standing business arrangements that exist between many Australian and Japanese pearling companies (including the exchange of pearls for the use of Japanese seeding technicians, for example), change is sure to come slowly. But whatever happens, one thing is certain: the future of the Australian pearl industry will remain as fascinating as its past. ■

Suggested Reading

Bain, M.A., 1982. *Full fathom five.* Artlook Books: Perth.

Doubilet, D., 1991. Australia's magnificent pearls. *Natl Geog.* 180(6): 108–123.

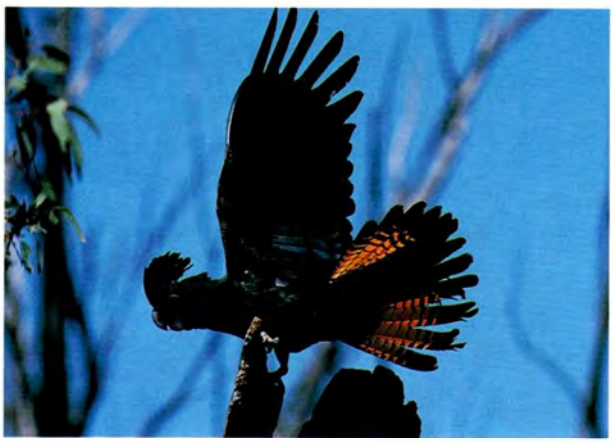
Idriess, I.L., 1947. *Forty fathoms deep.* Angus & Robertson: London.

Kunz, G.F. & Stevenson, C.H., 1908. *The book of the pearl.* Century Co.: New York.

Malone, F.J., Hancock, D.A. & Jeffriess, B., 1988. *Final report of the Pearling Industry Review Committee.* Fisheries Management Paper No. 17. Fisheries Department of Western Australia: Perth.

Wada, K., 1973. Modern and traditional methods of pearl culture. *Underwater J.* Feb. 1973: 28–33.

Berni Aquilina has worked in the Australian pearling industry for nine years. Her present position is as a pearl technician and research officer with Paspaley Pearling Company, Darwin.



A.G. WELLS / NPIAW

Red-tailed Black-cockatoo ***(Calyptorhynchus banksii).***

Swift Parrot ***(Lathamus discolor).***

Male Gang-gang Cockatoo ***(Callocephalon fimbriatum).***

PAUL DANIELS / GEO PRODUCTIONS

L.F. SCHICK / NPIAW

DAVE WATTS

Orange-bellied Parrot *(Neophema chrysogaster).*

TERRA PSITTACORUM

AUSTRALIA HAS LONG BEEN KNOWN FOR its abundance of beautiful parrots. In fact, early European explorers dubbed Australia *Terra Psittacorum*, or Land of Parrots. This is not surprising as Australia has over one sixth of the world's 340 species of parrots.

Parrots belong to the order Psittaciformes and include the cockatoos, lorikeets, rosellas etc. They are defined by their large head in relation to body size; short, blunt, curved bill; fleshy cere (the base of the upper half of the bill); and zygodactyl feet (two toes forward and two backward). It is this particular foot structure that affords them their remarkable dexterity when climbing and holding food.

Although parrots range through every habitat in Australia and many have adapted quite readily to man-made environments, a third of Australia's species are endangered. This appears to be the result of a combination of habitat loss, introduced animals and trapping for the lucrative overseas pet market.

This photo selection provides a glimpse of some of Australia's most magnificent parrots.

BESTE / YOUNG / AUSCAPE INTERNATIONAL

Eclectus Parrots *(Eclectus roratus)*.

L. ROBINSON / NPIAW

Varied Lorikeet ***(Psitteuteles versicolor).***

Little Corella ***(Cacatua sanguinea).***

R. BROWN

TERRA PSITTACORUM

TERRA PSITTACORUM

GEOFF LONGFORD / GEO PRODUCTIONS

Palm Cockatoo *(Probosciger aterrimus).*

P H O T O A R T

CYRIL WEBSTER / NPIAW

Scaly-breasted Lorikeet (Trichoglossus chlorolepidotus).

DAVE WATTS

Green Rosella *(Platycerus caledonicus).*

Since our first discovery, we had hungered for a find like this—a skull of the 'carnivorous kangaroo'.

A RUTHLESS ROO THAT CRAVED FLESH TO CHEW

BY MICHAEL ARCHER

MOVE OVER 'MONSTRO', take a rear seat 'Razorback'—there's a new killer in town—or at least there was. Picture this dark scene on the floor of a Queensland rainforest 15 million years ago:

The warm evening rain trickles down the mottled trunk and out onto the forest floor, pinkening the rivulets of blood that ooze from the limp body propped against the buttress. A crack of a branch alerts the killer. With lips dripping the salt-rich fluid of life and shreds of flesh dangling from his chin, moonlight ricochets like ruby lasers from his eyes as they sweep the undersurface of the canopy. They stop on the frozen face of a terrified possum. Convinced after a moment that this quivering morsel is too high to reach, the killer shakes his head and yawns hugely, lips pulling back to reveal long, rapier-like teeth. Then, holding the chest cavity open with his clawed fingers, he thrusts his tongue and teeth into the gaping hole to tear out the still-beating heart.

And who was this blood-besmirched ripper of the bush? Nothing we knew prior to our discoveries at Riversleigh in 1983 would have prepared us for the notion that it could be a kangaroo. If we thought of kangaroos at all, it was as gentle, doe-eyed hay-burners, fodder for the blood-lusts of the conventional mammalian carnivores of Oz—thylacines, dasyures, bandicoots and Marsupial Lions—all known and little-doubted suckers of flesh.

Not surprisingly, when confronted by the impossibly huge, blade-like premolar that jutted from the surface of a 15-million-year-old block of Riversleigh limestone, the thought that it might belong to a flesh-eating kangaroo simply never occurred to me. All I saw was an unfamiliar serrated tooth—yet another new beast of delicious mystery.

It wasn't until the jaw that held the tooth made its appearance in the acid vats in Sydney that the relationships of this large wallaby-sized animal became clear. It was at least closely related and possibly ancestral to species of *Propleopus*—Pliocene and Pleistocene rat-kangaroos as large as any living kangaroos, some weighing about 70 kilograms. These younger giants had been suspected by Tim Flannery (then a PhD student at the University of New South Wales) to have been omnivores or possibly carnivores in part because their distinctive premolars were somewhat similar in shape to those of the omnivorous Musky Rat-kangaroo *(Hypsiprymnodon moschatus)*, a cat-sized roo that survives in the rainforests of the Atherton Tableland.

But similarity in the form of teeth does not necessarily mean similarity in diet. We needed more evidence before we could conclude that the extinct roos were beasts that scorned salad. The second clue came from a paper that suggested scanning electron microscopic examination of scratches on the surfaces of teeth could help determine the kinds of foods eaten by extinct animals. Herbivores are more likely to have teeth with uniform striations, while carnivores have irregular scratches caused by the crunching of the odd-shaped bits of tooth and bone. Accordingly, in 1985 Tim Flannery checked out the teeth of the *Propleopus* rat-kangaroos and found scratches more characteristic of carnivores than herbivores. This conclusion was all the more interesting because these flesh-sucking giants apparently overlapped in time with Australia's Aborigines. Added to the presence of lion-sized Marsupial Lions, wolf-sized Thylacines, six-metre-long carnivorous lizards and giant pythons, camping in the bush in those days may well have been a very energising experience.

To test the idea that the Riversleigh roo, by this time named *Ekaltadeta* (pronounced 'E-col-ta-deeta') *ima*, was also an eater of its neighbours like the younger species of *Propleopus*, Kirsten Archer, then a student in Sydney Girls High School, used an atomic absorption spectrometer to measure how much of the naturally occurring element strontium was in the bones of undoubted carnivores and herbivores. (Strontium, which is chemically similar to calcium, is used by the body to build the animal's bones.) The idea was that carnivores ought to have more strontium than herbivores because they concentrate the dosages they get from eating herbivores. Kirsten's study, which earned her an award in the 1989 BHP National Science Contest, demonstrated high levels of strontium in the bones of *Ekaltadeta ima* and the Pleistocene Marsupial Lions—results that appeared to support the idea that the Riversleigh roo was a carnivore. But high levels were also found in Koalas, undoubted munchers of gum leaves. This unexpected and as yet unexplained observation suggested that the test was not as reliable an indicator of diet as had been hoped, so it was back to the drawing boards.

Meanwhile, back at Riversleigh, Henk Godthelp was swinging a sledge hammer in the richly fossiliferous 'Camel Sputum'

JIM REECE

Was Australia once populated by kangaroos that shunned a vegetarian lifestyle?

quarry when a rock popped in half to reveal a mass of bones and teeth. When he looked closer, he saw two huge and instantly recognisable premolars jutting out from the block's surface, fixed in the cheekbones of a skull! Few of us have seen Henk levitate with delight, but he did that day. Since the first discovery of this beast in 1983 we had hungered for a find like this—a skull of the 'carnivorous kangaroo'! Here might be more clues about the strange lifestyle of this animal.

After weeks of preparation in an acid vat in Sydney, the extraordinary relict made its first daylight appearance in 20 million years. The challenge of interpretation fell to University of New South Wales Honours student Steve Wroe. He contrasted the proportions of this skull with those of known carnivores like Tasmanian Devils and known herbivores like Eastern Grey Kangaroos before concluding that it was much closer in its basic structure to the skulls of carnivores. Furthermore, it appeared that the massive, blade-like premolars were of optimal value when the mouth was wide open and just beginning to close—a piercing moment perhaps better suited to the slicing of a lean leg of roo than a leaf.

Yet, like all ideas in science, this one cannot be said to have been proven. There are no truths in science; just degrees of probability. While it seems most probable that *Ekaltadeta ima* was a carnivorous kangaroo given evidence so far examined, as it should be the idea will always be open to testing. After all, it took nearly a century of similar testing before the Marsupial Lion's meat-munching habits were accepted in favour of the alternative notion that it used its spectacular premolars (the mind now boggles at the idea) to peel giant melons. Although ever open-minded, I rather suspect that any giant melons peeled by *Ekaltadeta ima* were shredded in search of the timorous, tasty beasties hiding within. ■

Suggested Reading

Archer, M. & Flannery, T.F., 1985. Revision of the extinct gigantic rat kangaroos (Potoroidae: Marsupialia), with description of a new Miocene genus and species and a new Pleistocene species of *Propleopus*. *J. Paleont.* 59: 1131–1149.

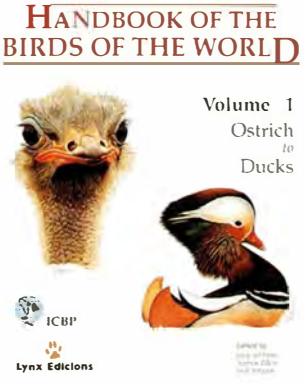
Archer, M., 1987. A wolf in kangaroo's clothing. Pp. 70–72 in *The antipodean ark*, ed. by S. Hand and M. Archer. Angus & Robertson: Sydney.

Flannery, T., 1985. *Propleopus oscillans* (De Vis, 1888): the Giant Rat Kangaroo. Pp. 245-248 in *Kadimakara: extinct vertebrates of Australia*, ed. by P.V. Rich and G.F. van Tets. Pioneer Design Studio: Melbourne.

Gilling, D., 1993. Lost paradise: food for fossils. Pp. 12–14 in *A quantum of Australian science*. Allen Unwin: Sydney.

Professor Michael Archer lectures in biology and geology at the University of New South Wales. Most of his non-teaching hours are devoted to the study of the fossil faunas of Riversleigh.

REVIEWS



Handbook of the Birds of the World Vol. 1 Ostrich to Ducks

Ed. by Josep del Hoyo, Andrew Elliot & Jordi Sargatal. Lynx Edicions, Barcelona, 1992, 696pp. $US165.00.

When I first saw the pre-publication literature on this book, it was the promise of illustrating every bird in the world that attracted me. Once I had the opportunity to actually inspect a copy, it proved to be far more than I had originally anticipated. This volume, of a projected ten-volume series, is one of the most impressive recent publications in the field of bird books. The *Handbook* has combined some of the best features of a range of different types of bird books, frequently matching or exceeding them in quality, and ultimately filling a niche for which there is no comparable work. The series is prominently endorsed by the International Council for Bird Protection (ICBP) and has a strong component directed to the conservation of birds and their habitats.

The opening section presents a brief but good introduction to bird biology and is well illustrated with colour photographs and diagrams. While the coverage is broad, there is an emphasis towards morphology at the expense of behavioural and social aspects, other than breeding. Nevertheless, as an initial venture into bird biology, the text more than adequately succeeds. It holds its own against most other introductory works.

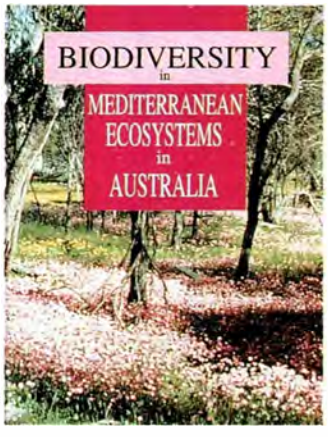
Volume 1 of the *Handbook* comprises 27 families, from the Ostrich through the ducks. Each family account is far more extensive and detailed than in any of the recent survey-style books. Most of such works are content to illustrate the text with static portraits of a representative species. While the *Handbook* has some of these in the family accounts, it is a real pleasure to peruse its rich array of excellent photographs illustrating many different behavioural aspects. There are 382 well-reproduced colour photographs in this volume.

A major feature of the series will be that, when completed, it will have illustrated in colour all the living species of birds and a fair number of extinct ones. This will have considerable appeal as some of these birds remain unillustrated even today. To depict all of them in a single series will be a landmark achievement. This first volume has 50 colour plates featuring 541 species. These show the major geographic variations, sex differences and colour morphs, but not subadult birds. The work of the artists is pleasing, and the reproduction of the plates does it justice.

For depth of information on individual species, however, this book cannot compete with regional handbooks. Each species account is a succinct summary, offering the standard information on description, distribution (including a range map), habitat, breeding and movements. The relationship with the ICBP is apparent in the section on status and conservation—an important inclusion in such a book. Perhaps the most valuable section is the bibliography for each species. Such an introduction into the literature will make the search for more detailed information much easier and less time consuming. In all, there are over 6,000 references in this volume.

There are inevitable minor quibbles and errors but in comparison with the overall quality of the production, these can be forgiven. Congratulations are due to the editors, artists and other contributors for undertaking such an ambitious project and achieving it with such high standards. I eagerly await the next volume in the series. A warning, however: the books are not inexpensive. Many readers may wish to find an accessible set of these books without owning their own. On the other hand, there are far worse ways to spend your children's inheritance.

—Walter E. Boles
Australian Museum



Biodiversity in Mediterranean Ecosystems in Australia

Ed. by R.J. Hobbs. Surrey Beatty & Sons, NSW, 1992, 246pp. $65.00.

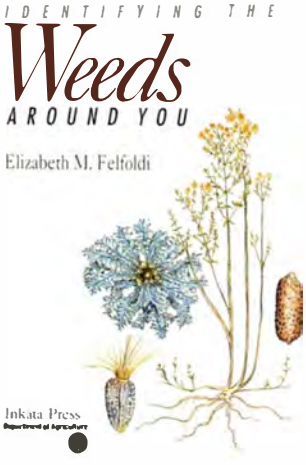
This volume arose from a workshop on ecosystem function and biodiversity held in Perth, Western Australia. The 11 contributions are called chapters but, in style, they are closer to individual scientific papers. Each was clearly written independently of the other as there is considerable overlap in scope and findings. Furthermore, although the book title suggests that the entire Australian Mediterranean ecosystem is covered, only Western Australian ecosystems are considered in detail.

Despite these drawbacks, the picture that arises from this book is a fascinating one. In Chapter 2, for example, Steven Hopper considers the patterns of plant diversity in the south-west of Western Australia. He suggests that the flora of the region (some 8,000 species) was established relatively recently—the fossil record seems to indicate that until the Miocene much of the area as far inland as Coolgardie was covered with rainforest. Relatively few plant families contribute to the regional flora today, but those that do possess some genera that have large numbers of species. The *Acacia* genus, for example, has over 400 species. This may be the result of rapid speciation in the few groups that survived mid-Tertiary climate change.

One of the strengths of this book is its discussion of the relationship between biodiversity and the way ecosystems function. This discussion is enlightening, with a range of opinions expressed. Likewise, the discussion on restoring biodiversity by J.D. Majer is of great interest, particularly to those involved with land restoration projects.

Overall, this book will be of most use to the specialist but I can also recommend it to anyone interested in the biology of one of the most diverse floristic regions on Earth.

—Tim F. Flannery
Australian Museum



Identifying the Weeds Around You

By Elizabeth M. Fefoldi. Inkata Press, NSW, 1993, 303pp. $39.95.

This book sits neatly as a companion reference to *Noxious weeds of Australia* by Parsons and Cuthbertson

(Inkata Press, 1992). Both books are very detailed in their botanical descriptions and informative in their discussion of the cultural requirements for each species.

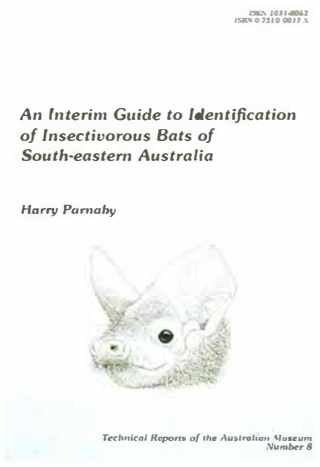
Elizabeth Felfoldi, however, has also very sensibly attached a definition after most botanical terms. This has eliminated the need to flick through the appendices to find any unknown terms. She further assists in the comprehension of the language with hand-drawn and labelled visual descriptions of any identifying morphological (shape) features. Furthermore, her discussion of the cultural nuances of each plant is very helpful in investigating the plant's controls and uses. Her coverage of control methods also differs markedly in that only cultural controls are suggested—she could be applauded loudly for this alone. Not only does this put the onus back on the individual to research their biological control or poison, but it encourages a fundamental understanding of the plant.

The use of cultural controls encourages a fundamental understanding of the plant.

Felfoldi's book also focuses on plant identification via seed description. These descriptions are well presented in family groupings and illustrated by black-and-white photographs. This method of identification is rather unusual but proved to be a very practical one. The only drawback is that a plant must produce mature seed before it can be identified; and for weeds this may be too late to prevent a potential disaster.

This book is directed towards the needs of agriculturalists and botanists. However, it is approachable for an untrained amateur.

—Andrew McGahey
The Total Earth Care Company, NSW



An Interim Guide to Identification of Insectivorous Bats of South-eastern Australia

By Harry Parnaby. Australian Museum, Sydney, 1992, 33pp. $14.00.

Although bats have become better known to the wider community over the last 20 years, they are still surrounded by mystery and folklore. Their 'mystery' even extends to how many species there are and what they should be called.

Harry Parnaby is well known among the mammalogists of Australia for his continuing work on the taxonomy of bats. His attention to detail, along with the work of some Western Australian taxonomists, have revealed there is a diversity of bats flying around Australia beyond that suspected just 20 years ago. As these revisions are currently being worked on, identification of bats is still as much an art as a science.

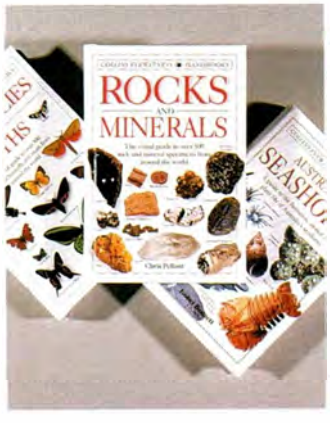
Harry has tried to reduce the confusion by releasing this guide but continually warns that it is interim and will be out of date within a few years. The guide concentrates on identification with extensive, well-illustrated keys and detailed species accounts. The bulk of the book is devoted to the details needed to identify species, with only a small amount of information on their natural history. The broad reference list and annotations within the text allow the reader access to other literature dealing with the latter aspects of bats.

The coverage of the genera is uneven, with only the 'difficult' genera having general introductions before the individual species accounts. However, for the bat novice all the genera are difficult and an introduction for each would have been useful. Those with a little experience will not notice these differences in treatment.

This book is as much a field guide as for use in the laboratory or museum. Unfortunately the wire binding combined with the size render it susceptible to damage on field trips, and careful attention to its packing with other books is required if you do not wish to spend time bending the spine back into shape. If revised editions are printed regularly, then this short life expectancy of the binding should not be an overriding concern.

This guide is a technical publication and has little to offer the person with only a passing interest in bats, but it is an essential book for anyone working with fauna in south-eastern Australia.

—Murray Ellis
NSW National Parks and Wildlife Service



Collins Eyewitness Handbook: Rocks and Minerals

By Chris Pellant. Collins Angus & Robertson, NSW, 1992, 256pp. $29.95.

This book is profusely illustrated in colour, supporting its claim to be a visual guide. The Introduction is concise, pictorial and practical, with helpful headings like "Field Equipment" and "Organising your Collection". Basic characteristics and formation of rocks and minerals are covered briefly. There is a simple rock identification key based on colour and grain size, and a mineral table arranged in hardness groups from soft to hard.

The major sections on minerals and rocks follow, with one to three entries per page. Each rock and mineral has a photo within a colour-coded information frame that summarises various physical properties.

The minerals follow a traditional chemical arrangement, from native elements like gold to silicates such as felspar. The frames around each photo indicate group, formula, specific gravity, cleavage and hardness. The 275 entries have a brief description, followed by notes on formation and tests.

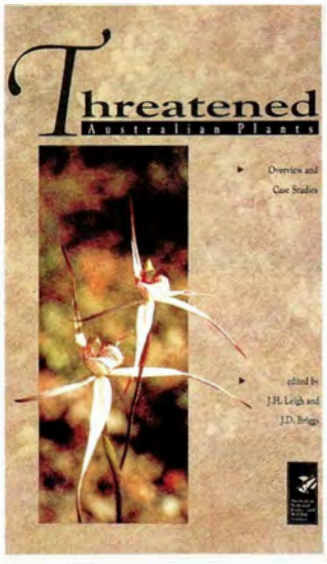
The photos are generally good, except for a few of low-contrast massive minerals. It is, however, a pity that the specimen size and locality were omitted from the photos. In fact, the book has no information on rock and mineral localities or geographical distribution.

Crystal systems are named and shown with a standard symbol, but this single shape does not always match crystals in the associated photograph and therefore could be misleading. The Introduction deals too scantily with these crystal system shapes, and the trapezohedron, although mentioned in the text, is not explained at all. Also not explained are the differences that distinguish named varieties from species, and the property of refractive index.

The rocks are grouped under igneous (62 items), metamorphic (31 items) and sedimentary (55 items). The photo information frames indicate group, origin, grain size, crystal shape, classification, occurrence and colour. The major entries under texture and origin are generally informative. A meteorite and tektite section deals with stones (chondrites and achondrites) and stony-irons but unfortunately omits the major iron meteorite group. The two-page Glossary at the end is a welcome addition, but would benefit from a wider coverage.

Overall, this book is visually pleasing and has many attractive features, but would have been improved by locality or distribution data, a reading list and explanation of some glossed-over terms. At $29.95 it is affordable to the beginner and amateur, and contains much useful information presented in an easy-to-read and pictorial format.

—Ross Pogson
Australian Museum



Threatened Australian Plants: An Overview and Case Studies

Ed. by J.H. Leigh & J.D. Briggs. Australian National Parks and Wildlife Service, Canberra, 1992, 120pp. $20.00.

Back in 1984, Leigh, Boden and Briggs produced a landmark book, *Extinct and endangered plants of Australia* (MacMillan). Until then, few Australians had ever entertained the idea of an extinct or endangered plant. Readers were shaken from their complacency by this large and colourful book, featuring 279 endangered or vanished plants from around the country.

The authors of that book were caught in a dilemma. They recognised there was an urgent need to alert Australians to the plight of rare plants but, because of this lack of awareness (among biologists as well as the public), much still remained to be learnt about the subject. As a consequence, *Extinct and endangered plants of Australia* contained many inaccuracies and omissions. Some of the 'extinct' plants were later found alive and blooming, but this proved a small cause for celebration, as botanists also found the number of threatened plants had been grossly underestimated.

It is a measure of how much we have learnt since then that, of the 20 endangered plants featured in this new book, only eight rated a mention in the previous book. The plight of the other 12 wasn't accurately known in 1984.

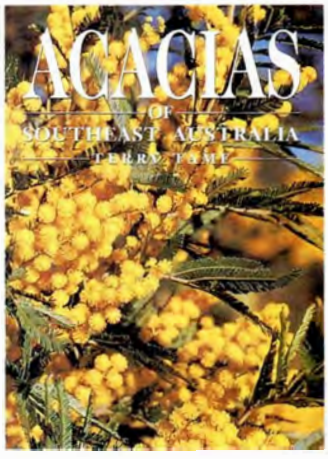
Rare plants urgently need publicity so that governments and land managers will feel compelled to act—pressured by public concern. This is where *Threatened Australian plants* comes in. Like the earlier book it throws a timely spotlight on the issue. This book is no compendium, but a selection of 42 case studies of endangered and vulnerable species from around the country, supplemented by information about the numbers of rare plants nationally. The Introduction provides a good insight into the subject by highlighting a diverse selection of plants, all illustrated by colour photos.

When I interviewed Dr Boden about rare plants a few years ago, he admitted there were not enough resources to save every endangered plant, that very difficult choices would have to be made about which plants to save, and that plants with popular appeal—orchids, mintbushes *(Prostanthera* species) and other colourful species—would probably receive priority. I am pleased to see this book (and presumably the botanical community) has not opted for a populist approach. The 42 plants featured include a very sombre-looking sedge, a grass and a diminutive peppercress, although most of the others are very colourful. The threats these plants face range from clearing and fire to feral pigs and Water Buffalo and, in the case of the Palm Valley Palm *(Livistona mariae)*, Aboriginal harvesting in the past. It is noteworthy that the Long-leafed Milliganía *(Milliganía longifolia)* would have lost most of its habitat (river cliffs) and become 'highly endangered' if the infamous Gordon-below-Franklin Dam had proceeded.

A final chapter reminds us that Australian plants have fared badly under human impact—almost a quarter of the world's presumed extinct vascular plants come from Australia. The authors say that most landholders are sympathetic to rare plant conservation, but note that in the last 14 years "two incidents were known where deliberate destructive action was taken to eliminate two separate species. The first action was taken by an owner who did not want his land resumed as a nature reserve and the second by a developer who didn't want an area in the middle of a large housing estate development to become a reserve".

Finally, Australia has about 28,000 non-vascular plants (mosses, lichens, fungi and so on) and, although much has been learnt about endangered vascular plants in the last decade, the conservation status of our non-vascular plants remains almost entirely unknown.

—Tim Low



Acacias of Southeast Australia

By Terry Tame, Kangaroo Press, Sydney, 1992, 206pp. $45.00.

The Names of Acacias of New South Wales

By Norman Hall and L.A.S. Johnson, Royal Botanic Gardens, Sydney, 1993, 69pp. $15.00.

Australians have long been fascinated by wattles *(Acacia* spp.). They are the only genus of Australian wildflowers to have their own special day. A species of wattle is our national floral emblem and the green and gold of the wattle is widely regarded as Australia's true national colours. The image of wattle abounds in traditional art, poetry and craft work. No other wildflower is more firmly imprinted on our national psyche.

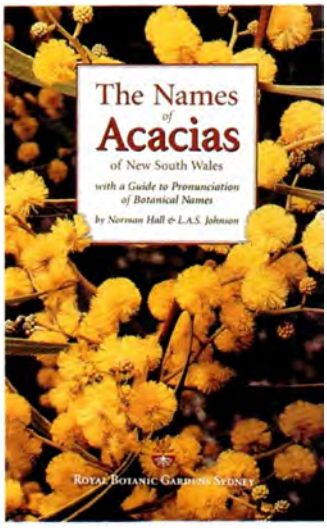
This fascination is confirmed by the number of books specifically written to help identify the acacias—books that were years ahead of the current trend towards publications on a particular genus. First, there was *A field guide to Victorian wattles* (Rogers 1968), then the classic *Acacias of New South Wales* (Armitage 1978), followed by *Acacias of South Australia* (Simmons 1981). So, is there a need for two new books on acacias? The answer is yes.

Terry Tame's *Acacias of southeast Australia* aims at describing and illustrating all the currently recognised species of *Acacia* in New South Wales and Victoria. It clearly succeeds in this aim and should become the definitive work on the identification of wattles in this region. Over 230 species are described and illustrated. All the essentials for identification are listed including detailed keys, meticulous line drawings of phyllodes ('leaves'), flowers, inflorescences, gland structure, seed pods and seeds. In addition, for each species there are descriptions, habitat preference, flowering time, distribution, historical information on the collection of the original specimen, and additional notes on the similarities to other *Acacia* species and usefulness for cultivation. Given the frequent name changes, the appendix of synonyms is a valuable reference. A chapter on wattles in cultivation should encourage gardeners to grow more interesting and suitable species.

Equally as impressive as the research that has gone into the text is the collection of almost 250 colour photographs illustrating all the species. Although grouped together at the front of the book, they are cross-referenced to the text. The photographs vary in quality and usefulness as identification aids but, given the difficulties of obtaining pictures of some of the rarer species, it is a commendable achievement to have all the species depicted.

No other wildflower is more firmly imprinted on our national psyche.

As a test of the book's claim that it is up to date and all-embracing, I checked the entry of *Acacia matthewii*. Stands of this newly named (1992) small tree are scattered from Newnes Plateau to Wolgan and Wollemi. Not only has it been



included, but there is a photograph of the species (although not in flower, making it difficult to distinguish from *A. cheelii)*. That confirms for me the quality and usefulness of this book. It will be the first reference I reach for when I come across an 'unknown' wattle.

The names of acacias of New South Wales is a pioneering work, difficult to pigeonhole, yet bearing the professional stamp of the authors. It is a book that delights in language and meaning, in accuracy of pronunciation and the historical record. How do you pronounce trachyphloia? What is the English meaning of brachystachya? Who was Willd., a name that occurs as author after many *Acacia* species? Such are the questions answered in this book.

The grand purpose of the authors is to break down the barrier of botanical terminology. "When meaning is known, the names are much less daunting." The book also presents a logical and comprehensive account of the pronunciation of botanical names, a guide that is relevant to all plants, not solely *Acacia*.

One must wonder what follows such a book. A volume on the names of grevilleas? Or eucalypts? Or melaleucas? Or should it simply be accepted for what it is—another indication of our fascination with wattles, a scholarly yet easy-to-read work, with intriguing information to which we will return again and again.

—Alan Fairley

Just Published

Australian Fisheries Resources
By P.J. Kailola, M.J. Williams, P.C. Stewart, R.E. Reichelt & C. Grieve. Bureau of Resource Sciences, ACT. $120.00.

December

Key Guide to Australia's National Parks
By L. Cronin. Reed Books, NSW. $24.95.

Australian Indigenous Orchids Vol. 2
By A.W. Dockrill. Surrey Beatty & Sons, NSW. $78.00.

Native Plants of Northern Australia
By John Brock. Reed Books, NSW. $45.00.

The Australian Rainforest Diary
By William T. Cooper & Stanley Breeden. Simon & Schuster, NSW. $19.95.

January 1994

Conservation Biology in Australia and Oceania
Ed. by C. Moritz, J. Kikkawa & D. Doley. Surrey Beatty & Sons, NSW. $93.00.

Riversleigh (revised edition)
By Michael Archer, Suzanne J. Hand & Henk Godthelp. Reed Books, NSW. $39.95.

Amphibian Biology
Ed. by H. Heatwole. Surrey Beatty & Sons, NSW. $TBA.

Field Guide to Australian Butterflies
By R. Fisher. Surrey Beatty & Sons, NSW. $TBA.

February

Field Guide to Crustaceans of Australia
By D. Jones & G. Morgan. Reed Books, NSW. $24.95.

Flora of the Sydney Region (revised edition)
By R. Carolin & M. Tindale. Reed Books, NSW. $55.00.

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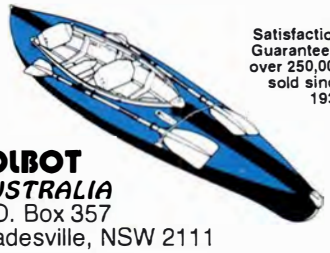

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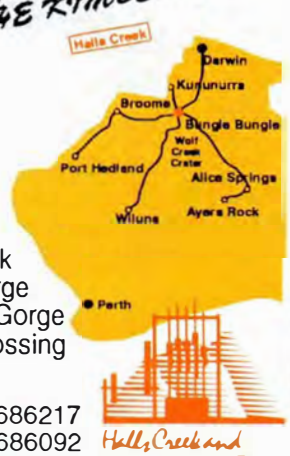

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Avicultural Society of South Australia
PO Box 3234 Grenfell St, Adelaide SA 5000. Phone: (08) 264 3295

Contact: Neroli or Bill Price, Contact Officers

General Meetings held at 8pm on the second Wednesday of each month at the Australian Mineral Foundation Lecture Theatre, 63 Conyngham St. Glenside.

BOCA, Bird Observers Club of Australia
PO Box 185, Nunawading, Vic 3131.
Phone: (03) 877 5342

Contact: Zoe Wilson, Manager

Australia-wide network of birdwatchers. Members receive *The Bird Observer*, monthly birdwatching magazine. Birdsong catalogue available. Participants welcome in conservation program and current "Birds and Wattles Survey".

Cumberland Bird Observers Club Inc.
PO Box 550, Baulkham Hills, NSW 2153.
Phone: (02) 872 4185 (answering machine)

Contact: Frances Czwalinna, Hon. Secretary

Monthly meetings at Community Hall, cnr. Old Northern Road and Old Castle Hill Road, Castle Hill. Field outings for adults and children, campouts. Newsletters.

NSW Field Ornithologists Club
PO Box C436, PO Clarence St, Sydney, NSW 2000.
Phone: (02) 960 1552.

Contact: Robyn Hill, Hon Secretary

Monthly meetings at the Australian Museum; field outings; Pelagic trips; newsletters & journals; Birdline 267 8961; New Year's campout; May camping tour of Qld/NT/Kakadu.

RAOU, Royal Australasian Ornitholgists Union.
21 Gladstone St, Moonee Ponds, Vic 3039.
Phone: (03) 370 1422

Contact: Michelle Rice, Development Manager

Everyone interested in birds welcome to join; receive colour newsletter, join social and educational activities, support bird conservation projects, visit observatories, discounted optical equipment.

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102 Bathurst St, Hobart, Tas 7000.
Phone: (002) 315 475

Contact: Victoria Templeton, National Coordinator.

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SASTA Office, c/- Plympton High School, Errington St, Plympton, SA 5038. Phone: (08) 293 2733.

Contact: Judy Morton, Office Manager

Publishes newsletter and journals

Science Teachers' Association of the Northern Territory
PO Box 41809, Casuarina, Darwin NT 0811. Phone: (089) 821 224

Contact: Ken Squires, Treasurer

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Science Teachers' Association of Queensland
Brisbane Education Centre, 36 Rose St, Wooloowin, Qld 4030.

Science Teachers' Association of Victoria
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Phone: (03) 428 2633

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Dinosaur Club WA
The Western Australian Museum Dept. of Earth & Planetry Sciences, Francis St, Perth WA 6006. Phone (09) 328 4411.

Contact: Bernie Fisher, Secretary

The club provides news of latest dinosaur discoveries and other prehistoric animals through its twice-yearly magazine *"Dinonews"*. $12 year for junior or senior membership.

INSECTS

The Australian Entomological Society Inc.
c/- Dept of Crop Protection, Waite Campus, University of Adelaide, PO Glen Osmond, SA 5064.
Phone: (08) 370 2987

Contact: Dr P. Madge, Secretary

The Society aims to advance and disseminate entomological knowledge. Quarterly journal and news bulletin are produced; annual scientific conferences are held.

The Society for Insect Studies
c/- Entomology Dept., Australian Museum, 6-8 College Street, Sydney, NSW 2000.
Phone: (02) 339 8348

Contact: C.E. Chadwick, President.

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Contact: Sandra Mann, Executive Officer.

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QUESTIONS & ANSWERS

MAX MOULDS

Like most cicadas, Northern Double Drummers are expert tunnellers.

Making a Clean Exit

Q. ***When the larvae of one of our local cicadas (a large brown cicada with white markings similar to*** **Henicopsaltria fullo)** ***exits from their earthy sojourn, they leave a clean neat hole in the ground up to 18 millimetres in diameter and, in some cases, over 30 centimetres deep. This is often hard red clay country. My question is, what happens to the excess soil from the hole? There is never a pile or even a small scattering of dirt outside the hole, and the total cubic amount involved seems too much for some sort of compaction method!***

—B. Kubala
Adels Grove, Qld

A. The cicada you refer to is the Northern Double Drummer *(Thopha sessiliba),* a species widespread across northern Australia. All cicada nymphs (larvae) compact the soil while tunnelling. This species, along with other *Thopha* species, are especially efficient at this by using copious amounts of liquid sucked from roots to soften the soil. Unlike most other cicadas, the cast skins of *Thopha* species, discarded by emerging adults on tree trunks, are always coated in a thin layer of dried mud. Soil is compacted along the length of the emergence tunnels right up to the exit hole.

—Max Moulds
Australian Museum

Elusive Cicadas

Q. ***Steve Van Dyck's interesting "Backyard Naturalist" article (ANH Summer 1992–93) discussed cicadas, but nowhere did he mention where in Australia cicadas are found. Hunting cicadas was not part of my childhood in suburban Adelaide in the '60s and '70s, nor that of my friends. Are cicadas found in Adelaide, or did I just have a very sheltered upbringing?***

—M. Vnuk
Queanbeyan, NSW

A. Cicadas are found throughout Australia including the arid interior and cold alpine areas. However, they are essentially tropical insects with fewer species inhabiting the south of the continent and Tasmania. Adelaide has virtually no suburban cicadas except in the Adelaide Hills. Further, all are small, inconspicuous species, except for the Redeye *(Psaltoda morens)* that in most seasons is absent or rarely encountered.

—Max Moulds
Australian Museum

KATE LOWE / AUSTRALIAN MUSEUM

PIC TEASER

Do you recognise this? If you think you know what it is, then send your answer to Pic Teaser, ANH Magazine. Please don't forget to include your name and address. The first correct entry will win a $20 gift voucher from the Museum catalogue. Spring's Pic Teaser was an assassin bug (family Reduviidae) from the Malay Peninsula camouflaged by a covering of fine wood dust.

Designing a Cuckoo's Egg

Q. ***I was intrigued by the birds' eggs shown in "The race of life" article in your Summer 1991–92 issue. In the photograph accompanying the article, there are six species of birds' eggs shown, each belonging to a Brush Cuckoo. There is variation in both colour and shape of the six species, yet the cuckoo manages to mimic each one accurately. How does it do this?***

—G. Wright
Glen Osmond, SA

J. McCANN / NPIAW

The Brush Cuckoo *(Cuculus variolosus)* and its various hosts are involved in an evolutionary 'arms race'.

A Egg colouration and patterning is usually characteristic for every bird species. Some species are very meticulous about recognising the proper appearance of their egg-type, whereas others show little attention to such detail. In the latter case, cuckoos need little 'effort' to fool the intended host parents, which will accept any eggs that occupy the nest. The attentive species, however, are not so easily duped. The cuckoo's egg must therefore mimic the host's sufficiently well that it is neither removed by the foster parent nor causes the host to abandon the nest.

Colour is added to the shell as the egg passes through the oviduct and this is under genetic control. Thus eggs of a certain appearance produce birds that carry the genes to produce more such coloured eggs. Different variations on the colour and pattern will fool only some of the host birds. Those eggs that fail to pass the examination fail to hatch, and the genetic effort to produce them reaches a dead end. In contrast, those eggs that are least likely to be rejected will have a higher success rate than others. The offspring will go on to produce more successful eggs, which give rise to more offspring, and so on.

This evolutionary fine-tuning channels the appearance of the cuckoo's eggs to fall within the range of its host's sense of acceptability. If, however, the cuckoo begins to make too large an inroad into the host's breeding success, there will be an advantage to those members of the host species whose eggs are less like the parasite's stereotyped standard. These individuals will then produce more offspring from their unparasitised nests. In time a new host egg appearance may become established. At some point during this process, the cuckoo's eggs will also start to shift towards the new form. And so the evolutionary 'arms race' between potential host and nest parasite continues.

—Walter Boles
Australian Museum

Answers to Quiz in Quips, Quotes & Curios (page 13)

1. Waratah
2. Eric
3. Ten
4. Newcastle Earthquake
5. Chris Schacht
6. Fossilised dung
7. Gippsland
8. North, South and Stewart
9. World Wide Fund for Nature
10. South America

A gold panner was disturbed by the cry "Piccaninny b'long God" and the arrival of a large contingent of local people carrying an unusual contraption.

STONEAGE MUTANT TURTLE IDOLS?

BY TIM FLANNERY

IDOLATRY IS SUPPOSED TO BE A uniquely human attribute. Because such behaviour, at least in its most basic stages, leaves no fossil record, and because it is supposedly absent in our ape relatives, there would seem to be frustratingly little hope of investigating its evolutionary origins. This is very galling, as the area is a fascinating one. Nonetheless (I have never been one to allow a lack of evidence to deter me from a good yarn), I devote this Last Word to a few thoughts on turtles, chimps and Stone Age idols.

I have long been an addicted chimp observer. I have never had an opportunity to observe them in the wild, and have had to satiate my addiction at the chimpanzee exhibit at Sydney's Taronga Zoo. The behaviour of captive chimps differs widely from that of free-living ones, and I do not suggest that Taronga's chimps behave in a naturalistic way. However, their behaviour is fascinating. At Taronga a whole clan of chimps roams in a large, semi-natural enclosure. At various times zoo authorities have tried to introduce other species into the exhibit, or wild animals have found their way in, and I have learned with interest of the result. The most spectacular failure in terms of deliberate introductions was that of the jackals, which had to be removed when it became apparent they were in danger of being torn limb from limb by the chimps. Likewise, woe betide any possum or pigeon that enters the enclosure. It is usually a matter of seconds before they are dismembered live, apparently through an overactive sense of curiosity on the chimp's part. But there is one outstanding success, one case of coexistence that has worked, and it is a most unlikely one.

Many years ago zoo authorities released American terrapins (turtles) into the moat that surrounds the chimp enclosure. The chimps rarely enter far into the water, so this probably initially protected the turtles. But turtles must come onto land to lay their eggs, and their behaviour while doing so is strangely casual, considering they are caged with a group of ferocious beasts. The female turtles take a leisurely stroll to the very top of the enclosure, depositing their eggs in the driest and most sunny spot. And what are the chimps doing at this time? They do not react with terror as they do when confronted with snakes and carnivores, nor do they attempt to touch the animal as they do when they are curious about something. They just stare—following the turtles with their eyes, as they plod to the top of the enclosure. Although anthropomorphic, it's as if the chimps are somewhat awed by, or respectful of, the turtles.

KEN GRIFFITHS

Could chimps and tortoises shed some light on the supposedly human practice of idolatry?

Turtles are strange creatures, which even today results in food taboos. They are not kosher because, according to Jewish tradition, the turtle is "in the seas or the rivers [and] has not fins or scales, . . . and is an abomination to you"; Leviticus 11(10). Our early human ancestors had a different view of turtles from both chimpanzees and Leviticus. ANU anthropologist Colin Groves (personal communication) has suggested that one of the major differences between the diets of early hominids and modern chimpanzees is that our early ancestors ate turtles. I think I feel a testudinate (turtle-like) theory of human evolution coming on—but I must save that for later, my interest in turtles here being in the feelings they engender in chimpanzees. If it is a form of awe, or respect, then could it be a progenitor to human idolatry?

Human idolatry is a varied thing. However, two marvellous examples of recent human idolatry give us an idea of the feelings that idols can engender. The 'Mooruk' was first brought to the attention of the world when Barbera Thompson was found living among the Aborigines of Torres Strait. She had been living with them for five years after being stranded there in the 1860s. She reports that the 'Mooruk' was an object of especial reverence. It was brought out on great occasions, tied to the head of a dancer, and offerings of food made to it. What was it? In Thompson's own words it was "one of those things that children play with, a small wooden [horse] picked up on the beach [12 months before]. They thought very much of it, and always used it in their corroborees" (Moore 1979: 157).

An even stranger object was the nameless horror of the North Coast Ranges, Papua New Guinea. Its comet-like ascendancy followed the 1934 earthquake that shook the area to ruin. According to the legendary Jock Marshall who toured the area soon after, a gold panner was disturbed by the cry "Piccaninny b'long God" and the arrival of a large contingent of local people carrying an unusual contraption. Wally (the gold panner) described the object as an old trade case, and around it was tied metres of bush vine. The locals proclaimed they had captured the "piccaninny b'long God" that had caused the quake. "At length I prevailed upon them to open up the case. This was a terrific organisation—the kundu was looped round and round and tied in a dozen knots to make doubly sure that the 'piccaninny' wouldn't escape . . . The ropes were at length undone; everybody shrank back a pace or two—the natives were actually scared and trembling. The lid was swiftly thrown back and disclosed . . . A small black indiarubber puppy! It had a tin whistle set in its tummy and gentle pressure produced a squeak at which the savages shrank back in horror" (Marshall 1935: 19).

I can readily envisage these two idols giving rise to major cults. As turtles may do for chimpanzees, these objects create a sense of awe in their human observers. Could idolatry, and (God forbid) even the mighty being Himself, have arisen from such humble circumstances? ■

Suggested Reading

Marshall, A.J., 1935. *The men and birds of paradise.* Heinemann: London.

Moore, D.R., 1979. *Islanders and Aborigines at Cape York.* Australian Institute of Aboriginal Studies: Canberra.

Dr Tim Flannery is Head of the Mammal Section of the Australian Museum. He has a long-standing interest in primates and a strange sense of humour.

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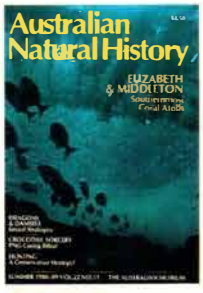

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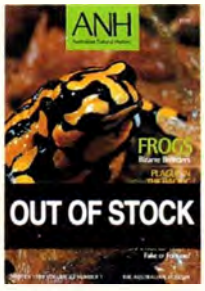

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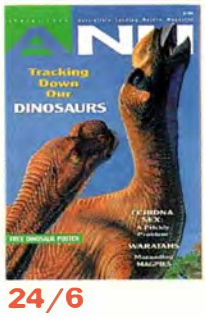

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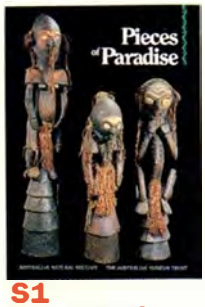

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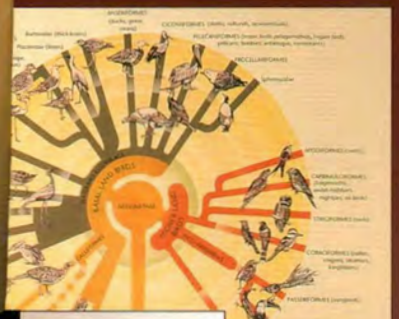

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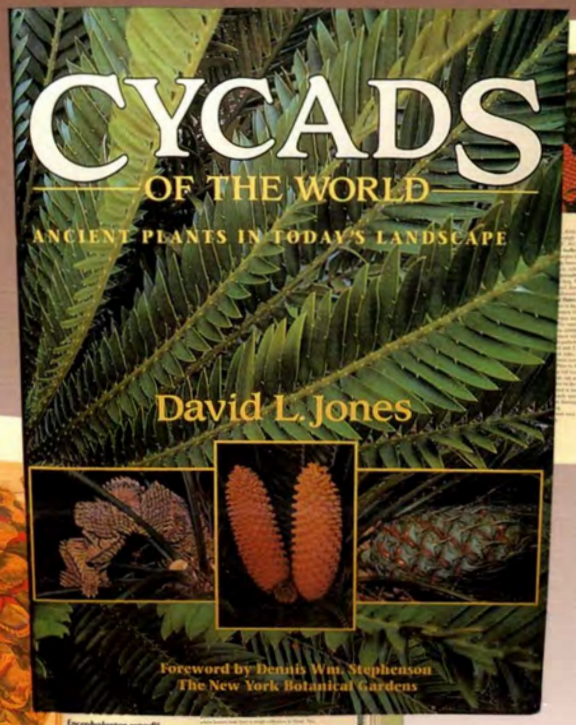

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