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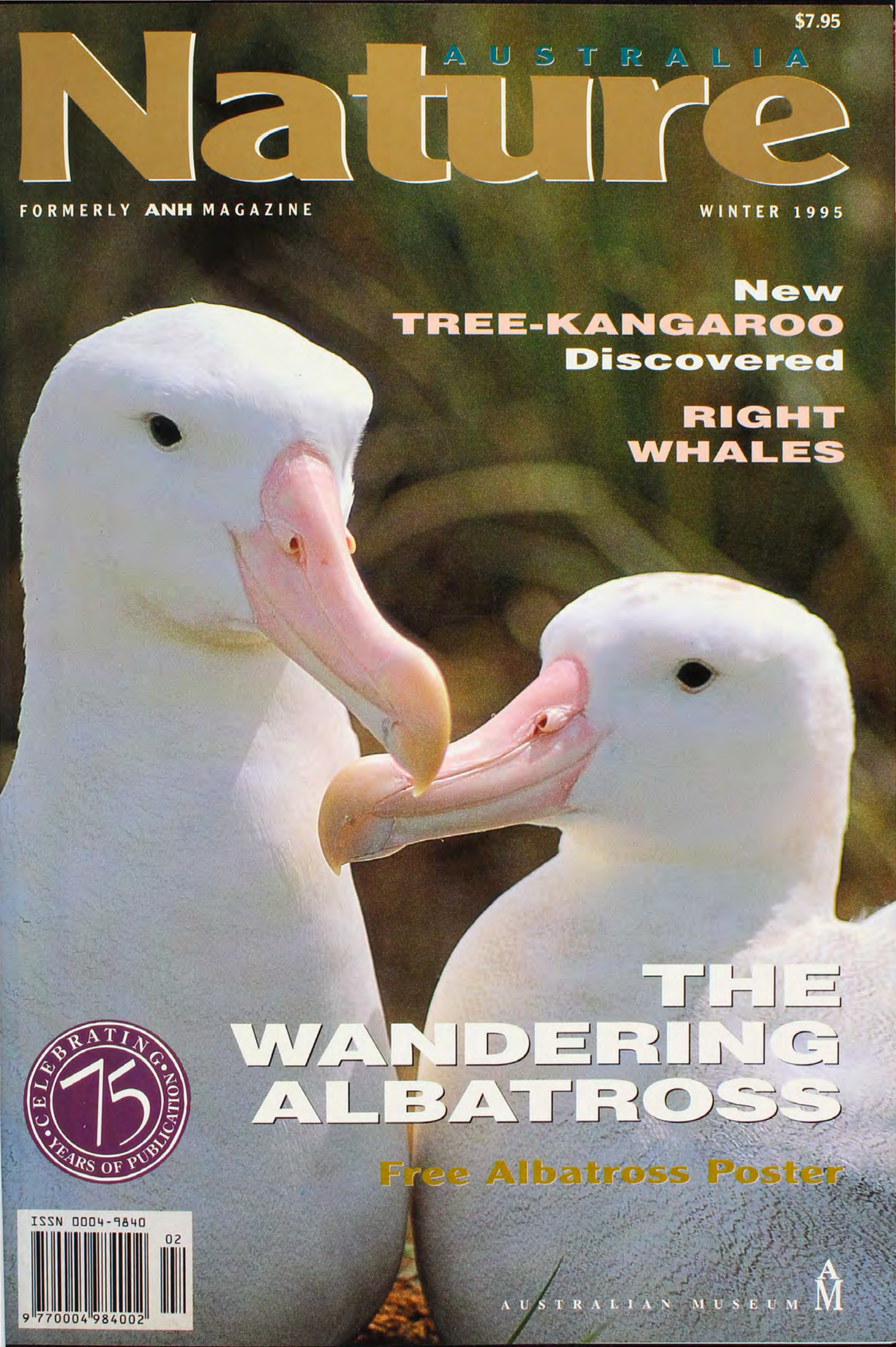
WINTER 1995



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RIGHT WHALES

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Up Front

Happy Birthday and welcome to *Nature Australia*!

This issue begins our 75th year of continuous publication and that is definitely something to celebrate. To mark this rare publishing event, and say thankyou to all our readers, we have some very special things planned for the year ahead. You have probably already noticed that we have become *Nature Australia*. For some time now, we have needed a name that more accurately reflects the sort of articles and photos we publish. It wasn't hard to decide what that name should be, we all said it straight away, and all of us who work on the magazine are very happy and excited by our new name, and hope you will be too. A lot has changed since the first black-and-white issue in 1921 (see Ronald Strahan's "Nature's Diamond Jubilee" article on page 26) but what hasn't changed is our desire to provide you with interesting, informative articles that are illustrated with the most spectacular photos we can find.

TIM FLANNERY

The new tree-kangaroo from Irian Jaya.

In this issue we have an exclusive—be the first to travel with Dr Tim Flannery to the mountains of Irian Jaya where his discovery of a previously unknown black-and-white tree-kangaroo made headlines around the world. We also go to a remote site at the Head of the Great Australian Bight where Stephen Burnell has spent the last four years studying one of Australia's largest Southern Right Whale nursery grounds. Our cover story reports on the status of Wandering Albatrosses. Superbly adapted to their migratory lifestyle, these magnificent birds should be one of the most successful in the Southern Hemisphere. Instead, they are an endangered species and it has taken researchers 20 years to confirm why. Have you ever had the misfortune of brushing up against a 'stinging' caterpillar? Then you should read "Itch, Prickle and Tarantulas" on page 54. Dr Uwe Proske looks at some of the animals and plants that have made use of this unpleasant form of defence, and investigates our physiological response to it. And finally, in The Last Word, we investigate a judgement passed down by the Land and Environment Court last year. What implication does this have on the value of Government fauna assessments and the science upon which they are based? This plus all the regulars await you in *Nature Australia*.

S.R. BURNELL

A Southern Right Whale mother and calf.

—Jennifer Saunders

AUSTRALIA
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Front Cover
Wandering Albatrosses (*Diomedea exulans*) mate for life and raise a maximum of one chick every two years. Despite the fact that this low productivity is compensated for by a high survival rate, Wandering Albatross populations are in decline. Photo by Tui De Roy/Auscape International.

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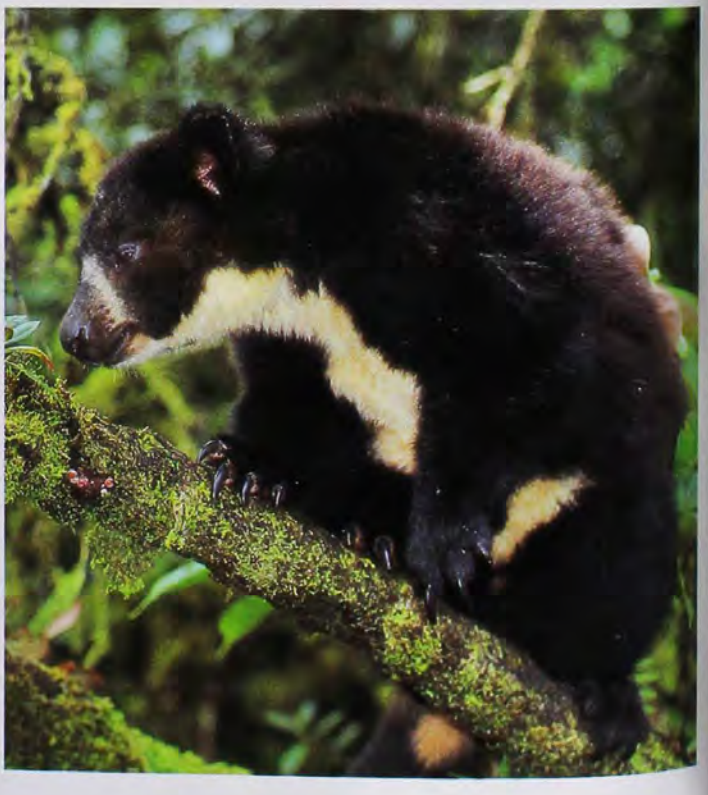

Regular Features

Columns

LETTERS

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

Conservation (F)laws

Peter Mirtschin's article in your Summer 1994–95 issue, on the negative side of some so-called conservation laws, has a familiar ring. I have maintained breeding programs for various native fishes including Dwarf Galaxias (*Galaxiella pusilla*) and Yarra Pygmy Perch (*Edelia obscura*) for up to 17 years for some populations. In 1988, new laws in Victoria made it illegal for me to keep either of these without a permit. I have applied for this permit several times but have not received a response or acknowledgment of any kind.

Some of the remaining *Galaxiella* populations are disappearing, unable to compete with the introduced Mosquito Fish (*Gambusia affinis*, also implicated in the disappearance of other native fishes and frogs). Despite this, the same department that ignores my applications has permitted transfer of large numbers of this species from one threatened population to another wetland riddled with *Gambusia* (the transferred fishes have disappeared).

I continue to breed *Edelia* and *Galaxiella* in many of my ponds, in environments that closely resemble their natural homes. Within Victoria, I am forced to ignore a law that supposedly protects two of Australia's 24 most endangered freshwater fishes but may be contributing to the demise of one of them. Yet at the federal level, my work is recognised as a significant management action in *The action plan for Australian freshwater fishes*, and the only captive breeding program for either of these species. The contrast between these attitudes is remarkable, and I strongly agree with Peter that this country is in urgent need of more user-friendly, uniform and commonsense wildlife regulations.

—Nick Romanowski
Dragonfly Aquatics, Vic.

Bravo, Peter Mirtschin for a thought-provoking criticism of wildlife policy. *Nature Australia* should invite an official response to stimulate discussion and encourage reform.

—Jerry Vanclay
The Royal Veterinary and Agricultural University, Copenhagen

Pleistocene Pandanus

I enjoyed Richard Braithwaite's article about pandanus in your Summer 1994–95 issue, but he does not consider the likelihood that pandanus leaves and shoots were harvested by Pleistocene herbivores. The pandanus thickets that are now being destroyed by buffaloes and feral pigs may have developed only within the last ten or 20 thousand years, following the extinction of diprotodons and giant kangaroos. I would also suggest that fruit bats are probably major dispersal agents of pandanus seeds.

—Tim Low
Chapel Hill, Qld

Chile and Leeches

The article dedicated to leeches in your Winter 1994 issue is very interesting but I think that the author makes a mistake when he states that land-living leeches are found only in South-East Asia and Australia. In fact, these vexing creatures can be counted by the hundreds on the forest floor (and eventually gliding into your trousers and socks) in certain places of southern Chile. The rainforests of the provinces from Valdivia to Puerto Montt also shelter a gigantic land-dwelling leech reaching a length of about 30 centimetres. As far as I know this gargantuan was discovered in recent times, and is said to prey on smaller worms and insects. Unfortunately it is very difficult in our country to get any information about the biology of these fascinating animals, so I do not even know the genus to which these species belong.

—Santiago De Rosa
La Plata, Argentina

The land-living leeches that are restricted to Australia, Asia and Oceania belong to the family Haemadipsidae. These are the truly terrestrial, obligatory blood-suckers. Terrestrial leeches are found elsewhere in the world, but these are not the specialised blood suckers that the author was referring to. Although these can also suck blood, most also eat small animals.

—G.H.

Batting Order

A MICROBAT's no larger
than a matchbox
And dines on insects should
they be around.
Food shortage is a bummer,
So at the end of summer,
They sink into a torpor,
just housebound.

Well, prior to that they do
a little mating,
But don't go in for lashings
of foreplay,
Just swift insemination,
Then delayed ovulation,
The sperm are stored to
berth another day.

The little beasts have multiple
sex partners,
(Well thank you ma'am;
no, don't apologise).
Some fellers are bi-sexual,
By no means ineffectual,
And take a certain pride in
penis size.

Leeches occur in many countries around the world but not all of them are obligatory blood-suckers.

JEAN-PAUL FERRERO/AUSCAPE INTERNATIONAL

KEV DEACON/ AUSCAPE INTERNATIONAL

These teeth may hold the secret to whether the Great White Shark is really a decendant of the giant Megatooth Shark.

A few species use delayed implantation,
Instead of that approach of mix and match.
They dock at time of mating,
But there's a time of waiting,
Until the food supply is up to scratch.

One must admire the MICRO-CHIRO-PTERA,
And wouldn't want to leave them in the lurch.
Though querulously quirky,
And sexually perky,
They're ripe for physiological research.

—Len Green
Vaucluse, NSW

Megatooth Sharks

We were delighted to see our fossil Megatooth Shark project pictured in John Long's "Big Tooth" article in your Summer 1994–95 issue. Since that feature was written we have been building our full-sized skeletal reconstruction using the scale model shown in the article as a three-dimensional blueprint.

The article includes the controversy over whether the Megatooth or Big Tooth Shark should be called *Carcharodon megalodon*, placing it in the same scientific genus as the living Great White Shark (*Carcharodon carcharias*), or whether it should instead be put into a different genus, as *Carcharocles megalodon*. The *Carcharocles* hypothesis holds that living Great Whites are evolutionary descendants of the mako sharks (genus *Isurus*), while the Megatooth is related but placed in a different genus. The article favours the *Carcharocles* terminology, and I thought I might explain a few of the reasons why many prefer the more traditional assignment of the Megatooth to *Carcharodon*.

First, the Megatooth and living Great Whites share what is known as a 'reversed intermediate' tooth in their upper jaws. This is a peculiar tooth, noticeably smaller than the immediately surrounding teeth, that looks like it is pointing the wrong way. Makos have an intermediate, but it looks much more like the surrounding teeth and has a 'normal' (non-reversed) orientation. Second, the internal tooth structure in the living Great White and Megatooth is very similar, according to the Danish palaeontologist Bendix-Almgreen. Third, the Megatooth and living Great White have symmetrical upper front teeth, while in makos these teeth are asymmetrical. Finally, both the Megatooth and living Great White possess broad triangular teeth, with serrations (which are absent in makos). The serrations and overall shape of the teeth in the living Great White become more and more like those of the Megatooth as the Great White grows larger.

In summary, the evidence at hand supports the interpretation of the giant Megatooth Shark as a member of the genus *Carcharodon* and a very close relative of the living Great White. Makos are in the same family of sharks (Lamnidae) as the Great White but, according to this interpretation, they are not the Great White's direct ancestors.

The one thing we all agree on, of course, is that the Megatooth was enormous—over 16 metres in maximum total length, based on the largest teeth found so far. As to the article's report of a 35-metre shark seen in 1918 off New South Wales—if it is true, I'm glad to be living along the relatively tame Atlantic coast of the USA!

—Michael D. Gottfried
Calvert Marine Museum
Maryland, USA

NATURE AUSTRALIA **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 $20.00 gift voucher from the Museum Shop catalogue. The winner this issue is Nick Romanowski.**

Nature Strips

COMPILED BY
GEORGINA HICKEY

Bee Cure for Cancer

Manipulating nature for our own benefit is part of human nature and when it comes to honeybees there's more to be gained than honey.

When a bee stings its victim, venom is pumped from a small sac in the abdomen. The fluid contains a simple protein called melittin that causes the pain in the sting and acts as a toxin by breaking open the cell membrane of cells that it contacts. Recently, medical scientists have been exploring the possibility of using toxins like melittin to kill cancer cells.

Since melittin will burst open any cell, a targeting mechanism is required to bring the toxin to the site of the cancer. One way of doing this is to attach melittin to an antibody specific to cancer cells. Antibodies are produced in the body in large quantities to fight off invading micro-organisms and mop up cells that have mutated and become cancerous.

A team of researchers from the University of Technology, Sydney (UTS) and CSIRO Division of Biomolecular Engineering is working on putting the two types of molecules together in the hope of producing an effective and highly specific anti-cancer drug. As explained by one of the team leaders, Bob Raison, at the May 1994 Horizons for Science Forum at UTS, such a drug would have big advantages over traditional chemotherapy, which is much less specific and results in the death of many healthy cells as well as cancerous ones.

In preliminary experiments researchers have been able to chemically couple melittin with an antibody

Researchers are using bee venom to develop an effective and highly specific anti-cancer drug.

WILDERNESS PHOTOGRAPHICS

KATHIE ATKINSON

A Blue Mountains peripatus, *Cephalofovea tomahmontis*. Special glands (right) on the legs of male peripatus secrete pheromones that attract the opposite sex.

specific for myeloma cells (a type of cancer found in bone marrow). However, the process of sticking melittin onto the antibody is difficult and can lead to unwanted chemical changes. Thus researchers are turning to genetic engineering to create a single synthetic gene that will code for the antibody and the bee toxin. If successful, the synthetic gene could produce large amounts of the drug in bacterial 'factories'. This approach would also save a lot of bees!

—Susannah Eliott
University of Technology, Sydney

Sexy Legs

Peripatus—those amazing half-worm–half-arthropods that mate with their heads—live in the dark crevices of rotten logs, underneath rocks, and in soil and leaf litter. Often individual peripatus are few and far between, and sometimes they are found with individuals of other peripatus species. So how do peripatus find members of the same species to mate with?

At least part of the answer is found in the peripatus equivalent of armpits. In males, special glands (called crural glands) open onto the undersurface of the legs via a small nipple-like structure. Secretions from these glands are deposited as a trail. Perhaps these secretions are pheromones that are used to attract mates?

To investigate how female peripatus responded to secretions from these glands, Susannah Eliott (now at the University of Technology, Sydney) and colleagues from Macquarie University placed female *Cephalofovea tomahmontis*, a Blue Mountains species, in air chambers. They offered them air that had been passed over either crural gland secretions, male or female body wall tissue, or distilled water (the control).

NOEL TAIT

In each of the trials, the female peripatus were mostly attracted to the crural gland secretions and showed little interest in the other air samples. These results suggest that the secretion is a sex attractant, at least to females of the same species. Whether the secretions also have an effect on males of the same species, or even females of a different species, awaits to be tested. This last point will be of particular interest, as *C. tomahmontis* cohabits with at least two other peripatus species.

—C.B.

Hippos in Stereo

Hippopotamuses (*Hippopotamus amphibius*) spend their nights grazing on land and much of their day submerged in water. It's tempting to think that these

enormous wallowing creatures do little more than eat and sleep. In truth, Hippos are gregarious, territorial animals with a rich repertoire of sounds they use to communicate. What is even more impressive is that they appear to communicate just as well under water as they do on land and have a unique dual hearing system that enables them to hear in stereo.

William Barklow from Framingham State College in Massachusetts has spent many long hours sitting by the Ruaha River in Tanzania, Africa, studying Hippo behaviour. Using a hydrophone (underwater microphone) he discovered that Hippos produce a variety of sounds in their throats that are transmitted through the water to other Hippos. In a similar way to some fully aquatic mammals such as dolphins, these underwater signals appear to be picked up through their jaw bones rather than their ears. The jaw bone is connected to the inner ear via the skull and has thicker and thinner regions that vibrate at different sound frequencies.

When Barklow played the sounds back to the Hippos from an underwater speaker, the animals responded by first surfacing and then orienting themselves towards the speaker. Barklow believes that the Hippos are using their ears above water in combination with their jaws below to pinpoint sound from other Hippos. The flat head shape allows them to remain almost completely submerged while their ears, eyes and nostrils stay just above the water's surface. In this way they can transmit and receive sounds under water and through the air simultaneously.

One advantage of this unusual stereo hearing system is that, since sound travels faster through water than air, a Hippo can relate the delay between the two signals to the distance of the source of the sound. The greater the delay, the farther the calling Hippo is from the receiver. It's a bit like counting the number of seconds between a lightening strike and the sound it makes.

So what do Hippos say to each other? Living in herds with one sexually dominant male per group, it seems that, like most social animals, their conversation revolves around food, sex and territories.

—Susannah Eliott
University of Technology, Sydney

Hippopotamuses use their ears above water and their jaws below to pinpoint sound from other Hippos.

FERRERO/LABAT/AUSCAPE INTERNATIONAL

CELEBRATE SOLSTICE

Summer and winter solstices affect almost everyone, and most life forms on Earth. They are globally significant days in our annual circle around the Sun. This has been true over the millennia no matter what organisms have dominated the globe. These two days of the year—the longest and the shortest—can serve to remind us that the climate, to which we are always making behavioural accommodations, is entering a new phase in its annual pulse.

The shortest day of the year in South Australia is the longest day of the year in Arizona, usually 21 June. There in the Chiricahua Mountains, biologist Wade Sherbrooke, Director of the remote Southwestern Research Station of the American Museum of Natural History, celebrates summer solstice by kissing hummingbirds, purely for the adventure, challenge and ritual. Each year he paints his lips red (a colour attractive to hummingbirds that feed on flower nectar), fills his mouth with sugar water, and invites these iridescent jewels of the avian world to sip nectar from his kiss. Maybe it helps him keep in touch with his biological origins, and maybe it helps him recall his dependence on a healthy worldwide ecosystem? Maybe we all need a solstice ritual of celebration to remember these things?

—G.H.

LINDA SEEGER SALAZAR/THE ARIZONA DAILY STAR

Wade Sherbrooke and a Black-chinned Hummingbird (*Archilochus alexandri*).

Two Tips Are Better Than One

Why do snakes have forked tongues? Natural philosopher Hodierna reasoned 500 years ago that the points of the tongue were used for "picking the Dirt out of their Noses". Anyone with small children would agree that creatures that are "always grovelling on the Ground" need something to unblock their nostrils. Another of history's imaginative philosophers theorised that snakes catch flies between the split tips of their tongues. By the beginning of this century, better sense was prevailing and the serpent's tongue was favoured as an organ of touch.

HANS & JUDY BESTE/AUSCAPE INTERNATIONAL

Black-bellied Swamp Snake (*Hemiaspis signata*). Like all snakes, its forked tongue helps pinpoint the direction of a smell.

But, of all the great thinkers who pondered the role of the forked tongue, Aristotle came closest, argues Kurt Schwenk, a University of Connecticut evolutionary biologist. The Greek philosopher believed the fork doubled the snake's sense of taste giving the creature "a twofold pleasure from savours".

Today, research indicates that the lithe and active reptilian tongue is more an organ of smell than taste, gathering odour molecules with each flick and delivering them, through openings in the roof of the mouth, to receptors (known as Jacobson's organs) in the snout. The fork, found in all snakes and some lizards, says Schwenk, improves olfactory capabilities. Two tongue tips make it easier to pinpoint the direction of a smell and to follow odorous trails, in the same way that a pair of ears is better for locating the origin of a sound and stereo vision helps judge distance.

According to Schwenk, fork-tongued lizards are better equipped to forage for prey and travel widely for food. Those without forks usually wait to ambush their prey. In snakes, the forked tongue not only improves hunting but helps males follow pheromone trails left by females. In a similar way, young snakes follow the paths of adults to safe winter hibernation haunts.

Schwenk believes forked tongues have probably evolved independently in reptiles at least twice and perhaps even four times. This, along with the success and diversity of snakes, are indications that for reptile tongues two tips are better than one.

—K.McG.

Owning a Pet is Good for You

If you own a pet (or even if you don't), you've probably heard that pets help patients in hospital to recover from illness, and that in nursing homes they provide friendship and companionship to the elderly. But if you're relatively healthy, what does your household pet do for you?

Your pet, if it's a cat or dog, improves your general well-being, so a recent study concludes. The study, by James Serpell of the University of Pennsylvania, surveyed the overall health of a group of 'average' people before and after becoming dog or cat owners. The subjects' health was compared to that of non-pet owners over the same period. The differences were striking.

Owning a pet dog, it seems, is best for you. The people who became dog owners sustained improved health over the whole ten months of the study. Cat owners initially fared as well but the improvement didn't last. Non-pet owners were worst off.

Why *are* pets good for us? This question was not addressed in the study but Serpell and others speculate on some possible answers. For one thing, interacting with pets lowers blood pressure. Also, pets are good listeners—they don't interrupt, question or argue. Our pets' mute acceptance of us often contrasts with our interactions with humans. Pets make us feel wanted. And for dog owners, taking our pets for a walk gives us exercise we may not otherwise get.

The exact answer to why pet ownership can make us healthy is complex, and is likely to be found in the fuzzy boundaries between mental and physical health.

—C.B.

Pets, especially dogs like this Dalmatian, are good medicine.

JEAN-MICHEL LABAT/AUSCAPE INTERNATIONAL

Stitchbirds Come Face-to-Face

Birds do it! Bees do it! In fact, everything does it and, with few exceptions, they do it front to back. Primates, especially humans, are among the few animals that usually adopt the face-to-face or missionary position. In birds, the male mounts the female, makes a brief 'cloacal kiss' and the act is over. Observations of an unusual New Zealand bird, however, reveal this position is not universal among birds.

The Stitchbird (*Notiomystis cincta*) is traditionally considered to be a honeyeater, more for want of any other comfortable place to put it. It differs from other honeyeaters in several respects, including having white eggs (not coloured, speckled or blotched), nesting in cavities and having a bill adorned with flycatcher-like rictal bristles. After watching captive pairs of Stitchbirds in the National Wildlife Centre near Wellington, Sue Anderson has also discovered that they differ in their mode of mating.

Males were seen to pursue their mates through the aviary. When they were ready, a couple would land on the ground, and the male would roll the female on her back. Lying prone with her wings outstretched, he would then mount her in a front-to-front position, amid loud calling. He would then dismount, fly to a nearby branch, and preen himself.

During mating, the Stitchbirds seemed oblivious to their surroundings. Indeed, a front-to-front mating position does not allow the birds to monitor their environment. This potentially leaves them very vulnerable to predation. It is perhaps significant in this respect that Stitchbirds are very rare, and only occur on offshore islands where there are traditionally few ground predators.

—G.H.

Self-quilling: An Occupational Hazard

The search for a naturally occurring antibiotic on the quills of North American Porcupines (*Erethizon dorsatum*) began when Uldis Roze (Queens College, New York) had a painful encounter with an errant quill that entered his biceps and travelled about 25 centimetres to his forearm before emerging without infection.

Working with David Locke, also from Queens College, and Nick Vatakis (New York University School of Medicine), Roze analysed the greasy coating on the short tail quills—those used mainly in defence. This was found to contain fatty acids that were already known to have antibiotic properties. The amounts varied from five to 20 per cent, depending on the season.

As to why they possess this antibiotic, the researchers looked to the porcu-

GEOFF MOON

Stitchbirds are unusual in that they adopt the missionary position while mating.

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CRAIG J. BROWN/WILDLIGHT/LAISON

The quills of North American Porcupines have antibiotic properties that act as insurance for when the animals fall out of trees.

pine's lifestyle. In New York State, where the studies were conducted, North American Porcupines live in deciduous forest and are semi-arboreal. In winter they live in dens but emerge to eat tree bark. In summer (when the fatty acids are up to 15 per cent higher) they rest in the upper branches of trees during the day, and feed at night. Because they have a high body weight, and the favoured tender shoots are found on the ends of weak branches, the porcupines often fall out of the trees. Indeed, when 37 adult skeletons from museums were examined, over a third were found to have healed fractures. With their habit of falling out of trees, the risk of 'self-quilling' and infection would be high, were it not for the quills' antibiotic properties. An antibiotic is a sensible evolutionary response to a need for occupational insurance!

But does this self-injury insurance defeat the purpose of the defence system? No, say the researchers; the pain inflicted by the quills is defence enough!

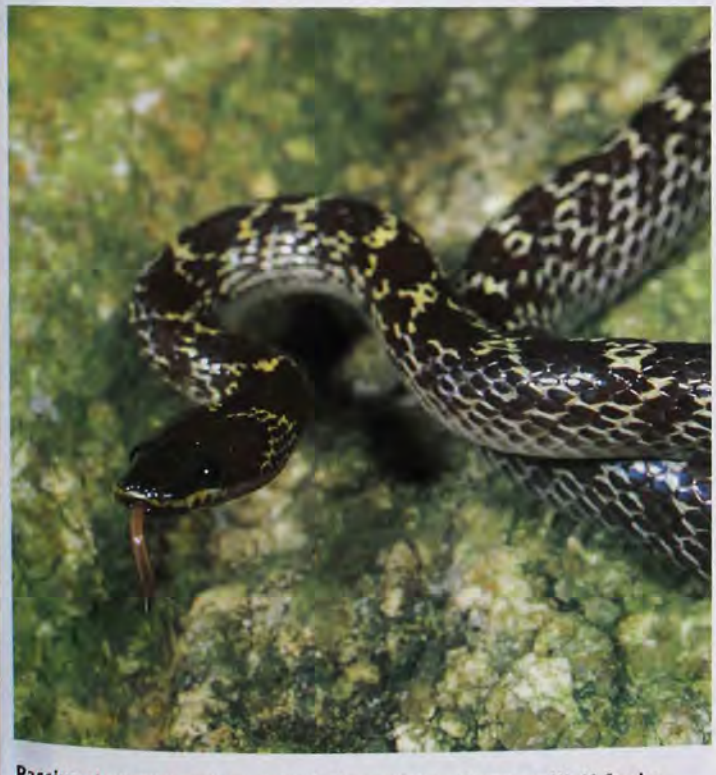
—R.S.

A Threat to Christmas?

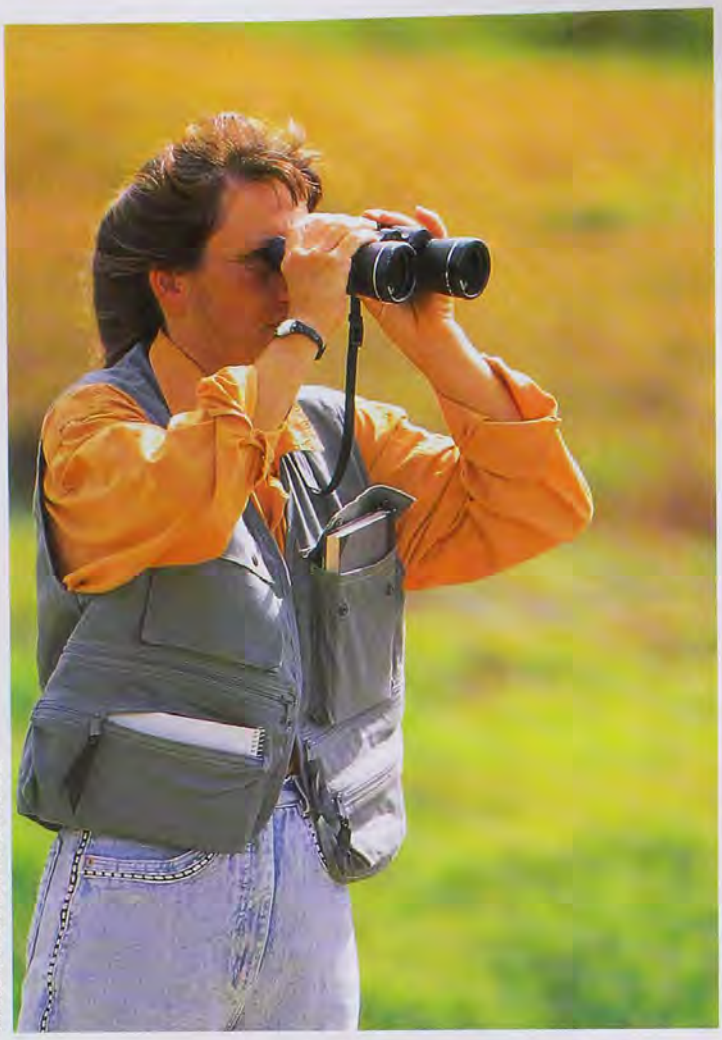
Christmas Island is located in the east Indian Ocean and is home to several endemic species of mammals, reptiles, invertebrates and plants. Previously threatened by phosphate mining and hunting, today the wildlife of Christmas Island is thought to be only slightly impacted by feral cats, rats and mice. The reason for this may be the island's rugged terrain, lack of a dependable year-round food supply, or competition for resources with the extraordinary number of Red Crabs.

However, the discovery of several Common Wolf Snakes (*Lycodon aulicus capucinus*) on the island is cause for considerable concern. Wolf snakes are nocturnal, climbing snakes with greatly enlarged front teeth that can inflict a nasty but harmless bite to humans. They are opportunistic predators and can grow very large when food is abundant. Feeding on a diverse range of vertebrate prey, they have the potential to decimate wildlife on Christmas Island, as did the notorious Brown Tree Snake (*Boiga irregularis*) on Guam in the north Pacific.

Thomas Fritts, a biologist



Passive stowaway and opportunistic predator: Common Wolf Snake.



JIRI LOCHMAN/LOCHMAN TRANSPARENCIES

Some birds may be repelled by a spotter's bright clothing.

with the US Fish and Wildlife Service, recently looked at the similarities between the two closely related snakes. The Brown Tree Snake and the Common Wolf Snake both arrived on their respective islands as passive stowaways during cargo movements. Both are generalist predators and form dense populations near human settlements and transport routes, and in this way are able to spread rapidly. Lacking an effective predator, the Brown Tree Snake attained extraordinarily large population levels and was able to spread unchecked throughout Guam. There are three birds of prey able to consume snakes on Christmas Island, but only the Christmas Island Hawk Owl (*Ninox squamipila*) is active at night when the Common Wolf Snake is most vulnerable.

In order to avoid a possible re-enactment of Guam, Fritts recommends that Christmas Island's serpentine intruder be eradicated before it becomes abundant.

—R.S.

Colour-bias Birds

Researchers collecting winter data on birds in the woodlands of central Texas often wear orange vests as a safety precaution so that hunters can see them. As most avian species have excellent colour vision, the birds probably see them too. Colour can provide important behavioural and ecological cues for birds, so how do they react when they see a brightly clad human in their midst? Are they attracted, repelled or indifferent?

Biologists Kevin Gutzwiller and Heidi Marcum, from Baylor University in Texas, believed that the answers could have implications for the general collection and interpretation of data on avian behaviour, habitat use and abundance. In the first documented report on the influences of an observer's clothing colour in avian field research, Gutzwiller and Marcum carried out bird censuses in 22 separate central Texas woodland sites over two consecutive winters. Conducting their field work both with and without an orange vest, they found that, of the 13 species commonly surveyed, three (the Carolina Chickadee, Tufted Titmouse and American Goldfinch) were repelled by the bright apparel.

These three species were easily approached when the orange vest was not worn. The work indicates the sort of biases that could occur when collecting field data on birds. Gutzwiller and Marcum argue that this, in turn, could lead to inappropriate decisions on habitat and population management. They suggest field researchers wear colours that affect the fewest species. In the absence of knowledge on the colour preferences of all birds, the best way to achieve that is by wearing dark drab clothes or camouflaged garments.

—K.McG.

Acid Chain

More than 30 years ago DDT accumulation in food chains was found to be responsible for thin, breaking shells in eagles' eggs. It remains one of the most potent examples of the flow-on effects of environmental degradation. Now, a research team led by Jaap Graveland from The Netherlands Centre for Terrestrial Ecology has sourced defects in songbird eggs to acid rain.

Over a period of six years, there was a fourfold increase in the proportion of Great Tits (*Parus major*) laying eggs with defective shells in the Dutch Buunderkamp forest—a forest that grows on poor, sandy, low-calcium soils. Graveland's research team found that, by comparison, eggshell defects were rare in forests with calcium-rich soils.

Like many birds, tits can't store calcium and the females must collect and consume material rich in the mineral during their egg-laying period. The researchers identified the bird's normal calcium source as snail shells, and showed that eggshell defects declined when the females were supplied with snail shells. They also found there were barely any snails in forests that had low-calcium soil and high levels of eggshell defects. Snails need large amounts of calcium to grow and reproduce, and therefore often supplement their diet of plant material by ingesting soil or rock or absorbing calcium through their skin.

The major cause of calcium loss in poor soils in The Netherlands and other industrialised countries is acid rain. In the intricate and interwoven way of ecosystems, this has caused a decline in snails, which has led to a calcium deficiency in Great Tits. Ultimately, if not already, the number of birds too may begin to decline as a result.

—K.McG.

A lack of snails, brought about by acid rain, causes Great Tits to lay thin-shelled eggs.

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The power from one horse is greater than one horsepower.

QUICK QUIZ

1. Which Budgerigars are the more talkative: males or females?
2. What astronomical feature is sometimes referred to as a 'dirty snowball'?
3. In which State of Australia would you find Anxious Bay?
4. What are the two previous names of *Nature Australia* magazine?
5. In which city was the September 1994 United Nations conference on world population held?
6. What are the faunal and avian emblems of Western Australia?
7. To which Pacific island were Brown Tree Snakes inadvertently introduced during World War 2?
8. What do you call a group of crows?
9. Name the invisible part of the electromagnetic spectrum that produces heat.
10. What does RAOU stand for?

(Answers in Q&A)

Horsepower

How many horsepower can a horse produce? One, you might think, but it's actually a lot more.

James Watt defined 'horsepower' in the 1780s at a time when horses were being replaced by steam engines. The cost of a steam engine was calculated as an annual premium based on the number of horses needed to do the equivalent amount of work. Knowing that a horse could walk around a mill wheel of 24 feet diameter 2.5 times per minute over a day, and assuming a pull of 180 pounds force (lbf), Watt calculated the horse's power to be 33,929 ft-lbf/min or about 550 ft-lbf/sec (metric equivalent 746 watts). He called this value one 'horsepower'.

Robert Stevenson from the University of Massachusetts and Richard Wassersug of Dalhousie University noted that a horse can actually produce much more than one horsepower. They used an estimate of 100 watts of power per kilogram of skeletal muscle and calculated the power from a 600-kilogram horse, assuming only 30 per cent of the animal's mass was skeletal muscle in use at once. This produced a figure of 18,000 watts or 24 horsepower. A value of 12–14.9 horsepower was measured for a horse in a 1925 Iowa horse-pulling contest. Even this estimate is more than ten times Watt's value of one horsepower. Was Watt wrong?

No. Watt's calculations were based on a draught horse working constantly all day. After all, it was this daily effort that was needed to determine the annual premium for a steam engine. Stevenson and Wassersug's calculations, on the other hand, were based on a theoretical maximum effort that might only last a few seconds.

—C.B.

Why Does Willie Wag?

Willie Wagtails (*Rhipidura leucophrys*) are not only among the most frequently encountered of our

G. WEBER

The Willie Wagtail wags its tail from side to side, perhaps to flush out ground-dwelling insects.

native birds, but also among the most charming. Their charm probably derives from their tail-wagging behaviour. Most birds flick their tails up and down, but a few species, like Willie Wagtails, wag them from side to side.

Why do Willie Wagtails wag their tails? There are several explanations: tail wagging may indicate to a predator that it has been seen; it may deter other birds from entering the territory; or it may provide balance. However, conventional wisdom suggests that tail wagging helps flush out ground-dwelling insects. The moving tail causes changes in light intensity or air movements that may startle insects into flight. Once flushed out of the ground vegetation, they easily fall prey to the versatile and acrobatic Wagtail.

My student Janey Jackson and I decided to investigate this 'foraging' explanation for tail wagging by watching Willie Wagtails in several suburban parks in Melbourne. First, we noticed that Willie Wagtails sitting on perches rarely, if ever, wagged their tails, which suggests that tail wagging is related to foraging. We also found that the birds adjust their tail-wagging rates according to weather and light conditions, perhaps to maintain a constant capture rate. In particular, they enthusiastically wagged their tails when foraging on either dull days or in the shade on sunny days, but wagged them less frequently in sunny conditions when the tail casts a more obvious shadow.

While these results are consistent with the idea that tail wagging helps flush out insects, it still remains to be shown experimentally. Of course, Willie Wagtails may wag their tails for reasons other than obtaining food, but it is difficult to explain why tail wagging should change under different light conditions if it is primarily associated with, say, territorial defence or balance.

—Mark A. Elgar
University of Melbourne

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Bed bugs could have been around us since the days our beetle-browed ancestors turned to caves as an innovative approach to modern housing.

IN BED WITH THE REDS

BY STEVE VAN DYCK

HEAVEN MUST BE HELL ON Sunday nights when the last of our Earthly prayers have ascended, ready for angelic sorting. The hungry are to be fed, droughts to be broken, clear skies to be arranged for weddings, lost kittens and wallets to be found. But what were people praying for 140 years ago?

"From red-bugs and bed-bugs, from sand-flies and land-flies,
Mosquitoes, gallinippers and fleas,
From hog-ticks and dog-ticks, from hen-lice and men-lice,
We pray thee good Lord, give us ease."
Anon. in Hocking (1968)

Unfortunately for that scrofulous generation of scratchers, everything but Divine intervention made itself manifest in their flesh. Today, mercifully, we tear at our skin less often and, while I'm not sure I'd recognise a gallinipper if it was chewing me, I am reasonably confident I've never been sucked by a bed bug...although I did come close to it once.

About 20 years ago I stayed with a family that had recently purchased an ultra-modern two-storey home. The place was more sterile than a bucket of phenol, the rooms luxurious, dimly lit and inviting, the lady of the house rabid for asepsis.

Knowing I had interests in crawling things for which she had less mercy than stomach, she invited me into the master bedroom one day to show me a curiously flattened bug she'd been able to clobber while vacuuming th carpet (strand by strand).

In form, the insect resembled a smaller version of one of those green stink bugs that occasionally pollutes a meal by hiding inside the silver beet and getting cooked. It was reddish-brown however, about six millimetres long and wingless, with a sharp sucking tube tucked under its body.

Things looked decidedly bleak for Mrs Sparkle's spotless reputation. As she read the meaning in my worried expression, I could see some of the colour draining from the poor woman's face. It wasn't the first time she'd been drained!

A perfunctory look up among the folds of her mosquito net and there they were...dozens of shuffling bed bugs, blood-suckers by night, net-lurkers by day. The poor woman went whiter than the offending tulle, slowly shook her head in disbelief and slumped into a chair. She was snookered: while having them in the house was contrary to her sanitary disposition, having them exterminated was to run the risk of a loose-lipped pest-man telling the neighbours what he'd found inside her home! As for me, like an innocent bushwalker stumbling onto 20 hectares of marijuana, I was happy to get away with my life!

Bed bugs, which were probably first encountered by humans in the eastern Mediterranean or Near Eastern region, could have been around us since the days our beetle-browed ancestors turned to caves as an innovative approach to modern housing. Had the humanoids twigged to the close relationship between the swallows and bats they'd ousted from the new accommodation, and the blood-sucking crawlies that lived in its cracking walls, they might have put up with the occasional bird or bat poo on the scatter rugs in exchange for a night free of scratching. The bugs, which had once regularly clambered out to feed on warm bat or

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Bed bugs feed by injecting their host with anti-coagulant-rich saliva and then sucking up the resulting blood–saliva mix. This saliva has been known to cause anaemia, insomnia and palpitation of the heart in some human hosts.

swallow blood, were now forced to look below, to the veins of the tunnel's new grunting tenants. The consummation was apparently sweet enough since bed bugs have been following hot on human heels to this day.

Aristotle suggested that bed bugs generated spontaneously from sweat. Before his trip to the underworld, Bacchus, the Greek god of wine, asked the great protecting deity Jupiter to book him in to inns along the way where bed bugs were few. But Bacchus wasn't the only one mindful of the blood relationship between lodging houses and bed bugs. In Ruth Park's *Swords and crowns and rings* (1977), the sickening description of a restless night in one of Sydney's doss houses during the depression is an encapsulation of bed bug behaviour:

"They found a boarding house, paid their money in advance, and were shown to a cubby with a spavined double bed...His scratching became frantic, and he lit a match to see what was biting him. The whole wall was hung with tiny black berries. As he gasped, they broke their ranks and vanished...He sank into sleep, and the bed bugs came out in their thousands and nearly ate him alive...In the morning both he and Jerry were marked all over with swollen welts; their shirts were speckled with blood exuded by the glutted bugs. The musky smell of the insects was in the air."

Bed bugs, of which Australia has one (European imported) species, *Cimex lectularius*, don't live on or permanently attach themselves to people's skin or hair; they prefer cracks and crevices in bedroom walls or spaces behind peeling wallpaper, picture frames etc. Their weakness for the folds of haversacks and luggage left lying near beds has recently earned them the new-age title of 'back-packer bugs' (and it was the return of her continent-hopping teenage children that was to blame for the sudden infestation in Mrs Sparkle's spotless home). Unless starving, they avoid the light, and are most active just before dawn. Then, attracted by the carbon dioxide and warmth produced by a sleeping person or pet (as little as two or more degrees above the ambient temperature will stimulate them to look over the menu), they spill out of the crannies to gorge on blood.

After stabbing a double-barrel hypodermic needle into the meal's skin, anticoagulant-rich saliva (which might prove irritating to a hypersensitive host) is pumped down one barrel to stop the host's blood from clotting before it gets to the bug's mid-gut. The blood–saliva mix is drawn up through the other barrel and the bed bug might take from five to 15 minutes to sate itself. Undisturbed feeding can lead to a six-fold increase in normal weight, and a week might pass before the bug needs to feed again. Toughness goes part and parcel with being a bed bug, and under cool conditions one might live for well over a year when the lickings are lean.

JOHN MASON/ARDEA LONDON LTD

Wherever humans have gone, bed bugs have followed.

Bed bugs are not just clever suckers. They are also clever stinkers. If a feeding adult senses danger (a suddenly switched-on light, a whiff of Aerogard), its stink gland will blast an aldehyde-rich vapour trail that can bring down the curtain on a feeding frenzy and send all the bugs careering for the crevices at a break-thorax rate of two centimetres a second. This, however, is usually not before the initial excitement of feeding has stimulated each bug to empty its bowels on the host's pyjamas.

Bed bug saliva might cause local irritation depending on the host's sensitivity, and bites from many bugs can lead to anaemia, insomnia, nervousness, debility, influenza-like symptoms, palpitation of the heart and eye disturbances. More worrying, however, is the recent recovery of the Hepatitis B virus from bed bugs (*Cimex hemipterus* and *C. lectularius*) in Africa. Although cow dung and horse hair were once burnt to eradicate them, and stags' horns, rabbits' feet and foxes' ears were hung near beds to ward them off, it was the plain iron bedstead (replacing the huge, wooden, heavily draped four-poster) and organic insecticides that put the check on their multiplication.

Their revolting lifestyle aside, bed bugs have had their practical uses. According to Pliny and Quintus Serenus, a decoction of seven crushed bed bugs mixed with wine could cure fainting spells, strangulation, quartan ague and lethargy. And, good news for poultry farmers, fowls that had eaten bed bugs would be rendered immune to snake bite for a day.

But in spite of such glowing recommendations I'll continue to rest my faith in Panadol and pray for the deliverance of free-range chooks from all things reptilian (keeping one eye, of course, on the wall while kneeling by the bed)! ■

BED BUGS

Classification
Order Hemiptera, family Cimicidae, genus *Cimex*, 13 spp. of which parasitise bats, 1 sp. parasitises birds, and 2 ('bed bugs') commonly parasitise humans.

Species
Common Bed Bug (*C. lectularius*) and Tropical Bed Bug (*C. hemipterus*).

Identification
5–7 mm long; reddish brown 'stink bug' appearance; wingless; body a flat, almost perfect circle.

Life History
Female lays 2 eggs per day up to a total of 250. White, kiwi-fruit-shaped eggs, 1 x 0.5 mm, laid in crevices. Eggs hatch in 7–10 days when temperature is between 20° and 27° C.

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Steve Van Dyck is a Curator of Vertebrates at the Queensland Museum where he has worked since 1975.

Despite its contraction in range, the Spectacled Hare-wallaby has fared well in comparison to other hare-wallabies.

SPECTACLED HARE-WALLABY

BY SANDY INGLEBY

AT THE TIME OF EUROPEAN settlement in Australia large parts of the mainland and several offshore islands were inhabited by hare-wallabies (*Lagorchestes* and *Lagostrophus* spp.). These small macropods resembled European Hares to early scientists. They were similar in size, and were renowned for their speed and agility. John Gould was particularly impressed by the jumping ability of one that was chased by his dogs across the plains in South Australia during the 1840s. He wrote: "the animal had arrived within 20 feet before it observed me, when...instead of branching off to the right or left; it bounded clear over my head".

Five species of hare-wallabies have been described (four *Lagorchestes* and one *Lagostrophus*). Of these two are now extinct, another two are endangered and only one, the Spectacled Hare-wallaby (*Lagorchestes conspicillatus)*, remains widespread.

Like other members of their genus, Spectacled Hare-wallabies are nocturnal, spending the day in small squats or shallow burrows under grass tussocks or low shrubs. They are well adapted to arid or seasonally arid environments, being able to produce highly concentrated urine and having low metabolic rates. They are generally solitary, although several animals may be seen feeding together. Their diet consists predominantly of grass and herb foliage, seeds and fruit.

The Spectacled Hare-wallaby inhabits open forests, open woodlands, tall shrublands and hummock grasslands. It has a wide distribution, however its occurrence within this area is extremely patchy and there have been marked contractions in its range during the last 100 years. It is still common on Barrow Island, and occurs across large parts of tropical Northern Territory and Queensland. However, its range in southern Northern Territory has contracted northwards by over 200 kilometres during the last 50 years, and it is now rare in the Pilbara and Kimberley regions of Western Australia. Its range in Queensland does not seem to have altered greatly during the last century, although numbers in central Queensland have declined over the last 20 years.

The main factors responsible for the decline of Spectacled Hare-wallabies appear to be habitat alteration by introduced herbivores and fire, and predation by feral animals. However, the importance of these factors seems to have varied in different parts of their range. Cats were almost certainly responsible for their disappearance from Hermite Island, Western Australia, from 1912–1950, but they do not appear to have been a major factor elsewhere. The combined effects of rabbits, foxes and introduced stock may have pushed Spectacled Hare-wallabies to extinction in the MacDonnell Ranges, Northern Territory, whereas land degradation through overstocking with sheep and cattle, and inappropriate burning patterns, are believed to have been important in the Pilbara and Kimberley regions. The cessation of traditional Aboriginal burning practices may also have disadvantaged Spectacled Hare-wallabies, although burning patterns have changed over large parts of their range, not just the southern parts.

Despite its contraction in range, the Spectacled Hare-wallaby has fared well in comparison to other hare-wallabies. This is probably because it is not confined to arid and semi-arid areas of central Australia but also inhabits the tropical north. In the latter area it would not have been exposed to the factors that caused other hare-wallabies to virtually disappear from the mainland. Foxes, rabbits and sheep are generally absent from parts of northern Australia where Spectacled Hare-wallabies occur today, and few habitats have been extensively cleared as yet. Indeed many other 'medium-sized mammals' (those weighing between 150 grams and five kilograms) that were once widespread have disappeared from arid or semi-arid areas but persist in the wetter northern parts of their range.

The Spectacled Hare-wallaby was classed as 'common' in Queensland during the early 1980s. However, it is at risk on mainland Western Australia and a more accurate description of its status over much of Northern Territory and Queensland today is 'vulnerable' or 'potentially vulnerable'. Attempts to determine whether the species is stable or continuing to decline are made difficult by the fact that numbers fluctuate from year to year. Populations in critical areas need to be monitored over successive years to determine trends.

During the late 1980s and early 1990s another factor loomed as a possible threat to Spectacled Hare-wallabies in the Gulf region of the Northern Territory. This is one of the few areas of the Territory where this species is relatively common, and one of its prime habitats here is Lancewood (*Acacia shirleyi*) forest interspersed with Bullwoddy (*Macropteranthes keckwickii*) thickets. A proposal was made to log Lancewood forests throughout a large part of the Gulf region to produce wood veneer. Fortunately the project was abandoned for economic reasons. However it illustrated that, while Spectacled Hare-wallabies did not appear to be threatened in that area, the situation can change rapidly.

Currently, few habitats suitable for Spectacled Hare-wallabies are present on reserved land, and the few national parks or reserves where this species has been recorded (except for Barrow Island) contain only marginal habitat. There is clearly a need for more areas of suitable Spectacled Hare-wallaby habitat to be included in the reserve system, and for inappropriate land management practices in other areas where they occur to be discouraged. Given the tragic history of extinctions among the medium-sized mammals of Australia, every effort needs to be made to preserve those that remain. ■

Dr Sandy Ingleby completed her PhD on the ecology of Spectacled Hare-wallabies and Northern Nailtail Wallabies. She is currently employed by Taronga Zoo as Program Manager of the Australian Conservation Training Initiative (ACTI).

JIRI LOCHMAN/LOCHMAN TRANSPARENCIES

Seeds of Chickweed and plantain have been recovered from Danish peat bogs inside the stomachs of corpses more than 1,500 years old.

WEEDS: THE FORGOTTEN FOODS

BY TIM LOW

I HAVE A SPECIAL FRIEND IN AFRICA called Wilberforce Okeka. An excellent self-taught naturalist, he lives at the edge of Kakamega Forest in western Kenya, where he works as a nature guide. Although he spent only seven years at school, he knows all of Kakamega's many rainforest birds and the Latin names of all the trees. During my eight days at Kakamega we became close friends, and I ate many meals at his house.

Like most rural Africans, Wilberforce is poor. His staple diet is ugali—boiled maize meal—eaten with boiled or fried leaves, usually bean leaves. For breakfast he often has sour maize meal porridge, and his wife sometimes makes chapattis. About once a month they eat meat.

An Indian peasant at Sasan Gir in Gujarat gathers Needleburr leaves to be served at a roadside stall.

Because Wilberforce and I have so much in common, as naturalists and conservationists, I was deeply struck by our differences. He owns very few books or other possessions, and his diet is very limited. I wanted to help him further his career. We plan to produce together a booklet on Kakamega's plants that he can sell to clients.

As we walked around the forest together, I could not help noticing that adjoining maize fields were infested with Potato Weed (*Galinsoga parviflora*). I know from reading and experience that this South American weed can be eaten as a vegetable. I suggested we gather some to eat with our ugali.

That night there was much giggling around the dinner table for everyone was surprised by how flavoursome the weed was. My hosts were amazed that I could come from the other side of the world and show them a new food growing 20 metres from their hut. I was amazed myself.

Over the following week I introduced them to another three wild vegetables: a nettle (*Urtica* species), a cress (family Brassicaceae) and Thickhead (*Crassocephalum crepidioides*). The nettle and cress were growing in the rainforest, but the Thickhead, like the Potato Weed, was growing as a weed in dis-

The sweet berries of Glossy Nightshade, and its close relative Blackberry Nightshade (*Solanum nigrum*), were eaten by convicts, Aborigines and colonial children. The leaves were boiled in Queensland, and overseas, as a substitute for spinach.

PHOTOS: TIM LOW

turbed ground.

Weeds are intriguing plants. The more common farm weeds are among the most successful organisms on Earth. They have followed humankind around the world, and some are so closely tied to cultivation they have no known natural habitat.

A very large number of garden and farm weeds have leaves and other parts edible to humans. Chickweed (*Stellaria media*), Pigweed (*Portulaca oleracea*) and Cobbler's-pegs (*Bidens pilosa*) are well-known examples. These are quick-growing opportunistic plants that sprout where soil is freshly disturbed. They are edible because they do not produce the tough leaves and complex toxins found in most long-lived plants such as shrubs and trees.

All around the world weeds like these have been harvested by the rural poor as foods, and often as medicines. They were the 'bush tucker' of our European forebears. Seeds of Fat Hen (*Chenopodium album*), a common farm weed in Australia, were eaten by ancient Europeans in Russia, Denmark, Greece and Italy. And seeds of Chickweed and plantain (*Plantago* species) have been recovered from Danish peat bogs inside the stomachs of corpses more than 1,500 years old.

During the 19th century some of these weeds were eaten by Australians. Botanist Joseph Maiden praised Green Amaranth (*Amaranthus viridis*) in 1889: "It is an excellent substitute for spinach...as it becomes more widely known, it is sure to be popular, except amongst persons who may consider it beneath their dignity to have anything to do with so common a weed." Other weeds eaten in the colonies were Pigweed, Common Sowthistle (*Sonchus oleraceus*), Yellow Wood Sorrel (*Oxalis corniculata*) and Lesser Swinecress (*Coronopus didymus*).

During travel overseas I always look for signs of weed harvesting. In eastern Thailand in 1978 I saw refugees from Pol Pot gathering Thickhead from stream beds in rainforest. In New Caledonia a Kanak told me they eat the leaves of Glossy Nightshade (*Solanum americanum*). At a roadside stall in Gujarat in India I was served fried Needleburr (*Amaranthus spinosus*) leaves. And at Lake Elementaita in Kenya I was told of the use of amaranth, Fat Hen, Nettle-leaved Goosefoot (*Chenopodium murale*) and others, although again, Potato Weed was not used.

My impression is that weeds are nowhere near as widely used as they ought to be. Kakamega is probably typical of many poor communities. Harvesting of weeds and other wild herbs was probably widespread before the influences of Western development came along. But living standards are declining in many Third World countries, and weeds can play a role in fending off malnutrition. There was a lot of hunger at Kakamega when I was there.

Weeds can play a role in Australia too, by giving urban dwellers a chance to get back to nature by foraging for their own food. For anyone who wants to try weeds I strongly recommend the recipe for spanikopita from my book *Wild herbs of Australia and New Zealand.* Dock leaves (*Rumex* species) are ideal, but you can use amaranths, Fat Hen, Potato Weed and other edible greens, separately or mixed. ■

Potato Weed is a common farm and garden weed in Australia and all around the world. It has been harvested as a vegetable in Mexico, Indonesia and many parts of Africa. A weed can be defined as a plant growing where it is not wanted.

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Tim Low is a nature writer, photographer and consultant living in Brisbane. In 1994 he spent ten weeks studying animals and plants in Africa.

Spanikopita

1 tablespoon butter
1 onion, diced
3 cups packed chopped leaves
2 or 3 eggs
200 grams fetta cheese, crumbled
pepper
8 black olives, chopped (optional)
1/3–1/2 packet of filo pastry
extra butter

Heat the butter in a pan and lightly fry the onion. Add the leaves and fry briefly. In a bowl beat the eggs and add the fetta, pepper, olives, onion and leaves. Mix thoroughly and set aside.

Melt about 50 grams of butter in a pan. Grease a baking tray and layer sheets of filo upon it, brushing every second sheet with melted butter. Use about 1/4 packet of pastry. Spoon the weed mixture onto the pastry and fold in the corners. Add more layers of buttered filo to form a lid, folding under the corners to form a neat pie. Brush the surface with melted butter and bake in a moderate oven for 30 minutes or until brown.

NATURE'S DIAMOND JUBILEE

BY RONALD STRAHAN

Over the last 20 years the magazine has progressed to the point where it is the most eminent magazine of its kind in Australia.

Every museum wants to make information available to the public through its exhibits, but the messages conveyed by specimens and labels are necessarily brief and often transitory. So, a good museum also extends its influence by the spoken and written word.

In this capacity, the Australian Museum has, since its earliest days, hosted countless lectures by scientific staff and visiting scientists. In the early 1900s, in fact, these lectures were considered to be a significant part of Sydney's entertainment scene.

As far as the written word was concerned, however, apart from the contributions of some enthusiastic early Directors to the daily press, and the publication of several stuffy and didactic 'guides' to the Museum, there was little that would arouse the general interest of visitors.

This situation changed dramatically in 1921 with publication of the first issue of the quarterly *Australian Museum Magazine*. The Museum was given a voice, not only to its visitors, but to the general Australian public. That public was given, for the first time, an authoritative and readable journal on Australian natural history.

It was an adventurous project, embarked upon against the wishes of some members of the Museum's governing body and provided with very limited funds. The then Director Charles Anderson assumed the editorship and the scientific staff, encouraged by a fee of a penny a line of printed text and three shillings (30 cents) for each photograph published, were keen contributors. Luckily, receipts from sales exceeded the costs of printing and postage and within a few years the magazine had become so integral to the Museum's activities that it was even able to withstand the effects of the Great Depression.

A striking feature of the magazine in the 1920s and 30s was the almost conversational style of most of the articles. This may reflect the fact that few of the curators had any formal scientific edu-

Packing the magazine for postage to subscribers in 1924.

AUSTRALIAN MUSEUM

cation and therefore retained the common touch. However, the same can be said of contemporary authors who, despite their scientific professionalism, are able (with a little help from the editors) to communicate their ideas with fluency and, often, with humour. The accusation that scientists cannot write except in stilted jargon does not apply to these contributors.

There being no comparable journal in Australia, the magazine has a unique and influential role. As a boy in Perth in the 1930s, I devoured each issue as it came to the school library, firing my enthusiasm for zoology. I know many other people shared this experience.

Decades passed and four issues continued to be published each year, essentially in the same format. The content remained excellent but the presentation was old-fashioned. In 1962, however, a full-time editor was appointed; the name was changed to *Australian Natural History*; and the typeface and layout were improved. Nevertheless, it still remained old-fashioned.

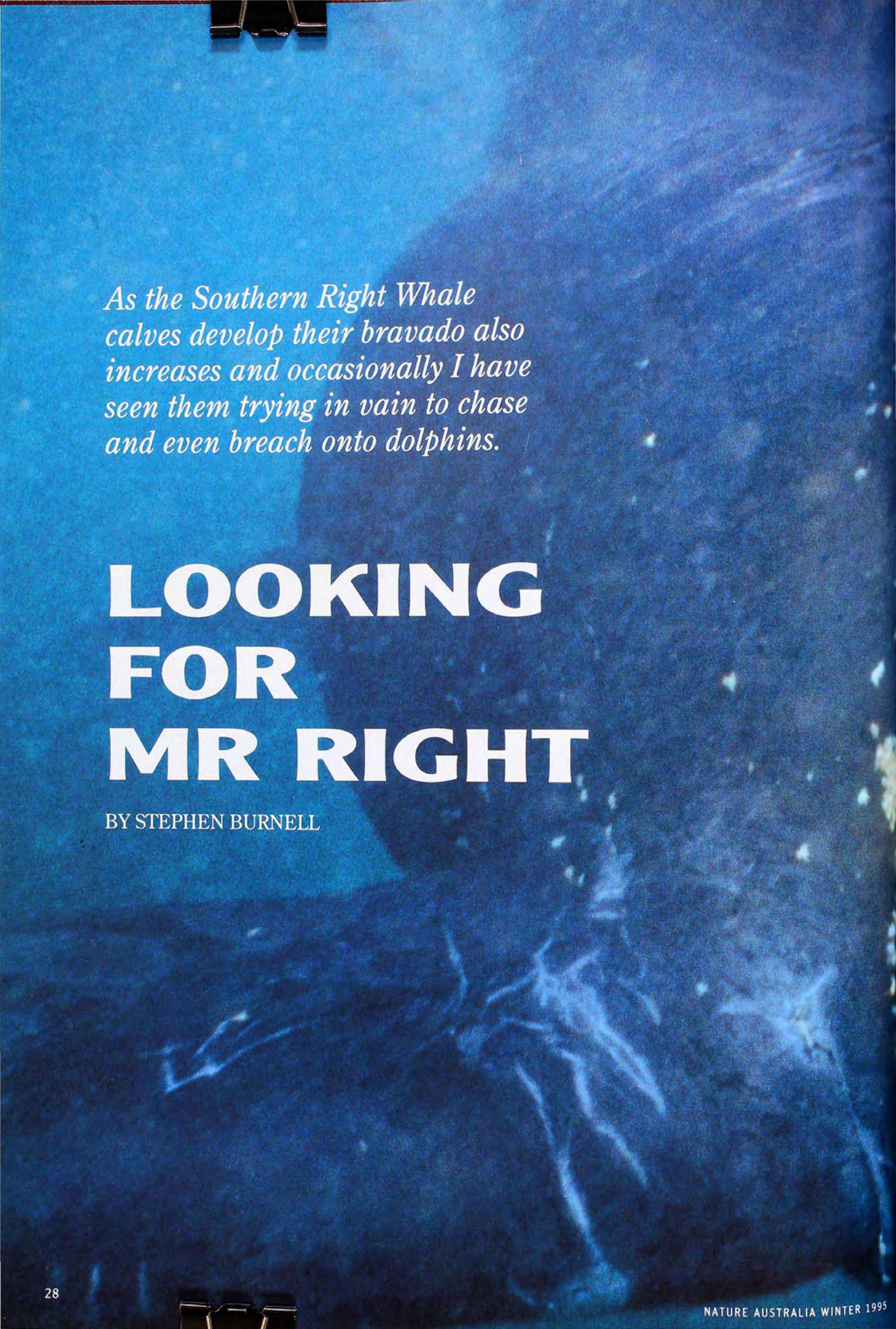
It was not until 1974 that *Australian Natural History* came into synchrony with the times. The page size was increased and, for the first time, the magazine was produced in full colour with a professional layout. Understandably, this made it more attractive but, even more significantly, it permitted the authors to tell their stories more effectively. The natural world is full of colour and it cannot be written about successfully without recourse to colour. In today's issues, a lot of effort is put into finding spectacular photos from all around the world. These photos are put through the same rigorous refereeing process as the text to ensure that readers are provided with the most accurate, up-to-date and spectacular material available.

The scientific staff, encouraged by a fee of a penny a line of printed text and three shillings (30 cents) for each photograph published, were keen contributors.

Over the last 20 years the magazine has progressed in professionalism to the point where it is not only the most eminent magazine of its kind in Australia but is also highly respected throughout the English-speaking world. As such it received the Australian Whitley Award for "Best Natural History Journal" in every one of the seven consecutive years that the category operated.

Seventy-five years of continuous publication is a rare and special event and one that couldn't have happened without you, our reader. Despite all the changes that have occurred over the years, this magazine has survived because it has remained relevant and interesting to you. And so, with this its birthday issue, it undergoes one more important and exciting change. As *Nature Australia* it will continue to strive to keep you informed, amused and amazed by the best nature photos and articles available. ■

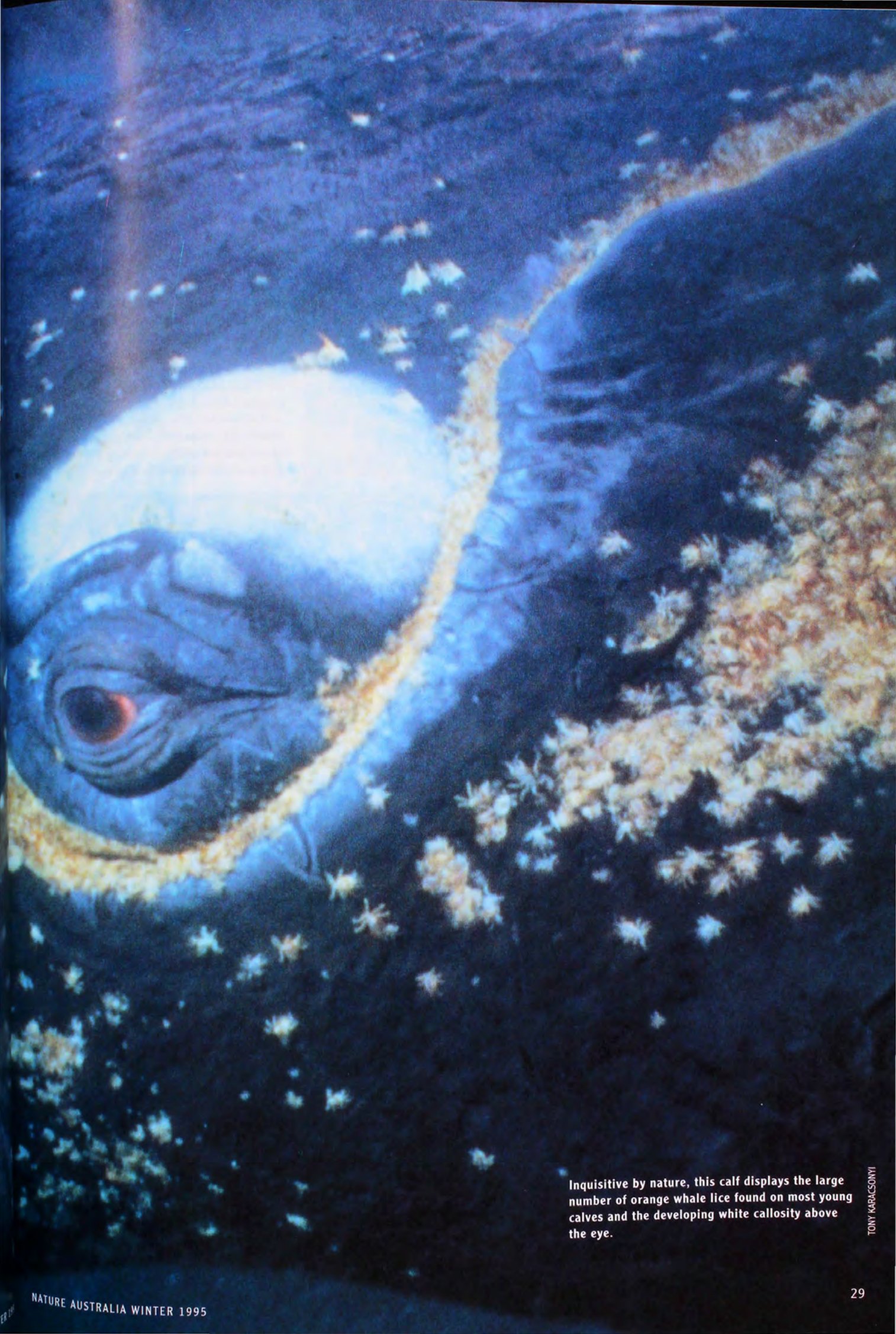
Ronald Strahan is Editor-in-Chief of the Australian Museum's Book Publishing section. His enthusiasm for this magazine has not waned since he first saw it as a schoolboy in the 1930s.



As the Southern Right Whale calves develop their bravado also increases and occasionally I have seen them trying in vain to chase and even breach onto dolphins.

LOOKING FOR MR RIGHT

BY STEPHEN BURNELL



Inquisitive by nature, this calf displays the large number of orange whale lice found on most young calves and the developing white callosity above the eye.

TONY KARACSONYI

EXAGGERATED BY THE COLD dawn air, the whale's blow hung motionless. Gradually it disappeared but was replaced immediately by others further out across the bay. From my vantage point on top of the cliff I watched more and more whales materialise with the new day. Without moving, I counted 28 whales, the closest no more than 50 metres from where I sat.

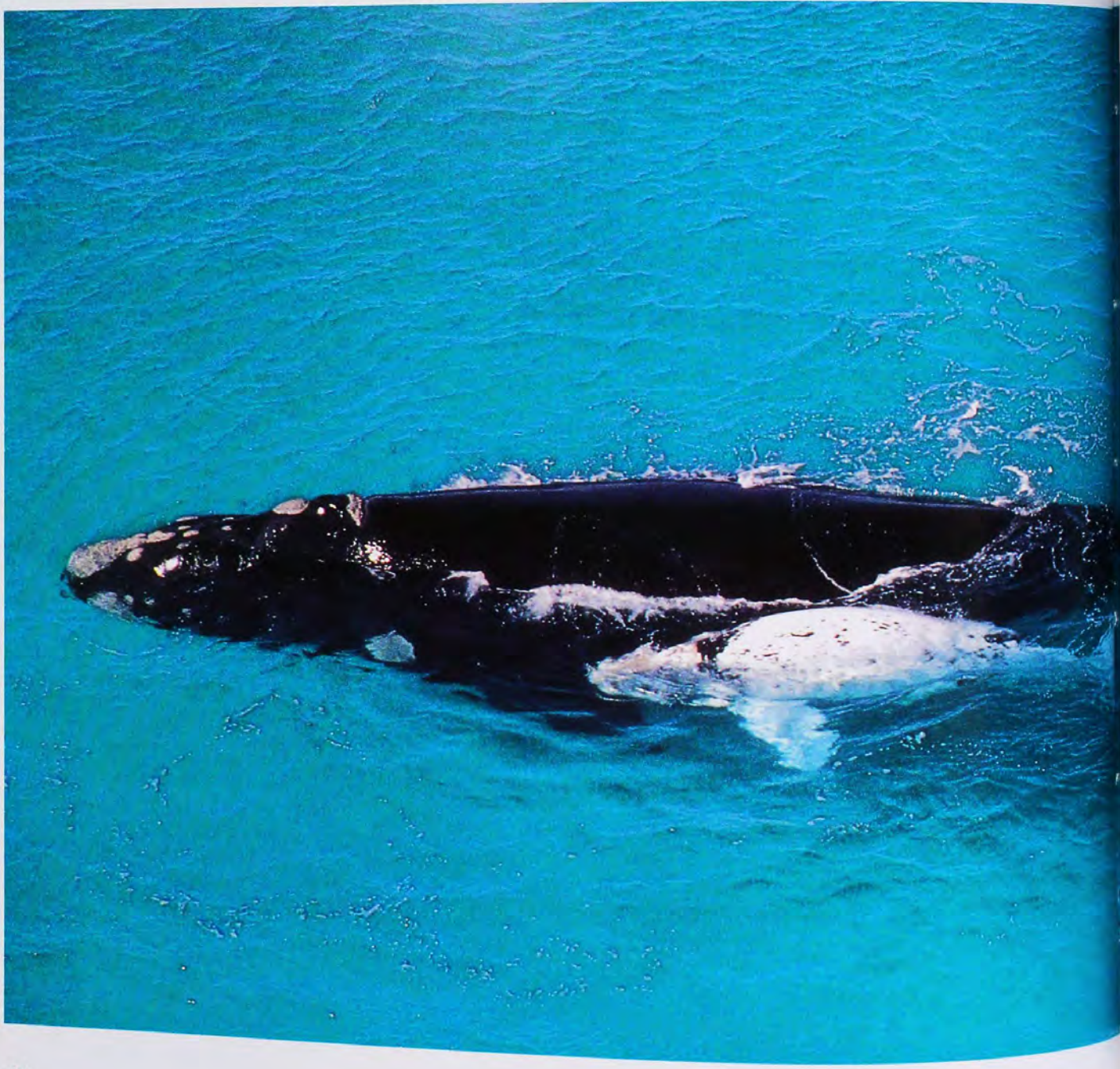
It was September 1988 and I was sitting at the Head of the Great Australian Bight in South Australia. The whales below me were Southern Right Whales (*Eubalaena australis*), which every year between May and October migrate to Australia's temperate southern coastline to calve and mate after spending the summer months feeding in sub-Antarctic waters. Each winter this remote site, situated about 1,000 kilometres north-west of Adelaide on the edge of the Nullarbor Plain, is transformed into one of Australia's largest and most consistent Southern Right Whale nursery areas.

Following my unforgettable introduction to this place, I have been fortunate to witness many encore performances, always different but each as spectacular as the first. For the last four years I have spent the winter months living with and observing the whales at the Head of the Bight while conducting an intensive study of their behaviour and ecology for my doctoral thesis.

Southern Rights were the first whale species commercially hunted in Australia. Together with the closely related Northern Hemisphere Right Whale (*Eubalaena glacialis*), they were named right whales by the early whalers because they were quite literally the 'right' whales to hunt; both species have fine, long baleen, a high yield of oil and swim slowly—an advantage last century when mainly small, open and slow boats were the only ones available. The scale of the slaughter is hard to comprehend. More than 26,000 Southern Rights were killed in Australian and New Zealand waters alone between 1820 and 1850 and, by the turn of the century, the species was very nearly extinct. This tendency for exploited species to become 'commercially extinct' prior to biological extinction is indeed a blessing for mankind, although not one that should ever be taken for granted.

Internationally protected in 1935, the species has been slow to recover and the current Australian population size is around 800 individuals, or roughly a quarter of the estimated 3,000 remaining alive in the world from a pre-whaling population of over 100,000. Classified as 'vulnerable to extinction' by the International Union for the Conservation of Nature, the species is

Calves are around five metres long and weigh about a tonne at birth. This rare white calf will gradually darken as it grows.



S.R. BURNELL

also listed under Australia's Endangered Species Legislation.

THE ABILITY TO RECOGNISE INDIVIDUAL whales is crucial for nearly every aspect of my study. Southern Rights have patterns of callosities on their heads that are unique and stable over time. These callosities are areas of encrusted, cornified skin that are white in colour and contrast well with the black body, forming a very efficient natural marking system. Apart from being a godsend for fanatic biologists, the evolutionary role of these structures is still not well understood. Once practised in the knack of identifying and remembering individual whales, it is quite possible for an experienced observer to know at a glance the identity of any one of 30 or 40 adult whales that may be in the study area at any one time. All whales are assigned an identifying number and many also get a name. Names are usually descriptive, some being obvious such as 'Michelin Man'—a large white-coloured calf, or 'Anchor'—a female with a distinctive shaped callosity pattern; others are more obscure like 'Chip' whose name originated from his three rows of paired callosities, or 'three by two'...a piece of wood.

S.R. BURNELL

The whale's proximity to shore and the 60-metre-high cliffs at the Head of the Bight provide whale-watchers and biologists with an exceptional view.

Pregnant females are usually the first to arrive at the site. They are often seen alone for several weeks prior to their first sighting with a calf. Although no births have been observed, calves known to be less than 36 hours old have been seen. Newborn calves are brown in colour, darkening to black within weeks. They are around five metres in length, a tonne in weight and appear quite wrinkled due to their lack of blubber. Mothers with very young calves are observed to move around a lot and I suspect that this is for the calves' benefit. Newborns have a very high respiratory rate, which means they must frequently surface to breathe. However they are probably also negatively buoyant (in other words they sink) due to their lack of blubber. Continuous forward motion, which occurs as the calf tries to follow its mobile mother, may actually assist them in surfacing and maintaining buoyancy control.

The calves rapidly put on weight and, as they perfect surfacing and breathing, their respiratory rate markedly slows. Calves do not suckle as such; rather they place their mouth over one of the female's two mammary slits, and the mother then everts the nipple and squirts the extremely rich and thick milk into the calf's mouth. The physiological drain on the mother is enormous: the copepods and other swarming crustaceans on which adult right whales feed do not normally occur in coastal waters so she fasts, while simultaneously putting around ten tonnes of weight onto her calf. Females give birth, on average, every three years. Gestation is thought to be a year and

SOUTHERN RIGHT WHALE

Eubalaena australis

Classification
Order Mysticeti (baleen whales); family Balaenidae (right whales and Bowhead Whale).

Identification
Large, rotund whales; no dorsal fin; 'V'-shaped blow; white callosities on top of head; short paddle-like pectoral flippers; max. length 18 m, weight 80 t.

Biology
Filter-feeders, prey consists principally of copepods and other swarming crustaceans; sexual maturity estimated at 8–10 years; gestation period estimated 11–12 months; average calving interval 3 years; life expectancy over 50 years.

Distribution
Circumpolar between approximately 30° and 60°S. Generalised movement from higher, more southerly latitudes where feeding occurs in summer to warmer, lower latitudes for breeding in winter. Three main populations off South America, South Africa and Australia. Australian population distributed around southern coastline from Perth to Sydney with majority utilising the south coast of WA and south-west coast of SA.

evidence from resightings of yearling calves returning to the Head of the Bight indicates that weaning occurs within 12 months. It appears then that females 'take a year off' after weaning their calf and prior to mating again, possibly to regain condition.

The behaviour of individual calves changes as the season progresses. Calves develop a much broader suite of behaviours, appearing to learn many of the more active ones by mimicking their mothers. As they grow they become more independent and the separation distances between mother and calf become greater. Mothers gradually increase the area of coastline they traverse and a repetitive pattern of daily movement exists that resembles an exercise beat, increasing in size over the course of the season, until finally the mother decides her calf is sufficiently developed to undertake the southward migration and the pair leaves the site.

There is a lot of variability amongst individual female behaviour and mothering strategies. This variability equates to personality and is fascinating to observe. Some females are loners, avoiding interaction with other whales; others socialise frequently, allowing their calves to play together. Interestingly, mothers with very young calves avoid interactions with other mother–calf pairs, which may be due to this early period being critical for bonding. On several occasions following close interactions between several mother–calf pairs I have observed mix-

A calf mimics its mother as the pair simultaneously breach. Young right whales appear to learn many of the more active behaviours in this way.

S.R. BURNELL

Like most young animals, right whale calves occasionally become boisterous, repeatedly breaching and slapping their flukes, sometimes deliberately onto their mother's back or head.

ups when calves follow the wrong mother. This may go unnoticed for several minutes, then pandemonium ensues as the mothers retrace their steps endeavouring to locate their own calves.

Like most young animals, right whale calves occasionally become boisterous, repeatedly breaching and slapping their flukes, sometimes deliberately onto their mother's back or head. Maternal response to these energy outbursts can vary from simply allowing the calf to nurse, to the amazing sight of the mother clasping the squirming calf in the 'V' of a pectoral flipper and rolling on her back until it calms down. Another strategy is what I have described as the 'discipline swim', whereby the mother simply swims rapidly away, forcing the errant calf to abandon its previous escapades as it desperately tries to keep up.

Seals and bottlenose dolphins are relatively common at the site and frequently interact with the whales. Except dur-

S.R. BURNELL

Used for filtering small crustaceans from the water, the large sieve-like baleen plates of an adult right whale can measure over two and a half metres long.

S.R. BURNELL

The pattern of callosities on the head is as unique as a fingerprint and allows identification of individual whales.

ing mating when nothing appears to distract them, adult whales usually show behaviours associated with annoyance and avoidance during such interactions, exhaling noisily and laterally swinging their heads and flukes. The dolphins in particular thrive on this reaction, flitting about the whales' heads and occasionally bow-riding the surge created; in fact, if the whales ignore them, the dolphins appear to quickly lose interest and move on. Very young calves usually exhibit fright behaviours during these interactions, sometimes almost climbing out of the water onto their mother's back. However, as the calves develop, their bravado also increases, and occasionally I have seen older calves trying in vain to chase and even breach onto the dolphins.

SOUTHERN RIGHT WHALES ARE VERY tactile animals. Although most evident in the strong bond between mother and calf, juvenile and adult whales of both sexes also engage in extended and deliberate physical contact. Prolonged physical contact between adult whales is usually described as 'courting' or 'mating', although it is clear that this is not always the case. Adult females and males will caress individuals of the same sex, and sexually immature whales are frequently observed displaying tactile behaviours including belly-to-belly clasping.

This species has a fascinating mating

S.R. BURNELL

Interactions between whales and dolphins are frequent and appear to be initiated by the dolphins.

system and, despite numerous jibes and claims to the contrary by friends and peers, I maintain that my interest in this subject is purely scientific! Right whales are promiscuous; I have seen females being repeatedly coupled by as many as seven different males. Intromission is usually rapid, and when large mating groups of whales form, they are often very noisy and surface active. Unlike many other species of mammals, male right whales rarely if ever show aggression when competing for a female. Several males tactically jostle for a place alongside or underneath a single female and, in what appears to be cooperative behaviour amongst males, they have been observed manipulating her into position. Although the female usually exhibits control over which males will couple with her, on several occasions in the larger groups it was clear that, despite continual rolling and attempts to move away, females were coupled 'without consent'.

There exists a traditional myth that mating whales will always lie belly to belly, clasping each other with their pectoral flippers. Although this position is observed occasionally, and particularly when only two whales are present, the true situation is definitely any which way will do! I have observed intromission head to tail, perpendicular and even when a female was lying belly up with her genital slit clear of the water. "How is that possible?" I hear you ask. Male right whales are, in no uncertain terms, well endowed. The penis is nearly three metres long and is a fibro-elastic type in contrast to the more common vascular variety of primates. This effectively allows the penis to be mobile and it is incredible to watch the appendage home in on the female's genital slit, twisting and turning as if with a mind of its own. When the whales separate, the penis is retracted into the male's body at incredible speed, resembling a flailing fire hose as it whips back and forth

No rules here! The fibro-elastic nature of the right whale penis means penetration is possible even when the female is belly up.

before disappearing. As if this wasn't enough, these males can also claim the dubious distinction of owning the world's largest testes—up to a tonne in weight! "So what?" you cry. "They *are* whales!" Well, consider that their nearest rival, the closely related Bowhead Whale (*Balaena mysticetus)*, tips the testes' scale at about 160 kilograms and the Blue Whale (*Balaenoptera musculus*), the largest creature on the planet, limps in with a paltry 70 kilograms!

So what do all these impressive statistics mean? It is a widely accepted evolutionary tenet that males of most species will compete to sire as many young as possible. What isn't immediately clear is that this competition between rival males can be considerably more discreet, and far more genteel, than biffing each other about in a physical stoush. A very interesting paper was published in 1986 by Robert Brownell (US Fish and Wildlife Service) and Katherine Ralls (Smithsonian Institution) discussing the potential for sperm competition in baleen whales. Sperm competition, as its name implies, means that the males achieve this sexual competition via their sperm. In essence, males using this system are trying to displace or dilute the sperm of rival males in the uterus, allowing the strongest and most numerous sperm the best chance of success. The researchers showed that certain anatomical and behavioural traits are indicative of sexual selection being driven by sperm competition. These include females commonly copulating with more than one male, little male–male aggression, and relatively large testes (which produce more sperm) and long penises (which deliver the sperm closer to the uterus). As we've seen, all these conditions apply to Southern Right Whales and, in fact, also to Gray (*Eschrichtius robustus)* and Bowhead Whales, which are thought to use sperm competition also.

The results from the study have been most encouraging although, as is often the case in research, each year produces as many new questions as answers. While we are steadily increasing our knowledge of the species, there are still many areas about which we know virtually nothing, such as migration routes and the location of feeding grounds. Likewise, effects of human activities on the whales are not well understood and, in the absence of this information, the preservation of critical habitat areas such as the Head of the Bight must be a priority. Studies of this kind—of animals that are long lived and with relatively slow reproductive rates—need to be conducted over long time periods and, although the prospect of a half-life on the Nullarbor sometimes daunts me, each year by June I am itching to return to a very special place and its very special whales. ■

Further Reading

Brownell, R.L. & Ralls, K., 1986. Potential for sperm competition in baleen whales. *Rep. Int. Whal. Comm. Spec. Issue* No. 8: 97–112.

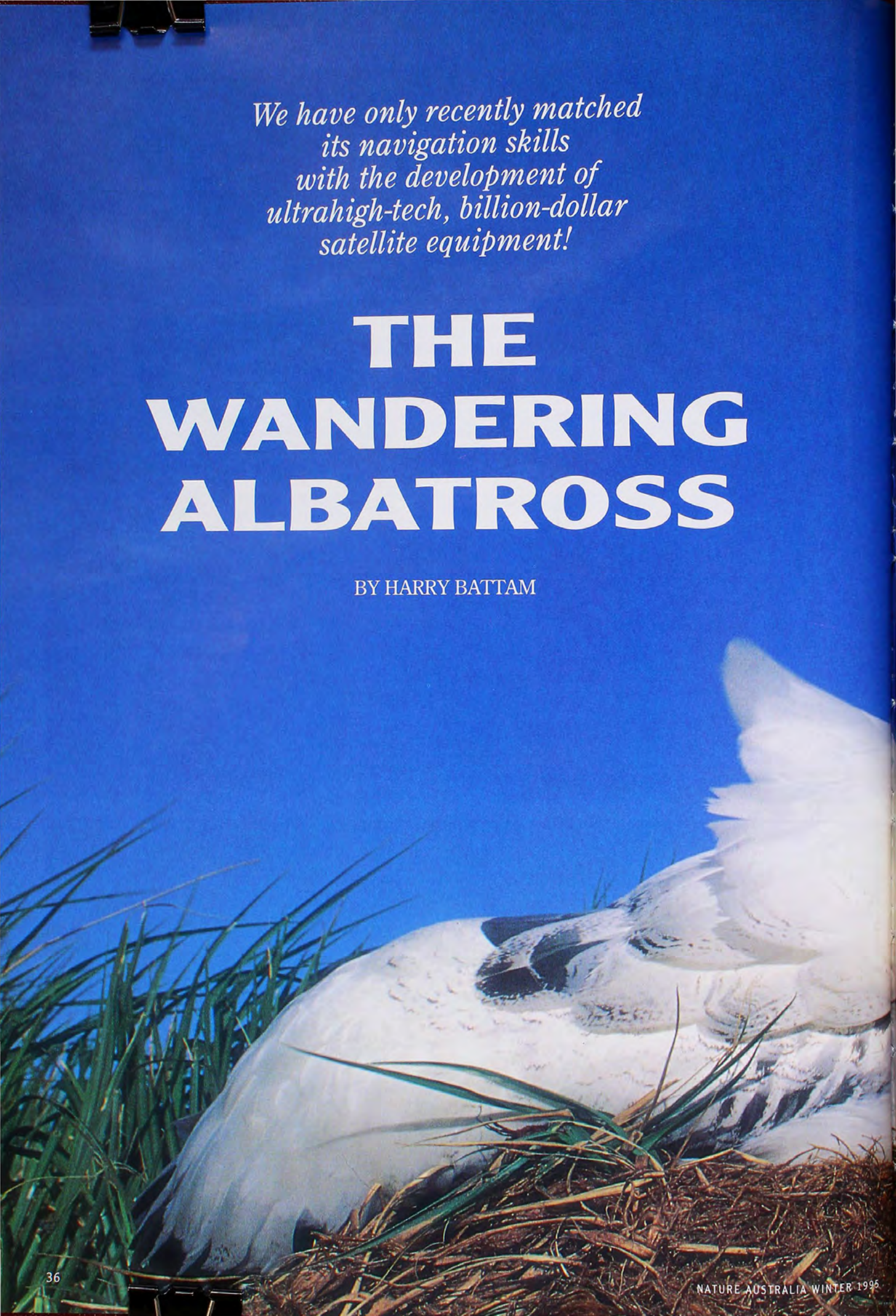
Stephen Burnell is a marine biologist and keen wildlife photographer with a long-held interest in marine mammals, particularly cetaceans. He is currently completing a PhD thesis at the University of Sydney on the behaviour and ecology of Southern Right Whales. *The author would especially like to thank the Yalata Aboriginal Community for their ongoing support of the project, BHP Australia for their financial support and the many volunteers who have assisted.*

S.R. BURNELL

We have only recently matched its navigation skills with the development of ultrahigh-tech, billion-dollar satellite equipment!

THE WANDERING ALBATROSS

BY HARRY BATTAM



This white or 'snowy' adult from South Georgia incubates its egg. Incubation, which is shared by both parents, takes up to 80 days.

JEAN-PAUL FERRERO/AUSCAPE INTERNATIONAL

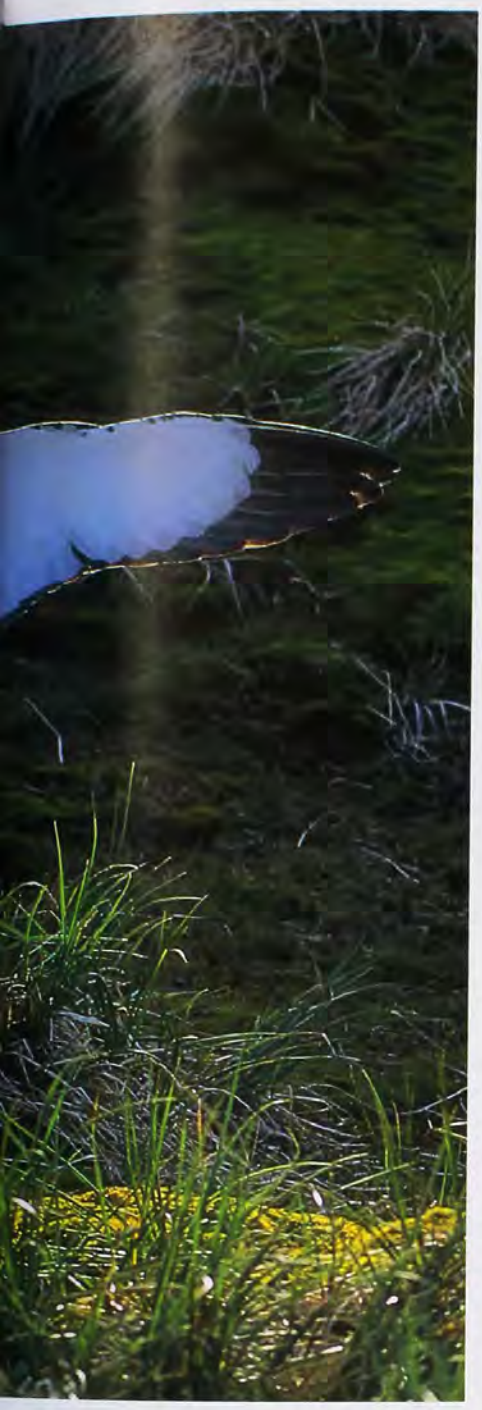
JEAN-PAUL FERERRO/AUSCAPE INTERNATIONAL

PRECISION NAVIGATOR, EFFORTless long-distance flier, and exploiter-extraordinaire of new food sources...all these attributes should make the Wandering Albatross one of the most successful birds of the Southern Hemisphere. Yet in three decades the population of this great albatross has halved and it is now an endangered species.

The Wandering Albatross (*Diomedea exulans*) is one of 13 recognised species of albatross, nine of which inhabit the Southern Hemisphere. Together with the Royal Albatross (*D. epomophora*), they are the largest of the world's flying birds, with wingspans ranging from 2.7 to 3.4 metres.

Wanderers normally mate for life and breed on the cold, windy, sub-Antarctic islands scattered throughout the Southern Ocean. Breeding begins in summer and it takes a pair over a year to raise the single chick. If successful in rearing a chick, the birds take a year off to regain their condition before attempting to breed again. However, should breeding fail, especially during the egg incubation period, then they may breed again the following year. This means that their maximum output is one chick every two years. To compensate for their low productivity, Wanderers have a relatively high survival rate, with about 95 per cent of breeding adults surviving each year. Statistics predict that one in every 100 breeding birds may live to an age of 90 years and this will probably be a male. About 60 per cent of breeding pairs are successful in raising a chick and 30 per cent of chicks will survive to breed seven or more years later. The most recent estimate of the world's breeding population of Wanderers is 21,900 pairs.

The Wandering Albatross is a very



The elaborate ritualistic courtship display between Wandering Albatrosses includes raised wing stretches and gurgling or croaking sounds combined with snapping and clapping of the bill.

complex species and varies considerably throughout its range. Five races (or subspecies) have been identified (see box). These differ in size, colouration and oceanic distribution, and also in the exact onset and timing of their breeding period. The Southern Ocean, Auckland Island and Antipodes Island races regularly forage off the New South Wales coast, and these are the main subjects of our studies.

NON-BREEDING ADULT AND YOUNG Wanderers have no ties to breeding islands. They range over the southern seas, seeking out their preferred diet of cuttlefish and squid carcasses, which float to the surface when these animals die. The world's oceans are inhabited by over 800 species of this albatross fodder and Australian coastal waters are well known to albatrosses as a prime source of their favourite food. The Common Cuttlefish (*Sepia apama*), which can grow to a length of 1.5 metres and a mass of some ten kilograms, is very common in southern Australian waters. In winter, along the New South Wales coast, thousands of these cuttlefish reach the end of their two-year life span, breed, die and float to the surface, attracting Wandering Albatrosses from as far as South Georgia, 15,000 kilometres away. At Bellambi, just north of Wollongong in New South Wales, exceptional numbers of dying cuttlefish occur and congregations of Wandering Albatrosses have been observed there since 1912. Wanderers have probably been coming to Bellambi for centuries, even millennia, for this annual cuttlefish feast.

A study of Wanderers was commenced at Bellambi in 1956 and continues today. It has added significantly to our knowledge of these master navigators. Since 1956 over 4,000 Wanderers have been banded off the New South Wales coast and over 400 of these have been found on breeding islands. Some birds recaptured at Bellambi in 1993 were banded 35 years ago. Exchanges of banded Wanderers between Bellambi and South Georgia in 1960 formed the first positive evidence of a link between Australia and the breeding colonies in the Southern Ocean, and demonstrated the extent of their migration flights.

Even while breeding, Wandering Albatrosses undertake very long flights. For breeding adults to find enough food to sustain themselves and their young for over 12 months, they must literally scour the oceans for many kilometres around. They are well adapted to do this. Their wings are long and narrow, allowing them to extract and efficiently use energy from the wind using a process called 'dynamic soaring'. There is a significant difference between wind speed at the ocean's surface and at higher altitudes. At an altitude of 10–15 metres an albatross acquires a lot of energy over a relatively short distance and then dissipates this energy over a much longer distance in a fast glide to the surface. It then uses its momentum and the wind to lift itself back to the altitude at which it started the glide. Using this process continuously, an albatross can fly at an average speed of 50–60 kilometres per hour for hours on end using as little as one per cent of its energy reserves.

Wanderers have probably been coming to Bellambi for centuries, even millennia, for this annual cuttlefish feast.

At South Georgia and the Crozet Islands, British and French scientists have been fitting small radio-transmitters to Wandering Albatrosses and tracking them via satellites during their

H. WEIMERSKIRCH/AUSCAPE INTERNATIONAL

On Possession Island a nesting adult is lifted for a weight check. The other incubating birds are seemingly undisturbed by this now regular activity during the course of their breeding.

G. ROBERTSON/AUSCAPE INTERNATIONAL

A dark-plumaged Wandering Albatross fledgling from Macquarie Island. Although currently still dependent on its parents, this individual is almost ready to leave the nest.

foraging trips. When Wanderers are feeding small chicks these trips are frequent and relatively short, up to 400 kilometres. As the chicks grow these trips are extended, increasing to thousands of kilometres. One Crozet bird travelled over 13,200 kilometres in a single trip and was away for 33 days.

Throughout all of their journeys they navigate with precision and find their breeding islands, tiny specks in a vast ocean, with ease. How they manage this we do not know, but studies of other migrating birds suggest that, apart from possessing an accurate biological clock, they are attuned to day length, the height of the sun above the horizon, the Earth's magnetic field and star patterns. We have only recently matched their navigation skills with the development of ultra high-tech, billion-dollar satellite equipment!

Since 1992, Australian scientists have used satellites to track Wanderers from Bellambi as they returned to their breeding colonies. Of the five transmitters fitted, three were lost over Australian waters, but birds carrying the remaining two were tracked across the Indian Ocean, where another one was lost. The surviving transmitter was tracked with its Wanderer back to a breeding colony on Possession Island in the Crozet Archipelago. Here the Wanderer parted company with the transmitter, which was found by a French scientist on the ground near its nest a month later. These flights resolved some contention about the direction taken by albatrosses returning to breeding colonies up wind of their winter foraging grounds. Some thought that they would circumnavigate the

They navigate with precision and find their breeding islands, tiny specks in a vast ocean, with ease.

world rather than attempt to fly against the Roaring Forties—the strong prevailing westerly winds of the latitudes in which they breed. The Wanderers simply did the same as the navigators of old. They migrated in lower latitudes where the wind speeds are less and made large tacks across the wind spanning ten degrees of latitude. It took three months to complete the journey from Bellambi to the Crozets, which included several stopovers for food along the way.

IN 1916, A NEW SEWAGE OUTFALL WAS opened at Malabar near Sydney. Through this outlet the Homebush abattoirs drained a large amount (estimated at a minimum of 1.8 tonnes per day) of offal and lard into the ocean. Wandering Albatrosses from around the world came to know this as a major food source and on occasions up to 700 birds could be seen sitting on the ocean just off Malabar. In 1970 a new treatment plant removed the offal component from the sewage and, since that time, the number of Wanderers throughout New South Wales waters has declined rapidly. The available evidence suggests that the Wanderer pres-

JEAN-PAUL FERERRO/AUSCAPE INTERNATIONAL

The gliding flight of an adult Wandering Albatross is made possible by their huge 3.4-metre wingspan. These long, narrow wings enable them to traverse great distances with very little energy expenditure.

ence in New South Wales coastal waters was abnormally high for the 50-year period that the Malabar offal was available. However, not all of the decline can be attributed to the disappearance of the Malabar food source.

Their ability to cover vast distances with minimal expenditure of energy and rapidly exploit new food sources is a strategy that assures Wanderers of an adequate year-round food supply. However, in recent times this strategy has placed the world's Wanderers in a precarious state. Over the last 25 years Wanderer populations have been declining at alarming rates. At South Georgia and Marion Islands, the decline has been of the order of one per cent per year in breeding populations. This has been mainly a result of a lower survival rate in young birds, which needs to be at 32–33 per cent to sustain a stable population, but has fallen to 30 per cent. At Macquarie Island the population fell from 44 breeding pairs in 1967–1968 to eight by 1991. In the Crozet Islands the population declined by 40 per cent over the period 1970–1976.

Other disturbing population changes were observed at Macquarie and the Crozets. Females disappeared at about twice the rate of males. This left many males without mates and their breeding potential was wasted. The cause of this

SORTING OUT THE WANDERERS

The Wandering Albatross (*Diomedea exulans*) is polymorphic, that is it comes in different sizes and shades. Its colouration ranges from uniform dark brown to almost pure white with many intermediate forms. Based on size, colour and distribution, five races or subspecies have been proposed.

Southern Ocean race (*D. e. exulans*)
Largest and most lightly coloured of the races. Ranges widely around Southern Hemisphere. Breeds on sub-Antarctic islands scattered throughout Southern Ocean. Breeding population estimated at 7,200 pairs. Breeding period: Nov. to Jan. 14 months later.

Antipodes Island race (*D. e. antipodensis*) Smallest and darkest of the races. Known range: south-western Pacific Ocean and Tasman Sea. Breeds on Antipodes and Campbell Islands, south of NZ. Breeding population estimated at 7,000 pairs. Breeding period: Dec. to late Jan. 13 months later.

Auckland Island race (*D. e. gibsoni*) Intermediate in size and colour to Southern Ocean and Antipodes Island races. Known range: Tasman Sea and coastal waters of southern Australia. Breeds on the Auckland Island group south of NZ. Breeding population estimated at 7,700 pairs. Breeding period: Dec. to Jan. 13 months later.

Atlantic Ocean race (*D. e. dabbenena*) Similar in size to Auckland Island race but lighter in colour. Appears to be limited to Atlantic Ocean. Extinct on Tristan da Cunha but still breeds on Gough and Inaccessible Islands. Breeding population estimated at 1,000 pairs. Breeding period: Dec. to Jan. 13 months later.

Amsterdam Albatross (*D. e. amsterdamensis*)
Small, very dark and similar to Antipodes Island race but with a black cutting edge on upper bill. Mainly inhabits Indian Ocean but one bird was killed on a longline in Tasmanian waters. Breeds on Amsterdam Island in the Indian Ocean. Breeding population estimated at 60 pairs. Breeding period: Jan. to Feb. 13 months later.

Juveniles of all races are chocolate brown in colour, as are adults of the darker races and these are usually incorrectly identified as juveniles. Males are also generally larger and of lighter colouration than females. Unfortunately, until someone comes up with a good field guide, confusion over subspecies will remain.

G. ROBERTSON/AUSCAPE INTERNATIONAL

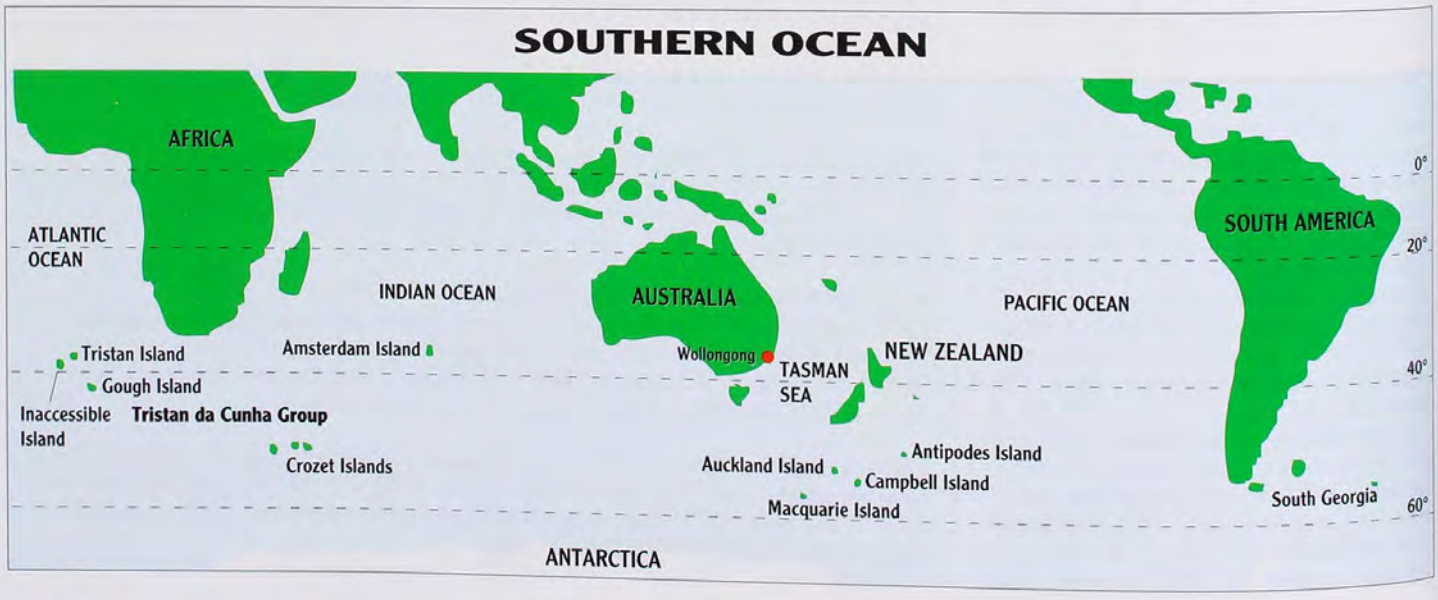
Attracted to the baited hook thrown from a longline fishing boat, a young Wandering Albatross is caught and drowns in the Tasman Sea. An estimated 8,000 Wandering Albatrosses are lost annually through activities designed to increase our harvest of the ocean.

devastation, which took nearly 20 years to confirm because their was no linking evidence, was by-kill (kill of a non-target species) from longline fishing.

LONGLINE FISHING USES VERY LONG fishing lines, typically 100 kilometres, with a baited hook attached to a 30-metre trace (a short line hanging vertically off the main line) every 100 metres. In 1952 the Japanese started longline fishing in the tropical and subtropical waters of the Indian Ocean where albatross numbers are relatively low. In the late 1960s, having depleted fish stocks, the major longline effort was moved to cooler waters particularly into the latitudes of the Roaring Forties and West Wind Drift (40–60°S), where albatross numbers are very high. At the same time it increased its effort fivefold, from 20 million to 100 million hooks per year, and started to catch and drown thousands of albatrosses.

When longlines are set, the line is paid out over the stern of the ship from a winch drum, and the traces with hooks and baits attached are manually clipped on as it goes out. The baits float briefly in the wake of the ship before sinking, and it is during this time that albatrosses are most vulnerable. Albatrosses have learnt to associate fishing vessels with reliable food sources and may gather in hundreds around a single longline vessel paying out a line. Hooked birds sink with the hook and quickly drown. Some tear out the hook and die later from the wound.

Another significant finding from satellite tracking studies at South Georgia and the Crozet Islands is that breeding males and females usually feed in differ-



D. PARER & E. PARER-COOK/AUSCAPE INTERNATIONAL

Neck stretching, head pointing and outspread wings thrown backward are all part of the albatross courtship display.

ent locations. Males tend to forage south of the breeding islands down to the edge of the polar ice, while females usually forage north of breeding islands where longline fishing is more prevalent. This means that more females than males die on longlines resulting in the unbalanced sex ratios observed in breeding populations. Why breeding males and females forage in different areas is unclear. Males are larger and of lighter colouration than females, and both of these attributes are advantageous for operating in a cold climate (think of Polar Bears). Perhaps the larger size of males originally enabled them to forage in colder latitudes and natural selection ordained the acquisition of a lighter plumage to enhance this adaptation. Whatever the reason, it is a good strategy, possibly minimising direct competition between females and the more aggressive and stronger males, so that both can be effective foragers. Recoveries of dead albatrosses from longline vessels also indicate that young non-breeding birds forage regularly in latitudes frequented by longline vessels. Their inexperience makes them particularly susceptible to drowning on a longline hook, accounting for the increased mortality observed in young albatrosses.

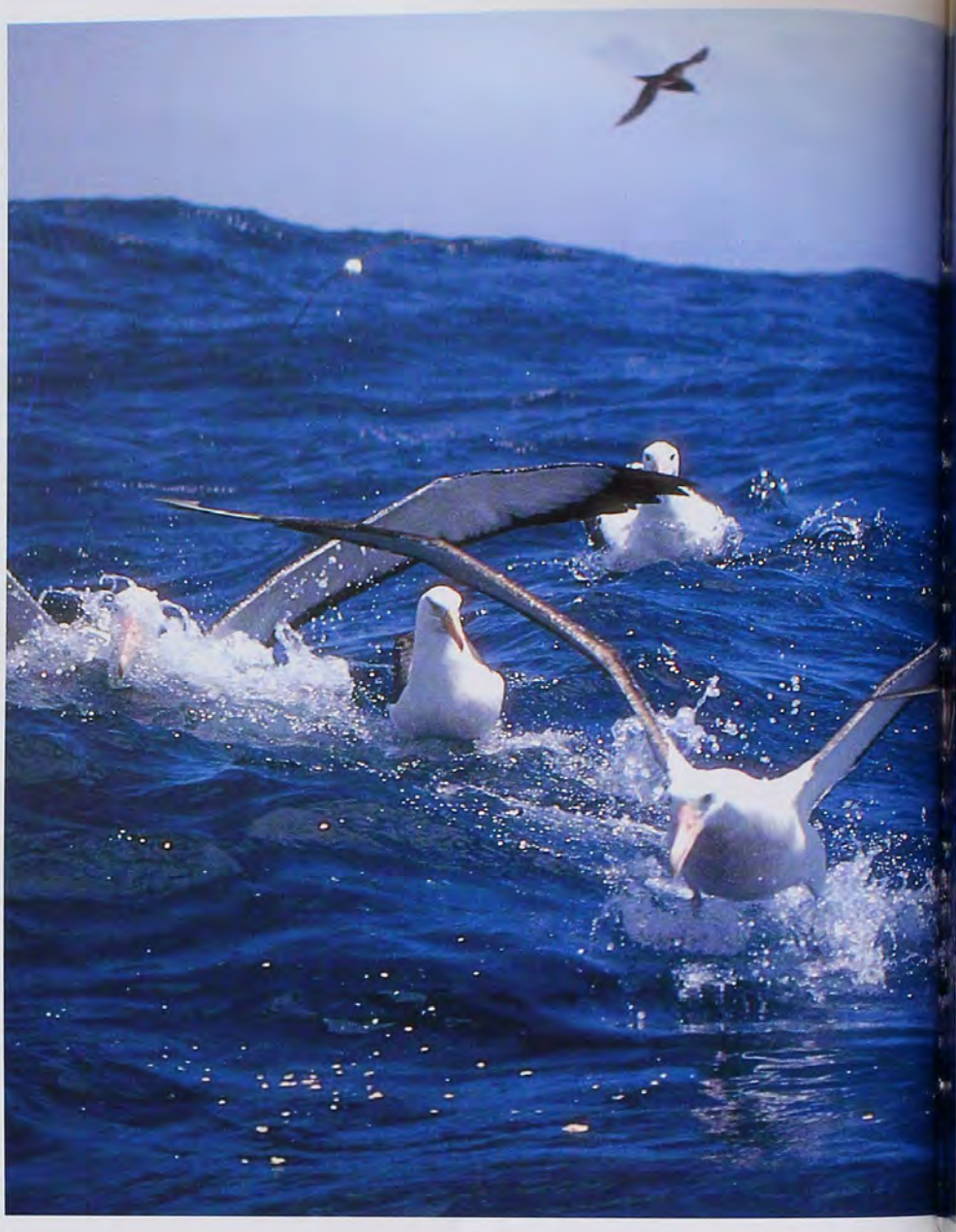
D. PARER & E. PARER-COOK/AUSCAPE INTERNATIONAL

A small colony of nesting albatrosses on Crozet Island.

The longline fishing industry is lucrative and has a long-term future if fish stocks hold up. It is therefore necessary for albatrosses and longliners to coexist. These days Australian observers

There is no guarantee that longliners will consider the welfare of albatrosses once they are outside Australian territorial waters.

working on longline vessels to enforce fish quotas have been trained to record albatross mortality. Dead birds are retrieved for an assessment of population damage and other studies. Nigel Brothers, from the Tasmanian Department of Environment and Land Management, has been working closely with the Japanese longline fishing industry for over ten years, and has introduced some significant changes to longline operations that should result in greatly reduced albatross mortality. These include use of a hydraulic bait thrower that launches baited longline hooks over the side of the ship so that they sink rapidly, the setting of lines at night when albatrosses are not active, and the use of long streamers to scare birds away from longline vessels. These changes also reduce bait loss, increasing the number of active hooks and the catch potential of the line. It is thus like-



Wandering Albatrosses lay a single egg every second year. Providing all goes well, the young bird will fledge between nine and 12 months and the adult birds will then take a year off to recuperate before laying again.

H. WEIMERSKIRCH/AUSCAPE INTERNATIONAL

HANS & JUDY BESTE/AUSCAPE INTERATIONAL

A group of albatrosses approaches a boat in search of food scraps. Many seabirds have adopted this style of 'supermarket shopping'—a habit that has proved to be deadly following the introduction of longline fishing.

ly that the economic benefits will encourage their use wherever the Japanese set longlines, not just in Australian waters. There is however no guarantee that longliners will consider the welfare of albatrosses once they are outside Australian territorial waters. Many nations now operate longline fleets in international waters and are beyond the influence of Australia or any other nation concerned about albatross by-kill. It will require a high level of international cooperation between the fishing industry and conservation agencies to alleviate what currently appears to be an intractable problem. Until this is achieved it is impossible to be optimistic about albatross populations.

A recent estimate of the total number of breeding albatrosses in the southern oceans is 950,000 pairs. An estimate of the total number of albatrosses killed on longlines in Australian and New Zealand waters is 50,000 annually, with Wandering Albatrosses accounting for 8,000 of these. This level of mortality is simply not sustainable for a bird with such a small world population and the Wanderer, as a result, has been classified in Australia as an endangered species.

Over the last 30 years breeding numbers of Wandering Albatrosess have halved. Even before this period, breeding populations were rapidly declining on Tristan da Cunha, Inaccessible and Amsterdam Islands. As an expanding world human population demands more from the ocean's resources, the task of protecting vulnerable species will not become easier. Our inadequate knowledge of albatross populations, their great dependence on resources in international waters, and their insignificant economic value results in complex political issues and no funds for research. Knowledge is an essential ingredient in arguments for albatross by-kill reduction. Usually no knowledge means a decision unfavourable to albatrosses. Various forms of tracking technology such as satellite systems, which can provide vital information in a much shorter time frame than was previously possible, are now available for use with albatrosses. Raising the funds to apply this technology is an urgent task, as a diminishing population increases the difficulty of acquisition of knowledge essential for their survival. ■

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Harry Battam has had a long-term interest in Wandering Albatrosses, having studied them since 1958.

Just as striking as its colour are its relatively short tail, a bold white stripe that runs around the base of the muzzle, and a white star on the forehead.

IRIAN JAYA'S NEW TREE-KANGAROO: JUST THE TIP OF THE ERTZBERG?

BY TIM FLANNERY

TIM FLANNERY

The high rocky crags of the upper slopes of the south face of the Carstenz Range are the primary habitat of the new black-and-white tree-kangaroo known to the Moni people as *Dingiso*.

IN THE EARLY 1900S, THE GREAT BRITISH explorer Alfred Wollaston led a team into the heart of Dutch New Guinea. But in the preface to his 1912 account of the expedition, it was noted "There can be no doubt that when the higher ranges between 5,000 and 10,000 feet [about 1,500 to 3,000 metres] are explored, many other novelties will be discovered...".

Until very recently, much of the higher regions of Irian Jaya's Carstenz Mountains, which Wollaston knew to be so potentially fruitful, remained biologically unexplored. Time did not pass the area by however, for in 1936 a Dutch geologist discovered the Ertzberg—a literal mountain of copper—just below the Meren Glacier. Mining began in the 1960s, and today the modern mining town of Tembagapura, equipped with all conveniences, has sprung up on the southern slopes of the Carstenz Mountains.

This painting depicts an adult female *Dingiso*.

ILLUSTRATION BY PETER SCHOUTEN

In May 1994 a joint Australian–Indonesian expedition set out to document the fauna of part of this vast and poorly known region. Our survey was to be the first ever to explore the mammals of the high forests of the Carstenz Range.

We hoped—somewhat vaguely, since we had so little to go on—to find some trace of an intriguing, possibly new species of marsupial we had provisionally dubbed the Pied Tree-kangaroo. In 1990 the South African photographer Gerald Cubitt sent me a series of colour photographs he had taken in Irian Jaya of a Dani man holding an odd-looking mammal. In his accompanying letter, Cubitt asked if I wouldn't mind identifying the animal for him. My reply was that I wouldn't mind in the least, except that I couldn't. I could see that it was a juvenile tree-kangaroo, entirely black but for a white chest flash, and with a short tail. It resembled none of the described species, although the possibility always existed that it was simply an unusually coloured individual of a previously known kind.

Who would offer the necessary funding for an expedition based solely on a few snapshots and a disreputable-looking scrap of fur?

Cubitt's photographs did, however, make some sense to me. The previous year I had collected an artefact among the Dani people of the West Baliem River, some 150 kilometres to the east of where Cubitt took his photo. A hat worn by a senior Dani hunter incorporated the fur of an animal that was clearly a tree-kangaroo, but differed from all of the known species in its colour pattern—black with a vestige of pure white. This hat, and Cubitt's photographs, were the only evidence

TERRY OWEN/OWEN IMAGERY

known to Western science that tree-kangaroos existed over the entire 400-kilometre-long Irian Jayan section of the Central Cordillera. Furthermore, I suspected that the young animal in Cubitt's photograph and the fur of the adult animal in the hat were one and the same species.

Following up such tenuous leads is no simple task. One can speculate upon such things at great length from museum collection rooms, but getting to the place and physically looking for the animal is another matter altogether. Who, for example, would offer the necessary funding for an expedition based solely on a few snapshots and a disreputable-looking scrap of fur? Not surprisingly, the idea was hardly overwhelmed by takers. The fur and the photos went into a drawer.

A solution came four years later, from an altogether different quarter. I

TIM FLANNERY

A white 'star' is invariably present on the forehead of *Dingiso*. Its function is unknown.

received another letter with photographs, this time from Irian Jaya itself. An executive working for the mining company P.T. Freeport Indonesia in Tembagapura discovered from reading my book *Mammals of New Guinea* that an animal given to him as a pet appeared to be the rare Great-tailed Triok (*Dactylopsila megalura*). Would I mind, he asked, coming over and having a proper look?

Within a few months we had organised an Australian Museum–Zoology Museum Bogor team of three to conduct a preliminary faunal survey of the southern slopes of the Carstenz Range. It was the region that had beckoned so enticingly to Wollaston all those years ago, but which, for him, had remained so frustratingly out of reach.

For those who enjoy a good bedtime story along natural history lines, Wollaston's account of his expedition is compulsive reading. It is elegantly written, brimming with acute observations and sprinkled with a peculiarly gentle but effective humour that frequently leaves one weak with mirth. There is pathos, too, related in close-lipped stoical lines, clearly written from the midst of the most appalling circumstances. The trip began in disaster when the esteemed collector Wilfred Stalker was drowned the day they arrived at their base camp at Wakatimi. Subsequently, they lost to disease many of their 260 Malay carriers and Gurkhas (Nepalese soldiers); they had their campsites and equipment carried away by flood at least twice; and Wollaston wrote more than once of standing all night in a campsite flooded up to his chest. Compounding these disasters was the frequently dismal state of the expedition members' health and the extreme difficulty of traversing the almost impossible terrain. Despite this, Wollaston's expedition struggled on for 15 months. They never managed to ascend higher than about 1,400 metres, even though

Hunters carry a young *Dingiso* to the author. *Dingiso* are incredibly tame animals, even when taken directly from the wild.

TIM FLANNERY

The hind foot of *Dingiso* is relatively long and slender for a New Guinean tree-kangaroo, and it is unique in having a tubercle where the 'great toe' is located in other marsupials.

the snow-capped peaks were sometimes in view.

Many times during our survey I had cause to feel guilty at the ease with which we reached our destination. A quick two-hour jet flight from Cairns brought us to Timika in southern Irian Jaya and from there, following formalities, it was only 30 minutes by helicopter to the famed Meren Glacier itself.

OUR SEARCH FOR THE TREE-KANGAROO was not destined to go as smoothly as our arrival. Our first task was to contact local hunters who possess extensive knowledge of the large marsupials of their homelands. We soon learned that there were two kinds of tree-kangaroo in the area. One, known to the Damal people as *Naki*, was golden-brown in colour. The other, *Nemenaki*, was reputed to be black and white. Accounts of it tied in well with Cubitt's photographs and our piece of skin.

The mystery of the identity of *Naki* was quite quickly solved, for it is a common species that occurs in less rugged country. It proved to be a subspecies of Doria's Tree-kangaroo (*Dendrolagus dorianus*) that occurs as far east as the Star Mountains of western Papua New Guinea. Indeed, in 1990 Lester Seri (from Papua New Guinea's Department of Environment) and I had named the subspecies *stellarum*, meaning 'of the stars', in reference to its initial discovery in the Star Mountains.

The mystery of the identity of *Nemenaki* proved more difficult to solve. Very few Damal hunters professed extensive personal acquaintance with it. Our first week of searching was lost as we were working with a group of young, relatively inexperienced hunters who were concentrating at what turned out to be too low an elevation. We had combed the relatively high beech forest that grows at 2,300–2,700 metres elevation to the south of Tembagapura. Despite a vast effort, and encounters with several *Naki*, our work was fruitless.

It was only when we met accidentally with Jonas Tinal, a young but experienced Dani hunter, that our luck changed. We were searching for frogs and other small game high in mossy for-

est below the vast Grasberg Mine at nearly 3,000 metres elevation. I was absorbed in the hunt at this remote and lonely place when I noticed shadows moving in the mist. They turned out to be Jonas, his two wives and a scrawny beast that Jonas referred to as his 'four million rupiah dog'—so called because its value as a securer of game was enormous: literally a million rupiahs (about $A700) per canine tooth! The party had walked up to this remote spot to hunt, and we arranged to meet several days later to examine what they had caught.

Imagine our dismay when we met them carrying not a complete animal, but the damaged partial skins of two *Nemenaki* specimens. Being hungry, they had eaten their catch and so the chance to undertake valuable biological research had been lost. Still, the scraps of skin and bones provided a few more bits of data from which to evaluate just what kind of creature *Nemenaki* was. We also learned that *Nemenaki* occurs very high in the mountains. Indeed, it is most abundant at 3,200–4,200 metres elevation—within view of the glacial ice itself.

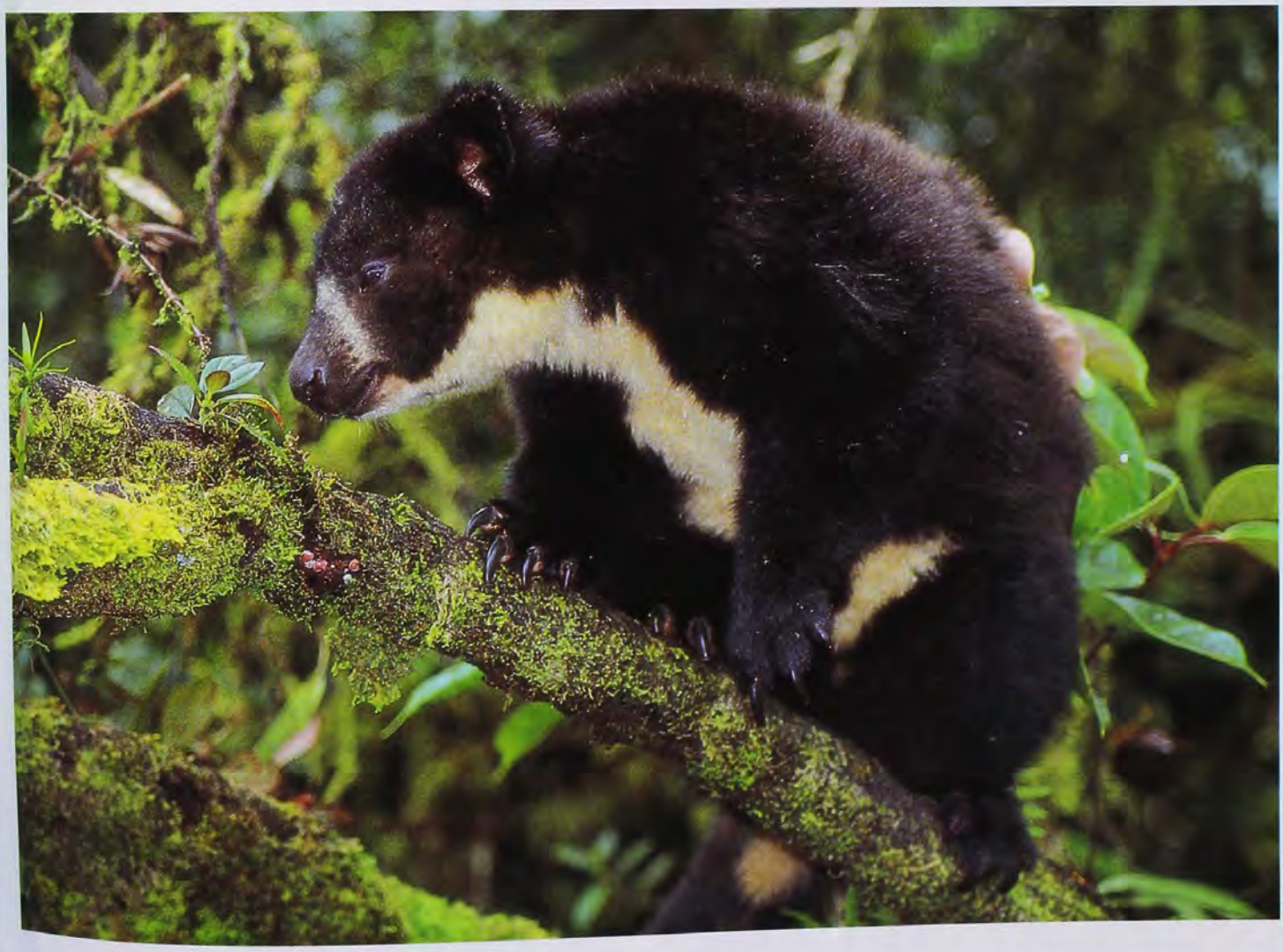
Finally, a few days after Jonas returned to his village, a fresh bunch of Dani hunters employed by us located an animal. They had been working with their dogs (one of which was called Photocopy, as its physical appearance was deemed by its owners to be a poor copy of the real thing) high up on Gunung Ki, in an extremely difficult and rocky area. Photocopy and his companions had got away from their owners when the distinctive call of New Guinean hunting dogs was heard. When the hunters finally caught up with the dogs, they found that they had located and badly bitten a female *Nemenaki*. By the time we had caught up with the hunters, the animal was dead.

All agreed that it was ridiculously tame. One hunter described how he caught it by slipping a noose over its neck and then led it away. Another tempted it to within his reach simply by offering it a bunch of choice leaves.

Despite our disappointment, I was fascinated to see *Nemenaki* in the flesh at last. My first impression, when I saw it being carried out of the ever-present mist on the shoulders of a hunter, was that it was not a kangaroo at all. At about the size of a medium-sized dog (8.5–9 kilograms in weight), it is boldly patterned in black and white. No other kangaroo is similarly coloured. Just as striking as its colour are its relatively short tail, a bold white stripe that runs around the base of the muzzle, and a white star on the forehead. These features give it more the appearance of a small bear or panda than a kangaroo.

As the weeks wore on we learned more of *Nemenaki*. The Dani, who avidly hunt it, know it as *Wanun*.

The white ventral and facial fur of *Dingiso* is clearly visible in its dim, mossy habitat.



TIM FLANNERY

Experienced hunters described how it rarely climbs trees and, unlike Doria's Tree-kangaroo, never jumps from the canopy but always descends backwards, just like a person. All agreed that it was ridiculously tame. One hunter described how he caught it by slipping a noose over its neck and then led it away. Another tempted it to within his reach simply by offering it a bunch of choice leaves. The Dani also described how, when first encountered, it would raise its arms above its head and emit a clear whistle. This distinctive behavioural response to a threat makes the individual clearly visible and may have the advantage of warning others of danger.

Towards the end of our expedition we decided to visit Pogapa, a settlement of the Moni people who live to the west of the Dani. The Moni had been Christianised by a missionary who, fortunately for them, had grown up in Irian Jaya and was extremely sympathetic with their traditions and way of life. Traditional beliefs are still strong among them, and the black-and-white tree-kangaroo, known to Moni as *Dingiso*, lies at the very heart of their culture (see box). It is thus afforded strict protection by many and, because it is common, its habits are well known.

Moni hunters confirmed the fact that when *Dingiso* is alarmed it whistles and raises its arms, revealing its white belly in the process. Other tree-kangaroos are silent or produce a low grunt, and no other species has a similar arm-raising display. Furthermore, Moni hunters were unanimous in indicating that it was largely terrestrial (another feature unique among tree-kangaroos). Later examination of its skeleton showed that in certain proportions it is indeed more similar to terrestrial kangaroos than other tree-kangaroos. Its skeleton also indicated that it is incapable of leaping out of the canopy as other tree-kangaroos do, for the bones are too fragile.

Initially, these terrestrial adaptations had made us think that it may have been a very primitive kind of tree-kangaroo. But further analysis has revealed it is probably a derived kind of tree-kangaroo that has reverted to life on the ground. This is an extraordinary evolutionary reversion, given that kangaroos as a whole are derived from tree-dwelling, possum-like ancestors, and that the first tree-kangaroos evolved from terrestrial ancestors.

The discovery of the black-and-white tree-kangaroo was doubtless the highlight of our expedition. But much more resulted from our six-week survey of Irian's high forest. Of the 42 mammal species found by us, over 25 per cent were entirely new records for Irian Jaya. Three—the black-and-white tree-kangaroo, an alpine rat found just below the Meren Glacier, and a bat mistnetted in dense mossy forest nearby—were discoveries entirely new to science. Many mammal species were photographed for the first time, while for many more the expedition resulted in the first insights into their obscure lives. Clearly, the great mountain range that once cradled the Ertzberg will continue to produce extraordinary discoveries for many years to come. ■

MAN OF THE ALPINE FOREST

TIM FLANNERY

A group of young Dani hunters. The Dani have exterminated *Dingiso* (known to them as *Wanun*) throughout most of their territory.

The Moni people of the western part of Irian Jaya's Carstenz Range know the black-and-white tree-kangaroo by three names. Its common name is *Dingiso*, meaning 'large black game animal'. *Mayamumaya*, an alternative name, means 'the one who has received the face of a man'. The third name, almost never used in everyday speech, is *Bondegezou*, a term of deep respect used by members of those descent groups to whom the hunting and eating of this animal is forbidden.

These names reveal a great deal about how the black-and-white tree-kangaroo is thought of by Moni and, consequently, how this species has remained relatively abundant in their territory. Unlike their Damal and Dani neighbours, the Moni place a specific importance on this particular tree-kangaroo as a key figure in their cosmology. To the members of several Moni clans, *Bondegezou* is 'the man of the alpine forest', the ancestral being from whom they are descended. For these individuals, to hunt this tree-kangaroo is unthinkable; to eat its flesh would be an abhorred act of cannibalism.

For those Moni to whom the black-and-white tree-kangaroo is sacred, what we regard as certain biological aspects of its behaviour are interpreted in an entirely different manner. For example, its alarm response—throwing the hands upwards and emitting a piercing whistle—is known to Moni hunters as the animal's explicit recognition of their shared clan status. As one elderly Moni hunter put it: "I see him on the path in the high forest and he tells me [by its behaviour] 'I know who you are'. I answer 'Yes, you are right. I will not harm you. I will wait until you go away'. And so I wait, and my dog lies down on the path, very still, until he has gone".

Missionisation has brought to the Moni people improved health and an end to warfare. Their culture has been altered irrevocably, but it has in many ways been a 'gentle' revolution. For, although most Moni now regard themselves as Christians, a large body of their traditional belief system remains intact. It is still possible for a biologist or anthropologist to ask the question, "Do you know this animal?" and for a hunter to reply, "Yes, I know it. This animal is the centre of my being". And it is to this that the conservation of the black-and-white tree-kangaroo—regularly hunted by other language groups throughout much of its range—is largely owed.

—Alexandra Szalay

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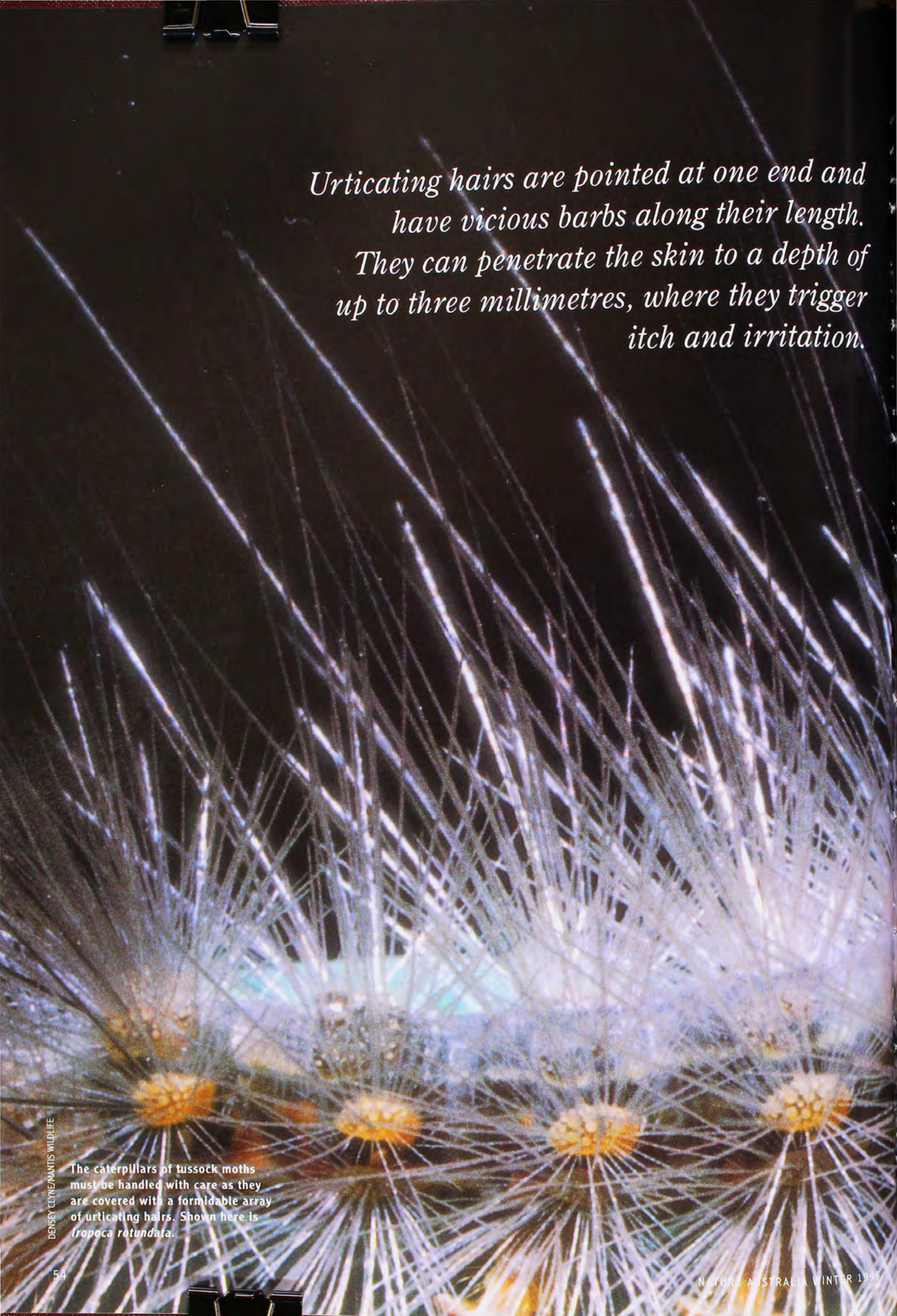
Dr Tim Flannery is a senior research scientist in mammalogy at the Australian Museum. He has been undertaking field work in New Guinea for the past 14 years and never fails to find something to surprise him. Alexandra Szalay is an anthropologist studying ethnotaxonomy and the importance of hunting among the mountain cultures of Irian Jaya.



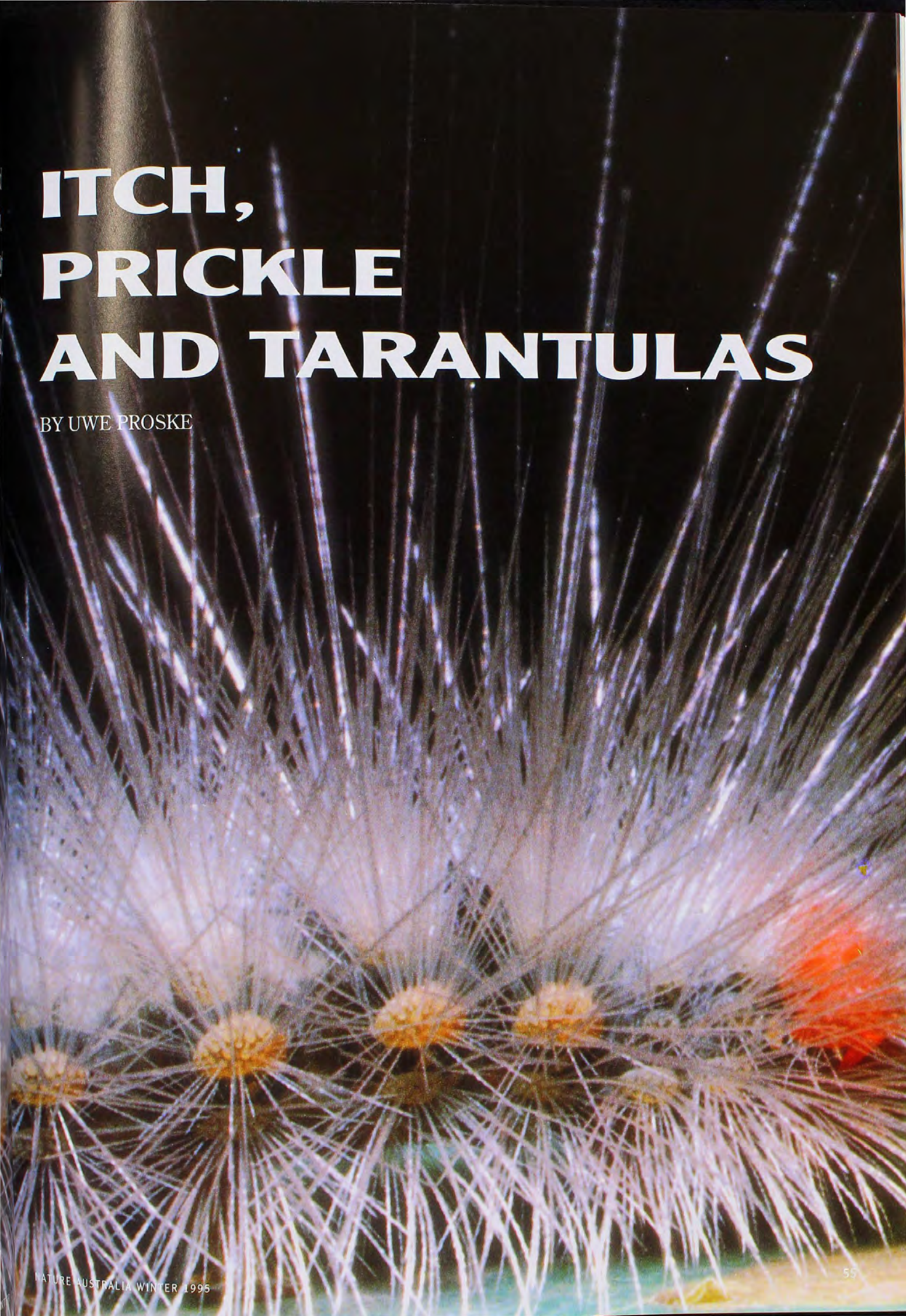
Urticating hairs are pointed at one end and have vicious barbs along their length. They can penetrate the skin to a depth of up to three millimetres, where they trigger itch and irritation.

DENSEY CLYNE/MANTIS WILDLIFE

The caterpillars of tussock moths must be handled with care as they are covered with a formidable array of urticating hairs. Shown here is *Iropoca rotundata*.

ITCH, PRICKLE AND TARANTULAS

BY UWE PROSKE



NICK GORDON/ARDEA LONDON LTD

HOW WOULD YOU FEEL IF YOU woke up in the middle of the night and found a spider walking over your bed—a huge, hairy spider with a 25-centimetre leg span and weighing 150 grams (the weight of a quarter-pounder hamburger)? This is the largest spider in the world, the Goliath (*Theraphosa leblondi*) of South America. It is only recently that some of the fascinating habits of this giant have been described for the first time, habits that are not only of interest to spider enthusiasts but that promise to provide us with new insight into the processes that lead to itch and irritation in our skin.

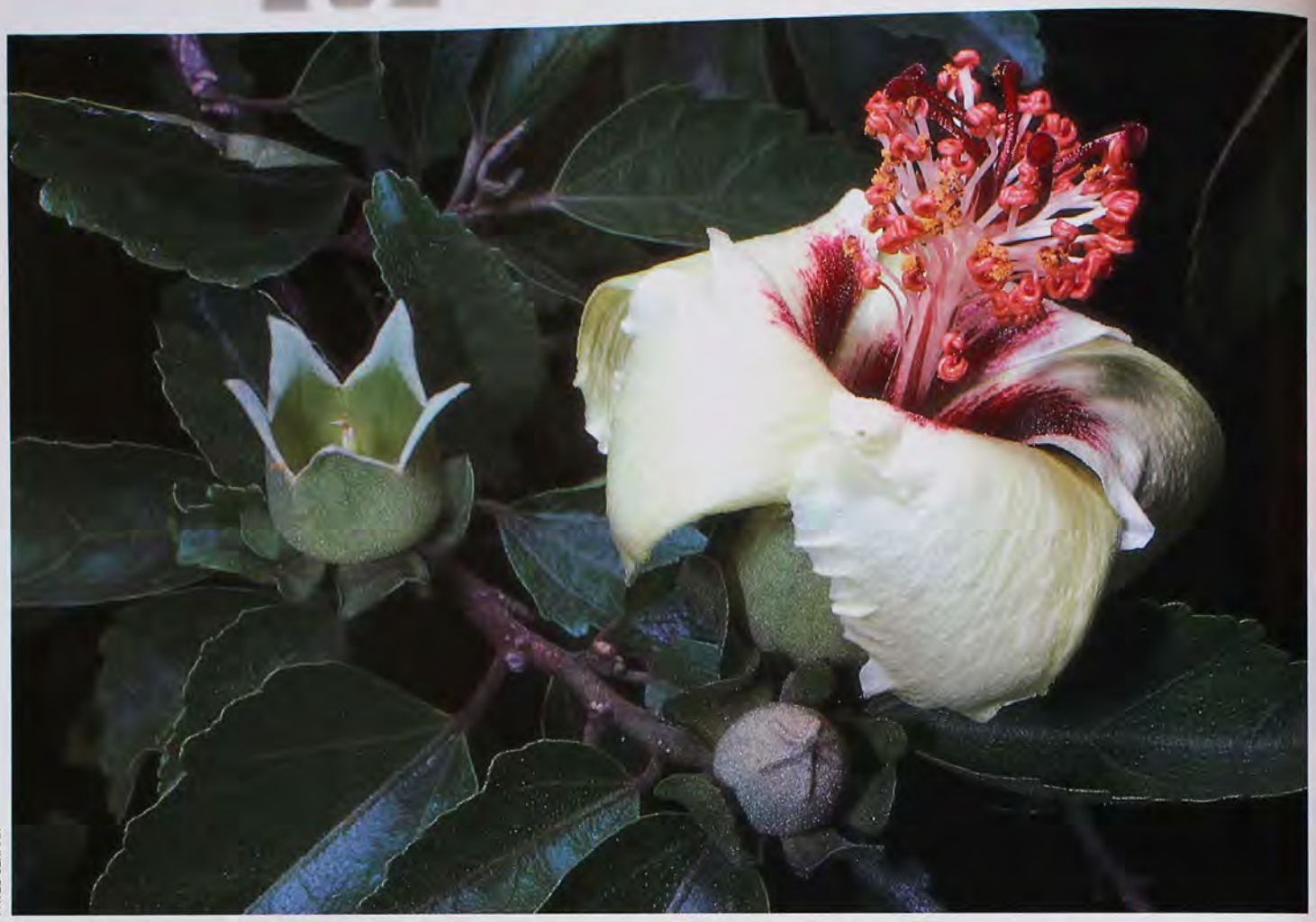
The Goliath lives in burrows, amongst tree roots and leaf litter in the jungles of French Guiana (northern South America). The burrows, often obscured by leaf litter, occur in clusters and their entrances are covered by a fine mesh of silk. Sam Marshall of the Department of Biology, University of Cincinnati, described in a fascinating account how he dug up one of the burrows and exposed a large female spider guarding her egg sac. In response to the disturbance the spider reared up and hissed at him. It turns out that Goliaths have pads of bristly hairs on their pedipalps (appendages next to the mouth parts) and on the first pair of legs. Rubbing pedipalps and legs together produces the hissing sound, which is quite loud and can be heard some distance away. If the hiss is not a sufficient deterrent, the spider resorts to its next line of defence—the main subject of this article. The spider lifts one of its rear legs and brushes it rapidly across the abdomen, releasing a small cloud of hairs. "Suddenly my hands and throat were burning and itching furiously, a sensation that persisted for several days", wrote Marshall. (The spider's final line of defence, incidentally, is a bite that, although not poisonous to humans, has sufficient force to break the neck of a mouse.)

Despite its massive size and a bite that's capable of breaking a mouse's neck, the South American Goliath's preferred form of defence is to release a small cloud of hairs that causes itch and irritation.

The urticating (itchy) hairs are located on the sides and rear of the Goliath's abdomen. These areas are quite distinct in appearance and can be distinguished by the naked eye from the ordinary hairs that cover the remainder of the body. Other South American tarantulas, such as members of the genus *Ephebopus*, have urticating hairs on their mouthparts. When threatened they rear up and move their mouthparts in a scrubbing motion, releasing a cloud of hairs. At about six microns (six thousandths of a millimetre) in diameter, urticating hairs are barely visible in the air. However, being pointed at one end and with vicious barbs along their length, when they land on the skin they penetrate the surface to a depth of up to two to three millimetres, where they trigger the itch and irritation.

MICHAEL CERMAK

Clearly visible against the black abdomen of this Mexican Red-kneed Tarantula (*Euathlus smithi*) are the fine, light-coloured urticating hairs used to protect the spider from predators.



PAVEL GERMAN

Arthropods aren't alone in their use of urticating hairs for defence. The seed pods of the Norfolk Island Hibiscus contain needle-like 'hairs' that are highly irritant.

The ability of the Goliath and a number of other South American tarantulas to release urticating hairs represents the evolution of a fascinating defence mechanism. It is found only amongst tarantulas in Central and South America. African and Asian tarantulas are just as hairy as their American cousins but they don't possess these specialised hairs. They make up for lack of this weapon with more aggressive behaviour: one was said to have chased a dog!

You may be wondering whether Australia has any indigenous tarantulas. That depends on what is meant by the term tarantula (see *Nature Aust.** Spring 1990). The word comes from the Italian 'tarantole', the name for a southern European wolf spider (*Lycosa tarantula*). Apparently, people bitten by a 'tarantole' were racked by uncontrollable muscle spasms and their frenzied movements were described as a kind of dance...hence the origin of the well-known dance, the tarantella. The South American tarantulas were probably called that by European explorers who used the name for any large and hairy spider. So, if *Theraphosa* is a tarantula, then we might propose that all members of the family Theraphosidae can be called tarantulas. Australia has three genera of theraphosids (*Selenocosmia, Selenotholus* and *Selenotypus*). These are known as the barking or whistling spiders and they occur in tropical and inland Australia. But, like their Asian relatives, the Australian representatives of the group do not have any urticating hairs.

Still, we have not been completely spared from the irritating onslaught of itchy arthropods! There are a number of species of Australian moths whose caterpillars have hairs that may cause skin injury and irritation. While cup moths (family Limacodiidae) are equipped with poisonous spines, the caterpillars of tussock moths (family Lymantridae) and some anthelid moths (family Anthelidae) have urticating hairs similar to those found in theraphosids. Skin irritation will result from handling these caterpillars or their cocoons, or even from stripping the bark off trees infested with them. Similarly some plants, like the Norfolk Island Hibiscus (*Lagunaria patersonia*) and the introduced prickly pears (*Opuntia* spp.) shed urticating hairs on handling.

Insects and spiders don't really have hairs as we know them; they are more properly called setae—spinous projections from the tough outer cuticle that protects the soft parts. Not all of a spider's hairs are irritating either. Most are too long and lack the sharp tips and barbs needed to penetrate the skin. At various stages of their lives all spiders moult, discarding their old outer skin and replacing it with a new one. This allows them to grow and also replenish their supply of hairs. In preparation for its next moult the Goliath builds a silk mat. While weaving the mat, it brushes its abdomen from time to time, incorporating urticating hairs into the mat. Small parasitic flies live with the spider in its burrow and feed on food remains and debris. When the spider is getting ready to moult, the flies lay their eggs on the silk mat so that once the spider has cast off its old shell, the young maggots can climb back on board. But most don't succeed. They become hopelessly caught up in the tangle of non-irritating and irritating hairs on the silk mat to be eventually discarded together with the mat. The spider uses a similar defence mechanism to prevent parasitic flies from feeding on its eggs in the egg sac.

I WAS FIRST MADE AWARE OF SPIDERS WITH urticating hairs by my colleague Paul Kenins. Paul is an expert on the sensations of itch and prickle in humans, and on the nervous mechanisms of pain. Paul, while working for CSIRO, was

Unlike their Central and South American relatives, Australia's theraphosids, like this barking or whistling spider *Selenocosmia stirlingi*, do not possess urticating hairs.

ESTHER BEATON/TERRA AUSTRALIS PHOTO AGENCY

*previously ANH

When the Coati catches a tarantula, it rolls it on the ground many times before it eats it, making sure that all of the urticating hairs have been knocked off.

able to work out why some woollen fabrics evoked a prickly sensation. One of the prevailing theories had been that some people were allergic to wool, not to its textural quality but to its chemical composition. The work of Kenins and others has convincingly shown that the irritating stimulus is indeed mechanical, just as it is for the urticating hairs of insects and spiders.

Itch and pain are sensations mediated by small nerve fibres supplying the skin. Kenins' experiments showed that quite a small force, such as that exerted on the skin by the end of a 40-micron-thick wool fibre, was enough to excite them. He also showed that the force (and hence prickle) from a wool fibre decreased with length (long fibres buckle more easily) and increased with width. Thus ways of minimising wool prickle include keeping the fibres long and their thickness below about 22 microns. (Unfortunately, even in a 20-micron wool sample there is usually a so-called 'coarse edge'—a population of fibres, sometimes five per cent, that exceed the average 20-micron thickness.) Two other variables of wool prickle are the area of skin in contact with the woollen garment and the kind of skin. The common expression 'thick skinned' is not entirely facetious. People do have very different skin thicknesses, that is, thickness of the outermost, horny layer. Obviously the closer the nerve endings are to the surface, the more likely they are to be stimulated by a prickly garment.

But what has all of this got to do with spiders' hairs? The fascinating thing about the Goliath's urticating hairs is that they trigger itch by purely mechanical means, just as the sharp ends of wool fibres do. They do this not just by pressing down on the skin, but by actually penetrating the outer layers to lodge some distance below the surface. That is why the irritation produced by a Goliath's hairs persists for several days. The other interesting point is that the Goliath's urticating hairs represent a potential tool for medical research. Up to now most of the work done on the neural basis of itch has used chemicals applied to the skin surface, or injected into the skin; chemicals like histamine. Using purely mechanical means to evoke itch represents a simpler, more easily interpreted form of stimulation.

When we experience an itch we respond by scratching the skin, which normally leads to some relief. The scratch reflex has presumably evolved as a means of ridding the body surface of invading parasites such as ticks, mites and fleas. If scratching persists, a point can be reached where the upper layers of skin become damaged and the itchy sensation converts to one of pain. Initially it was thought that the sensation of itch was produced by a low level of activity in pain nerve fibres and that, with stronger stimulation, the sensation would gradually convert to one of pain. However recent experiments on human volunteers suggest that itch is signalled by a completely separate population of nerve fibres. One explanation for the relief from itch produced by scratching is that the mechanical stimulus inhibits, probably at the level of the brain, the activity coming from the itch nerve endings.

However the body's reaction to itch and pain is similar. When we receive a scratch, the area of skin affected begins to swell and there is a spreading circle

DENSEY CLYNE/MANTIS WILDLIFE

Many caterpillars equipped with urticating hairs weave them into their cocoons to provide protection while the caterpillar metamorphoses.

of redness. The same kind of local inflammatory reaction, referred to as the triple response, is seen in an area of skin that we have been scratching in response to an itch. When urticating hairs penetrate the skin and reach the fine branches of underlying nerve endings, they stimulate the endings to trigger the sensation of itch, while at the same time setting off events that lead to local inflammation. In the case of urticating hairs we don't yet know why the sensation evoked is one of itch rather than pain. However we do know that every time both pain and itch nerve endings are stimulated, they not only produce the impulses that eventually lead to the sensation but they also release a local chemical that increases blood flow in the region (redness) and allows fluid to move out of the blood vessels into the adjacent tissues (swelling). In addition, any tissue damage produced by the urticating hairs will set up chemical reactions whose end products make the nerve endings more sensitive. Have you ever noticed that giving the second of two equally strong, painful stimuli to the same spot hurts more than the first? This is due to the sensitising of nerve endings by the local reaction. It is also the basis of a well-known piece of good advice: don't repeatedly scratch an itchy spot, because it will only make it worse. (Lucky for some of us, this sensitising action is blocked by aspirin!)

Tarantulas equipped with urticating hairs rely on the local swelling and inflammation triggered by the hairs as part of their defence mechanism. If small mammals like mice, which occasionally try to eat tarantulas, breathe in these hairs, their respiratory tract may become inflamed and swollen to the point where the animals die from asphyxiation. However one regular predator takes some special precautions. When the Coati (*Nasua nasua*), a racoon-like, tree-dwelling mammal from the Americas, catches a tarantula, it rolls it on the ground many times before it eats it, making sure that all of the urticating hairs have been knocked off. Certain South American Indians also include tarantulas in their diet and they too remove the urticating hairs before eating them, in this case by singeing them in a fire.

IT IS INTERESTING TO THINK ABOUT exactly how urticating hairs might produce their effects. There are different kinds of these hairs and each seems to be specially adapted for the purpose. The hairs of Arizonan tarantulas produce an intense inflammation of the nasal passages of mice, their most common predators, yet these same hairs have little or no effect on humans. The Goliath's hairs, on the other hand, as well as being irritating to mice and other potential predators, evoke in ourselves a very unpleasant sensation of itch and a burning throat. So there must be something about the design of the hairs that determines whether or not they set up irritation in a particular species. The challenge for us as biologists is to recognise that design and to work out how it is able to achieve its effects so successfully.

When Paul Kenins rubbed a portion of Goliath's body casing (shed after moulting) onto the skin of his arm, he developed a red itchy patch that persisted for several weeks. It is Paul's intention now to study the mechanism of itch in much the same way as he did for prickle in wool. If the supply of tarantula hairs becomes short, he may try the fine fibres from fibreglass or rockwool, which are chemically inert yet have an irritating action on the skin. The response they produce is, of course, not likely to be quite the same as from Goliath's hairs. But that observation, in itself, may help to unravel their mechanism of action. As one neuroscientist studying itch recently put it, "we have only just scratched the surface of this prickly problem". ■

DENSEY CLYNE/MANTIS WILDLIFE

JIM FRAZIER/MANTIS WILDLIFE

A number of Australian caterpillars use irritating 'hairs' or setae for defence. Cup moth caterpillars like this *Doratifera vulnerans* have poisonous spines (bottom) that are everted from within the body when threatened.

Further Reading

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Dr Uwe Proske is a reader in physiology at Monash University in Melbourne. He has been working for many years on the properties of sensory receptors but the mainstream of his research is concerned with receptors found in our limb muscles and how these help to regulate posture and movement.

***Russula* sp.**

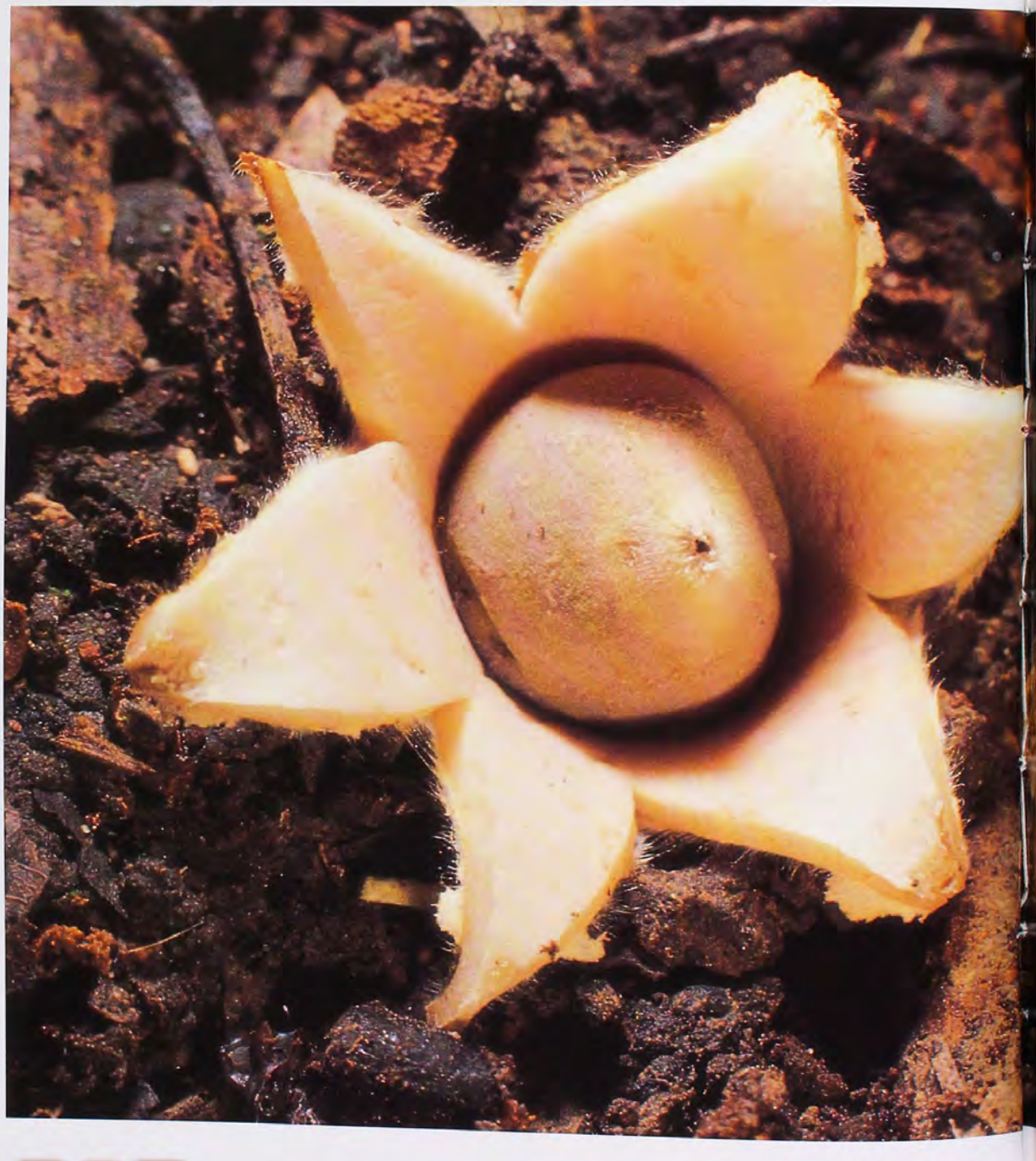
FUNGAL ARTISTRY

BY PHILIP GREEN

In bush pubs, stories are sometimes told of spooks and spirits that emerge in the forest at night and glow with an eerie green light. Far-fetched ramblings of intoxicated bushmen? Probably not! Actually, this is a reasonable description of the Ghost Fungus (*Pleurotus nidiformis*), which emits a cold green light bright enough to read a newspaper by. Usually it grows in clusters around tree stumps, generating a distinctly spooky aura in the cold forest night.

The fruiting bodies of fungi often appear in the damper autumn months, growing on the ground, fallen branches, logs and leaves, as well as in backyard gardens and lawns.

Philip Green has crawled on hands and knees through leech-infested forests from Queensland to Tasmania to photograph fungi with his trusty macro lens and multiple flashguns, and here is a sample of his fungal artistry.



Unidentified species.

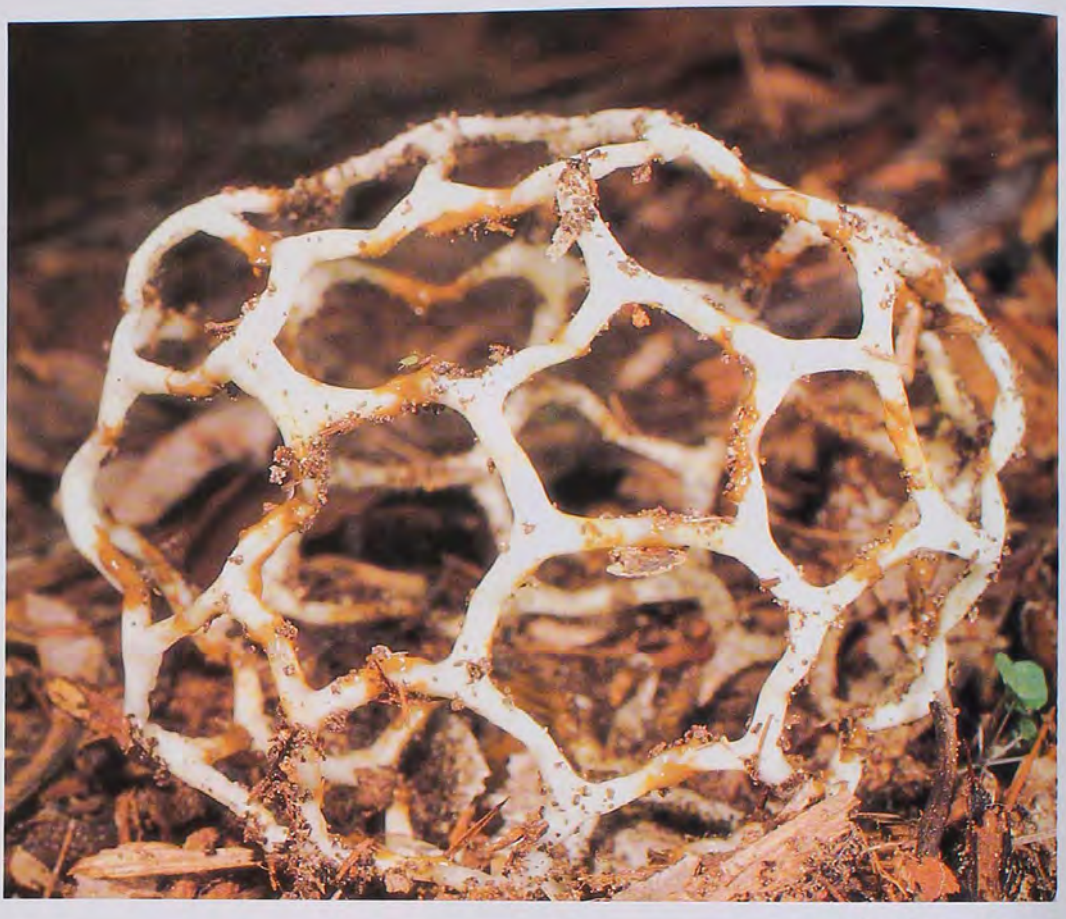
Geastrum sp.

P H O T O A R T

Hygrocybe sp.

Unidentified species.

FUNGAL ARTISTRY



Ileodictyon cibarium.

Trametes versicolor.

Hygrocybe miniata.

Stereum ostrea.

Marasmius sp.

FUNGAL ARTISTRY

PHOTOART

Hygrocybe sp.

Hygrocybe sp.

Two hundred years without a smell of an extinct platypus and then three genera and four species are discovered in rapid succession.

MYSTERY OF THE MULTIPLYING MONOTREMES

BY MICHAEL ARCHER

OUTRAGEOUS IDEAS, LIKE eccentric people, can have irresistible appeal. Take Rupert Sheldrake's most curious notion of 'morphic resonance'. According to him, an indefinable change takes place in an unidentified 'ether' whenever anything new is done. As a consequence, a second creature can somehow draw on this 'resonance' to more easily accomplish the same thing or something better. Examples of this 'resonance' might include constantly improving swimming records, or discovery of ever-larger dinosaurs. His suggestion provoked snorts of indignation from scientific circles not because it was patently absurd but because it was not clear how, or even if, it could be tested (testability being one of the key criteria for distinguishing ideas of science from those of faith).

After reading the paper, I also dismissed the idea as totally loopy. Yet a curious 'thing' has been happening to me that might tempt a less sceptical soul than I to give Sheldrake's odd fruit of the mind a second look. This 'thing' has been the maddening mystery of multiplying monotremes.

Until very recently, the egg-laying monotremes, which include the living Platypus and echidnas, were only known from Australia and New Guinea. Because they are much more like extinct mammal-like reptiles in their anatomy than marsupial or placental mammals, all of us assumed monotremes must have had an ancient record—but where was the evidence that could test this assumption?

Despite more than 150 years of searching throughout Australia, until 1972 fossil monotreme teeth were rarer than hen's teeth. One Tertiary echidna had been discovered, in gold-bearing river deposits in New South Wales, but at 20 million years old it was neither particularly ancient nor overly informative. It was a toothless, long-beaked echidna broadly similar to the one that survives in the rainforests of New Guinea. About extinct platypuses, the record remained infuriatingly silent.

Then in 1972 the 'thing' began. Mike Woodburne (University of California at Riverside) and I (then of the Queensland Museum) were sorting the residues of 23-million-year-old clay in the Tirari Desert of South Australia. Mike spotted a very strange but well-formed tooth, puzzled over it for a moment, then handed it to me. It was, although we didn't realise it at the time, the first known tooth of a fossil platypus. That was remarkable enough but in the same year, perhaps even the same week, in isolated sediments approximately the same age, Dick Tedford (American Museum of Natural History) and his team found a second, very similar fossil tooth on the other side of the Flinders Ranges. Both teeth were named *Obdurodon insignis*, meaning 'significant lasting-tooth', distinguishing these from the vestigial rudiments of teeth found only in juvenile living Platypuses.

Just over ten years later, a mystery woman at Lightning Ridge, north-western New South Wales, sold a small 120-

The discovery of this jaw, currently known as 'Hotcrossbunodon', represents a new family of Mesozoic monotremes for Australia.

CARL BENTO/AUSTRALIAN MUSUEM

million-year-old opalised lower jaw fragment with three molars to Dave and Alan Galman who in turn, in 1984, showed it to Alex Ritchie (Australian Museum) who, with trembling fingers, called me because he realised it was Australia's first Mesozoic mammal. After seeing the jaw, Alex's revelation proved to be only half the reason that I stared goggle-eyed at this gem of a fossil—because it was clearly yet another Platypus-like monotreme, one we named *Steropodon galmani*.

I could tell *S. galmani* was a Platypus-like monotreme because my hands were still tingling from the sensation of fondling the teeth of a similar fossil platypus we had just that year discovered in 15-million-year-old limestone deposits at Riversleigh, north-western Queensland. Just one year later, hot on the heels of both of these finds, came the discovery of a complete skull of the giant toothed platypus of Riversleigh, which we named *Obdurodon dicksoni*.

A mere six years later, this time in Patagonia on the other side of the world, Edguardo Ortiz-Jauriguizer (Universidad de La Plata, Argentina) sat on a 61–63-million-year-old tooth that neither he nor his expedition's leader Rosendo Pascual recognised—until they compared it with pictures of the teeth of *Obdurodon insignis*. They concluded that it was yet another fossil platypus, one we all named *Monotrematum sudamericanum*. We were invited to join Rosendo's Universidad de La Plata team the following year to look for more and, to everyone's delight, we found two additional teeth—a 200 per cent increase in knowledge about this most unexpected addition to the rapidly rising pile of fossil monotremes.

But the best was yet to come. What were the chances that a *second* mammal jaw would turn up at Lightning Ridge, and that it would also turn out to be a monotreme? I would have bet a million dollars against such a thing happening—and I would have lost. In 1994, miner Bob Sutherland placed in Robert Jones' hand (Australian Museum) a second small, opalised lower jaw, also with three molars, that he had found at Lightning Ridge. When Robert looked at the jaw, he screwed up his nose in disbelief and handed it to Tim Flannery (also of the Australian Museum) whose eyes popped. When Tim rang me, he suggested I sit down before he told me he was staring at a *second* albeit very different Mesozoic mammal from Australia, one that had teeth like a 'hot cross bun'. After studying it carefully, we concluded that, although it was the weirdest thing we had ever seen, being as different from Platypuses as they were from echidnas and certainly representative of a new family of mammals, tooth shape argued that it had to be (no prizes for guessing) yet *another* monotreme.

Which, I suppose, brings us back to Sheldrake's 'morphic resonance'. Two hundred years without a smell of an extinct platypus and then, one after another since 1972, three genera and four species of fossil platypuses, as well as a new family of monotremes, are discovered in rapid succession. Is the explanation for this mushrooming menagerie that each new find made the next one easier?

Perhaps, but less mysterious explanations seem at least as plausible. The 1972, 1984 and 1992 South Australian, Riversleigh and Patagonian finds are probably a simple consequence of the intense palaeontological attentions these areas had begun to receive, respectively, in 1970, 1983 and 1991. Although the fossil collections from each area were dominated by marsupials and/or placentals, once sufficient sediment was quarried the rare monotremes were bound to make an appearance.

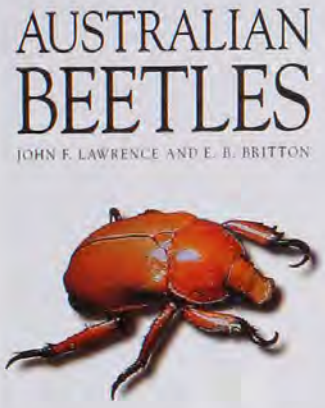
The Lightning Ridge discoveries, however, invite a different explanation. Why did it take so long for the first Lightning Ridge monotreme to turn up considering miners have been hauling flashing fossils to the surface of this area since the early 1900s? Maybe it didn't! Earlier monotremes may well have been found but, unappreciated, then annihilated to produce fiery gems to decorate a world of placental fingers.

Another more intriguing point may have been signalled by the two Lightning Ridge monotremes. If you closed your eyes and dipped your thumb into the Mesozoic fossil pie of any other continent, the chances of first hooking out two monotremes would be virtually zero. Even if you did this in modern Australia, the chances of hooking two different monotremes instead of marsupials, native rodents or bats would be minuscule. Are we not urged then to suggest that monotremes may have been the only one of the three modern groups of mammals that cavorted beneath the Mesozoic skies of Australia?

The fossil record of the southern continents has led us to conclude that neither placentals nor marsupials reached Australia until 70 million years ago at the earliest. That leaves the preceding 50 million years for monotremes to have explosively developed in Australia. What kinds might have evolved to fill the mammalian niches of a whole continent? The mind boggles yet it seems likely that 'Hotcrossbunodon' will turn out to be just the beginning of a new army of extraordinary monotremes still awaiting discovery. Real or rot, 'resonance' don't stop now! ■

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



Australian Beetles
By John F. Lawrence and E.B. Britton, Melbourne University Press, Vic. 1994, 192pp. $44.95rrp.

Australian beetles by John Lawrence and Everard Britton addresses under a single cover the great taxonomic and ecological diversity of Australian beetles and their affinities with the world beetle fauna.

This handsome publication is adapted from the Coleoptera chapter (Chapter 35), by the same eminent authors, in the CSIRO's 1991 two-volume edition of the monumental *Insects of Australia*. However, the original text has been updated and substantially enhanced by the addition of photographic plates, such that *Australian beetles* now stands as a production of independent utility rather than simply a chapter lift out.

Apart from the revised text, notable additions to the earlier *Insects of Australia* format include the incorporation of 64 colour photographs and approximately 50 high-quality scanning electron micrographs (SEMs) of larvae and adult beetles. Although primarily intended to assist in the interpretation of taxonomic characters and functional adaptations, the SEMs provide a fascinating microscopic vision of the structural landscape of the coleopteran body.

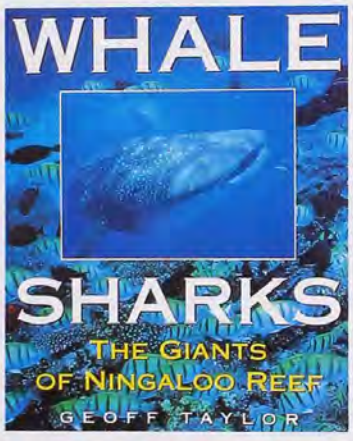
In number of species, beetles dominate the world's insect orders and in Australia there are approximately 29,000 known species. These are currently placed in 117 families and, since most of these occur elsewhere in the world, this publication has an obvious international application.

The book is divided into the sections "Introduction", "Classification and Keys" and "Family Treatment", and there is an extensive and revised bibliography. The introduction covers fossil history, collection techniques, anatomy and general biology. Each family is characterised and discussed in the main text and examples of adults and larvae are illustrated by black-and-white line drawings. Significantly, there are detailed family keys to both adults and larvae, and these are cross-referenced to plates and text.

Beetles have been very successful in occupying a plethora of microhabitats and their ecological diversity rivals that of their taxonomy. In this tome the authors have newly incorporated a review and synthesis of habitat interactions, mutualisms and host relationships that were lacking in their original *Insects of Australia* treatment. They also provide an overview of forest canopy beetle faunas, the poorly appreciated function of beetles as pollinators of many Australian native plants (not just bees do it), their role as decomposers of organic material and as diffusers of nutrients throughout food webs, vertebrate host relationships and the association that beetles have with fungal bodies. This coverage of beetle ecology significantly increases the utility of *Australian beetles* to students of the order.

Echoing English author G.K. Chesterton, there is undoubtedly a beetle view of the world of which man is entirely ignorant. *Australian beetles* provides the definitive introduction to our beetle fauna and gives insight into this beetle vision of the world. Ultimately, coleopterists and natural historians will find themselves drawn to its purchase.

—Geoff Williams
Australian Museum



Whale Sharks: The Giants of Ningaloo Reef
By Geoff Taylor, Angus & Robertson, NSW, 1994, 176pp. $39.95rrp.

After a chance encounter with two juvenile Whale Sharks off the north-eastern coast of Queensland, I welcomed the opportunity to review this book and find out more about these animals. Until the last decade, knowledge of the biology and habits of this species has been quite limited, a factor probably due to their size (up to 12 metres) and apparent elusiveness, and no doubt their lack of commercial importance. It was amazing to approach these huge, wild but gentle sharks without fear. As Geoff Taylor says, "there is no other giant creature on this planet that we can observe and interact with at such close quarters".

Geoff Taylor, a general practitioner originally from England, moved to Exmouth, Western Australia in 1982. From Exmouth he was able to study and film the Whale Sharks at Ningaloo Reef. In this book, one of the most comprehensive on Whale Sharks to date, he recounts the development of his interest from his first dive with them to photographing and filming them. Eventually he gained support to conduct research to help fill in the gaps in our knowledge of these animals. Geoff Taylor was the first to document the connection between Whale Sharks and the annual coral spawning at Ningaloo Reef.

The book has eight chapters covering, among other things, the biology and ecology of the Whale Sharks, and the history of Whale Sharks in folklore and early scientific recordings. A chapter on Ningaloo Reef and the North West Cape gives a brief commentary on climate, geology, the flora and fauna, and the marine life of this remote region of Western Australia. Two chapters cover his participation in the making of a documentary and the initiation of research into the population dynamics, feeding habits and migration of the Whale Sharks. Part of this research indicates that Whale Sharks do not reach sexual maturity until they are over 30 years old, suggesting that they may have one of the longest life spans of all animals, living for at least 100 years.

Throughout the text are anecdotes recounting the author's personal experiences and increasing involvement over the ten years since his interest in Whale Sharks began. This pervading sense of adventure, laced with interesting facts, makes the book entertaining and easy to read.

Geoff's keen interest in Whale Sharks has inspired his underwater photography, and the photographs in this book (most of them by the author) illustrate admirably the energy and productivity of the reef and adjacent Cape. The photographs include the coral and its spawning, fish, Dugongs and

of course the Whale Shark itself.

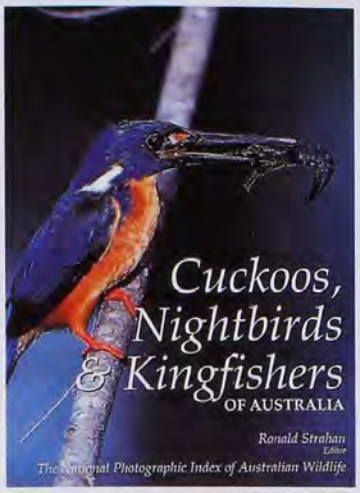
In the final chapter, "Ningaloo Reef Under Threat", the author discusses potential threats to the future survival of the reef. He emphasises the need for management strategies to reduce potential environmental stress on both the reef and the Whale Sharks, and recognises the inevitable fact that both Ningaloo Reef and the Whale Shark "will probably have to 'earn their keep' as a tourism resource before their protection will be given priority over our economic development by politicians".

Due to the nature of the layout and content of the chapters, some of the information is disjointed, leading to a certain amount of repetition as well as the author referring back and forth between chapters. He also tends to get bogged down in the recounting of the whale sightings, repeatedly mentioning throughout the book when, where and by whom the various sightings were made.

None of this, however, overrides the fact that the book makes for a fascinating and interesting read. The book is produced, published and printed in Australia to a standard so as to be affordable, and I recommend it to anyone with an interest in Whale Sharks or as an enjoyable introduction for those who have not yet discovered the magnetism of these delightful animals.

Finally, Geoff Taylor must be congratulated for his self-motivated and untiring energy directed toward the knowledge and well-being of the Whale Shark. In the words of Dr Eugenie Clark, Senior Research Scientist at the University of Maryland, "Geoff's studies should be supported and encouraged for he is the only person in the world who is focussing his trained eye and expert abilities on the study of this most magnificent fish" as he "continues to fill in the missing pieces about the little-known biology and habits of one of the greatest creatures that has ever lived on our planet".

—Sally Reader
Australian Museum



Cuckoos, Nightbirds and Kingfishers of Australia

Ed. by Ronald Strahan. The National Photographic Index of Australian Wildlife, Angus & Robertson, NSW, 1994, 270pp. $95.00rrp.

This book continues the series based on the National Photographic Index of Australian Wildlife and deals with an array of different groups of birds including both non-passerine and passerine cuckoos, nightbirds, kingfishers, swifts, bee-eaters, pittas, lyrebirds, scrub-birds, larks, swallows, pipits, wagtails (true), cuckoo-shrikes, trillers and bulbuls. The volume is beautifully presented, the photographs are generally of a high standard, and the text is readable and informative.

There is a brief introduction to each family or order of birds and then a species account including up to four photographs illustrating nests, young and adult birds of both sexes. Information for each species is then summarised under standardised headings such as description, habits and breeding and a distribution map is included here. At the back of the book are brief synopses of vagrant and very rare species, plates showing the eggs of the birds described, a bibliography and a species index.

Although the text is written by a variety of authors, consistency is achieved by an informal writing style and the species' summaries, which give brief but vital information on the birds' appearance, voice, habits, habitat, food, breeding, distribution and status. I particularly liked the anecdotal style of many of the authors and their use of apt and poetic quotations from other naturalists.

One worrying element of the use of some early accounts is that, for some species, we know little more now than we did when the birds were first discovered. For example, little new information has been added on the habits of the Chestnut-breasted Cuckoo since Dr Macgillivray's 1914 description based on William McLennan's field work. This is obviously not a criticism of the book under review, but a reflection of the vastness of our country, the distribution of population and government priorities in budget allocations.

In general, and for the bird species with which I am familiar, I found the information up to date and accurate. However, there were a few occasions where information in the text was contradictory to that given in the species' summary. For example, the text for the Azure Kingfisher correctly mentions that this bird is extinct on the Adelaide Plains and Mt Lofty Ranges, but the summary includes the Mt Lofty Ranges in the bird's range.

As is to be expected, most of the photographs show the birds clearly and in good light, and would generally help in the identification of a species. Many photos are equally aesthetically pleasing, with appropriate backgrounds and a delicate balance between the various components of the photos. A few are stunning, such as a Rainbow Bee-eater in flight and carrying a wasp in its bill, nestling Pheasant Coucals and many of the kingfisher illustrations.

Typographical errors were few and suggested the use of a spell-check facility rather than rigorous editing. A more serious flaw in the book was the captioning for photographs that illustrated the text on general descriptions of orders and families. In most cases, the captions indicated 'adult' or 'adult male', but did not give the species of bird illustrated.

This unfortunate oversight will not trouble experienced ornithologists (in fact some may take it as a challenge to test their skills of identification), but could worry the beginner. There was also one example of a reversal of captions, on pages 90 and 91, where the captions for the Tawny and Papuan Frogmouths appear to have been transposed.

Apart from these few occasions, I recommend this book to all serious ornithologists, to those interested in wildlife photography and to readers who have an interest in the groups of birds covered by the volume. The book is a pleasure to open, to read at length, or to dip into.

—Penny Paton
University of Adelaide

The Encyclopaedia of Aboriginal Australia

Ed. by David Horton. Aboriginal Studies Press for the Australian Institute of Aboriginal and Torres Strait Islander Studies, 1994, 1340pp. $130.00rrp.

This will be a welcome and essential addition to any library used by people who wish to gain general knowledge about Australian Aboriginal and Torres Strait Islander people and their society, history and culture. A wealth of information about a wide range of subjects, people and places is contained in these two volumes. Teachers, students, and anyone with an interest in Aboriginal Australia will benefit greatly.

In his introduction, David Horton says, "this is not an encyclopaedia of material culture, or archaeology, or anthropology, nor is it an encyclopaedia of Aboriginal studies. It is an encyclopaedia of Aboriginal Australia, or an encyclopaedia of the Aboriginal people". He wanted it to be about links with the land, as Aboriginal society is. As such he wanted every group to be at least mentioned and to be situated in the land. To this end there are entries about tribal and linguistic groups (based on Tindale's 1974 book and maps) as well as contemporary communities and organisations that we read about in newspapers today.

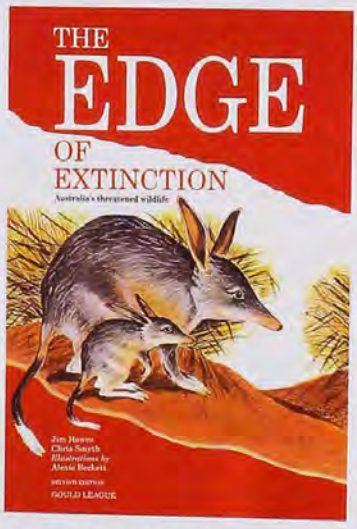
There are also entries about individuals—Aboriginal people who are or were prominent artists, activists, leaders, singers, sportspeople or writers, as well as some non-Aboriginal people who played important roles in Aboriginal history. Places at which significant events in Aboriginal history took place and important contemporary places are also incorporated. And, despite what David Horton says in his introduction, there are entries that relate to archaeology and material culture, like baskets, Bondi points, diprotodons, rock art, skin cloaks, stone artefacts and small tool tradition. Among the entries there are also longer essays on major areas including art, economy, education, history, land ownership, language, law, music, media and politics just to name a few. Shorter essays on subdivisions of these topics and entries cover books, plays, dance, bands, cultural groups and organisations.

Given the breadth of the subjects covered in the encyclopaedia and the number of entries (over 2,000), each entry usually summarises its topic in about 250 words. This means that alternative opinions cannot always be expressed, but entries are cross-referenced to other related entries, and references to further reading are provided so that people interested in exploring further have avenues for doing so. For words that have more than one spelling an entry-guide index supplies alternatives to assist in finding entries.

The volumes are well illustrated with black-and-white and colour photographs on just about every page. Most of the photographs are small, but usually very clear and informative. Small maps of Australia indicate the locations of places and groups that are the subject of entries. The volumes are not devoid of errors or opinions over which researchers would differ, but those I have seen are of a nature that do not detract from the encyclopaedia's worth or purpose.

This is the first comprehensive reference book about Aboriginal and Torres Strait Islander people (ATSI), and the Australian Institute of Aboriginal and Torres Strait Islander Studies (AIATSIS) is to be commended for its publication. AIATSIS is the largest centre of its kind for information relating to the culture and lifestyle of past and present ATSI peoples, and its library is without equal. The principal function of AIATSIS is to promote ATSI studies. This encyclopaedia will certainly assist in this work.

—Val Attenbrow
Australian Museum



The Edge of Extinction: Australia's Threatened Wildlife

By J. Hows and C. Smyth. Second edition, Gould League, Vic., 1994, 40pp. $12.95 plus $4.00 postage.

This book is written in an easy, informative style and seems geared for school projects, and therefore the school library market. It deals with Australia's threatened fauna and flora giving the probable reasons for their decline and what is being done for their future. The book is divided into chapters relating to certain themes and habitat areas, and the endangered flora and fauna they contain. These include: "Why Are Species Threatened?", "Forests", "Grasslands", "Coastal and Marine Areas", and "Keeping Them Alive". For each habitat mentioned there is a detailed account of the history and plight of eight species that live there. This is followed by a list of extinct and endangered animals and plants not included in the main text. Each of the main text species is accompanied by an ink illustration and a distribution map. As a result, the book is not exhaustive but it explains why this tack has been taken in the section titled "About This Book".

Unfortunately, a few facts have been poorly researched. On the Lake Eacham Rainbow Fish, for example, the species' second chance is described as follows: "Fortunately, the Taronga Zoo, Queensland authorities and aquarists collected individuals before it was too late and are doing very well with captive breeding programs". The true state of affairs was that specimens were collected illegally by some aquarists before the species was known to be endangered. On the announcement of the extinction of the species in the wild, the somewhat surprised aquarists discovered that they were the sole managers of the last known living specimens. These were bred up and distributed to as many people and institutions as wanted them, including Taronga and the Queensland authorities. A small point perhaps, but credit where credit is due! Some of the illustrations vary a little in accuracy too—frogs only have four toes on their front feet but both species illustrated have five!

All in all the book is worthwhile and a recommended addition to any school library.

—Martyn Robinson
Australian Museum

Possums of the World: A Monograph of the Phalangeroidea

By Timothy F. Flannery. Geo Productions, NSW, 1994, 240pp. $99.95rrp.

Possums of the world is one of the latest in a series of books by Tim Flannery. Over the years we have learned to expect regular provocative outpourings from this energetic and prolific young scientist. In this case the surprise is not so much the new taxonomic arrangements, or even the description of new species, but the cooperation with an illustrator to produce a coordinated word and picture description of a group of animals.

The book is organised to present textual and visual depictions of each individual species, giving equal weight to each and every one. It is not a book on possum biology. Such a book would have 200 pages on the Common Brushtail and 25 on everything else. It is, instead, a celebration of all possums. The star attraction is the collection of remarkable colour plates by Peter Schouten that portray life-like representations of real animals with accurate colour rendition. The text consists of an introduction including a brief summary of the biology, relationships, fossil history and distribution of possums, followed by accounts of each family and species. The species accounts are disappointingly brief for a monograph and are rather too reliant in many instances on Strahan's *Complete book of Australian mammals* (1983). Papuan forms are, on the whole, the subject of more detailed accounts based on the author's own experience. Each family account is accompanied by detailed half-tone drawings of feet and heads of representative species, and each species account has a page of text facing the main colour plate with occasional further text and drawings or plates of other forms following.

Technically the production and especially the colour rendition are superb. The only minor fault is that the layout of the species descriptions has placed an unfortunate restriction on the amount of information presented. The descriptive page (usually singular) has too much blank space and does not allow enough room for the text to do justice to most species. For two species the subheadings do not match the following text. The distribution maps are an oversimplification for a monograph and would have been better on a larger scale with actual localities plotted. Many species actually have disjunct distributions of isolated populations, which with the present format look like continuous large populations; and, on a more serious note, the map for the Common Brushtail indicates it does not occur in Tasmania. These are minor quibbles and hopefully they can be corrected before the reprintings, which must surely follow from such a marvellous production.

—George M. McKay
Macquarie University

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52 Lorenzo Cres, Rosemeadow, NSW 2560. Ph: (046) 21 1530
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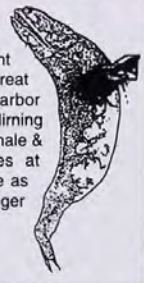

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Q&A

Blue Flower-wasp

Q: *I have always wondered what the large blue insects are that I find around my garden (specimen enclosed). Can they sting and what do they eat?*

—Stephen Saunders
Whitebridge, NSW

A: This large and striking wasp is known as the Blue Flower Wasp (*Scolia soror*) because of its steely blue–black body and deep blue wings. These flower wasps belong to the family Scoliidae and, unlike many of their close relatives in the family Tiphiidae, they are winged in both sexes. Little is known about the biology of scoliid flower wasps but it is thought that the larvae are parasitic on scarab beetle larvae (curl grubs). Adults frequent flowering trees and shrubs, and seek their prey by burrowing in the soil. Compost heaps are one of their favourite garden sites.

The Blue Flower Wasp is one of several very similar species found throughout much of eastern Australia. Female Blue Flower Wasps, like those of other large species, can probably administer a painful sting but in their normal course of activity they are not aggressive and appear to ignore human presence. Should you find one in your garden, regard it as a friend; maybe it is seeking a curl grub pest!

—Max Moulds
Australian Museum

Bird Talk

Q: *How do young birds communicate with their parents other than by obvious vocalisation? Recently I observed two Rufous Whistlers (*Pachycephala rufiventris*) in my backyard. The parent flew off to forage, meanwhile the fledgling silently moved to another tree. The parent returned with food to the first tree, then flew to the second and fed the youngster. Was this pot luck or is it possible the fledgling calls beyond our hearing range? The parent was vocal but I never heard anything from the offspring.*

—Lyn Clarke
Bunbury, WA

JEAN-PAUL FERRERO/AUSCAPE INTERNATIONAL

How does a female Rufous Whistler locate her young?

A: Many features of birds' hearing appear similar to that of humans. The optimal hearing ranges are more or less equivalent (one to four kilohertz). Below this range, the decrease in sensitivity is gradual. Above five kilohertz, birds' hearing acuity decreases rapidly, reaching a limit at about ten kilohertz. (Owls are exceptions, with an upper limit of around 12 kilohertz.) Likewise, the optimal shortest duration of a sound to be detected is similar between birds and humans (200 milliseconds). These figures, however, are generalisations because few species of birds have been tested.

We do not know for sure the auditory capabilities of Rufous Whistlers. It is possible that the female you watched could have located her young by its calls. Unless you were paying very close attention, a short, soft call could have been given by the young bird without you noticing. It is also possible that the female could have seen her young. Visual acuity in birds is very good, with many able to resolve fine detail at some distance. A very small movement may have been sufficient to attract the mother bird's attention.

Like many aspects of bird behaviour, there is still much that is not well understood. Those studies that have been conducted have rarely involved Australian species. This may be significant: more and more we are finding that many Australian birds really are different from those in the rest of the world.

—Walter E. Boles
Australian Museum

Leviathan Feats

Q: *I am bewildered about how lactating Humpback Whales manage to produce the huge amounts of milk their*

FRANCOIS GOHIER/AUSCAPE INTERNATIONAL

A Humpback Whale (*Megaptera novaeangliae*) mother with her calf.

calves need. If they feed on plankton alone, then they must virtually starve away from Antarctica. Also, as a fellow mammal, when I was lactating, it was necessary to drink quite a large amount of water. Do whales actually drink salt water? If so, have they some special way of excreting excess salt, or is the milk very salty?

—Rosemary Boon
Oatley, NSW

A: Humpback Whales, like many other Antarctic animals, are able to build up their store of fat over the summer feeding period in sufficient quantities to last them during winter migration months. These reserves are stored in the blubber layer, the thickness of which is generally greater in Humpbacks than in most other species of baleen whales. This, combined with a slow metabolic and respiration rate, enables these animals to travel the distances they do and, in the case of females, suckle a calf on the return journey. Recent evidence suggests that these whales do feed towards the end of the trip. During October and November, Humpbacks have been observed feeding on schooling fish in the waters of southern New South Wales.

In regard to their drinking, whales do not drink. Whatever excess salt is taken in is excreted by their extremely efficient kidneys.

—Linda Gibson
Australian Museum

Answers to Quiz in Nature Strips (page 18)

1. Males
2. A comet
3. South Australia
4. *Australian Museum Magazine* and *Australian Natural History*
5. Cairo
6. Numbat and Black Swan
7. Guam
8. A murder
9. Infrared radiation
10. Royal Australasian Ornithologists Union

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P I C T E A S E R

Do you recognise this? If you think you know what it is, then send your answer to Pic Teaser, *Nature Australia* 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. Autumn's Pic Teaser was an earless dragon (*Tympanocryptis cephalus*) from Western Australia camouflaged amoung gibber stones.

The science upon which the impact assessment was based was hard to find.

HOLLOW ARGUMENTS

BY HARRY PARNABY

A JUDGEMENT LAST YEAR (1994), made in the Land and Environment Court of New South Wales, is a triumph of pseudo-science over long-term rational forest management and the public interest. The case was about conservation prescriptions for a logging licence in the Wingham Management Area—an area that contains significant stands of productive old-growth eucalypt forest.

A local community group, backed by some of Australia's leading wildlife ecologists, challenged the effectiveness of the Government's conservation prescriptions aimed at reducing the potential impact of logging. The group claimed that, while some of the conservation measures were sound, most were not stringent enough and the impact assessment was seriously flawed. This represented something of a test case, as it was to potentially set the standard for a dozen or more other management areas requiring logging licences, areas that also contain a significant part of the remaining unlogged productive old-growth forest in eastern Australia.

A large number of endangered animals, such as owls, parrots, possums and most bats, depend on hollows in old eucalypts for shelter and breeding sites. Even in the fastest growing eucalypts, suitable hollows do not form until they are at least 150–200 years old, yet logging regimes aim to log regrowth trees before they reach 120 years old—long before hollows form. It is clear that logging of hollow-bearing trees is bad news for hollow-dependent animals and doubly bad if such trees are cut faster than hollows can form, which is the current situation.

Studies of potential impacts of forestry operations is a new field of science, still in its infancy. Despite 200 years of European settlement, basic information about ecological requirements is unavailable for the majority of animals. Biologists are often struggling just to determine what species are present in an area, let alone the specific locations where the endangered species are found in each State forest. This latter point is important, because the Government's management conditions depend on knowing the specific location of individuals.

I was engaged by the community group as one of a number of fauna consultants to review aspects of the science behind the Government's fauna impact assessment, and the steps proposed by the Government to minimise logging impacts on fauna. Alas, the science upon which the impact assessment was based was hard to find. In its place was unsubstantiated conjecture, often dressed up as definitive statements of fact, and conclusions that were not a logical consequence of the data presented. All basically claimed that the logging had no major impact on the endangered fauna.

In particular, the cornerstone of the Government's argument was so flawed that it is hard to believe it was not immediately thrown out of Court. Bearing in mind that the forest consists of a complex mosaic of logged forest and old-growth forest, the argument went like this. It was claimed that, because endangered species were sighted in logged forest, this meant they were able to survive there. But without knowing the locations of roost and den sites, or the distribution of other resources, transient individuals (en route through logged forest from one unlogged area to another) cannot be distinguished from animals actually using the resources of logged forest. It is thus illogical to claim that such species can survive in logged forest.

The argument justifying the logging of old-growth forest continued to stray from reality. Given that animals were found in logged forest, it was claimed that logging had little adverse impact on the fauna. For those species for which little or no information exists, it was also boldly concluded that there would be no significant impact; that is, when in doubt, assume no impact! Of great concern is not the question of whether endangered species can survive in logged forest, but rather, why some biologists reached such a conclusion in the absence of supporting evidence.

If one accepts such flawed reasoning, a series of conclusions can be made that conveniently endorses the current logging regimes and commitments to the timber industry. Why? If, as they claim, logged forest is suitable habitat, the conservation reserve system would then not have to be so large, nor would it be essential to connect such reserves with corridors of unmodified forest. More areas could be logged and fewer restrictions would be necessary for logging operations, because logging, so the argument goes, does not have any significant impact on the survival of endangered species.

But is there really a problem? Won't the forest regrow on a sustainable basis? No. Not old-growth forest. In effect, hollow-bearing trees and old-growth forest represent a non-renewable resource. Research indicates that longevity in many forest trees ranges from a few hundred years to over 2,000 years. Many essential requirements of endangered species, such as tree hollows, take centuries to form. Logging in Australia is effectively a mining operation. It has not been managed on a sustainable basis and little remains of those forests that were already centuries old when Captain Cook first landed.

In the Wingham case, the Judge rejected the majority of amendments proposed by the community group, although he did make some minor adjustments to the existing logging prescriptions.

It is sad that the main advocates for long-term forest management and protection of our priceless old-growth forests were not the Government departments vested with this task, but a small community group. The Government, which is meant to represent the public's interest, instead acted to protect the jobs of a few score timber workers and the profits of the timber industry.

Something is seriously wrong when a small community group is left to defend the public interest. Is Government policy so committed to economic rationalisation that the interests of the timber industry subjugate the interests of the public in terms of sensible forest management?

Obvious restrictions exist on the extent to which scientists can criticise the Government that employs them. However, it is a different matter when scientists, in this day and age, advocate the biological equivalent of the flat Earth theory, upon which conservation measures are then based. ■

Dr Harry Parnaby is a Research Associate at the Australian Museum and a consultant specialising in bat faunal impact assessments.

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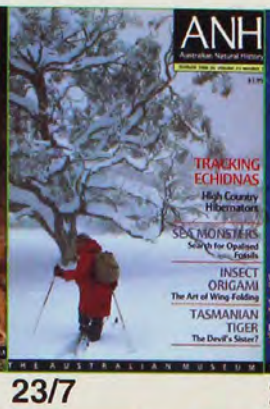

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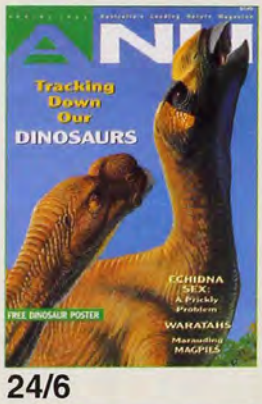

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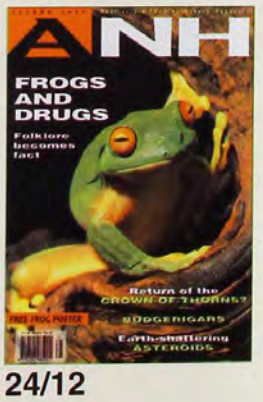

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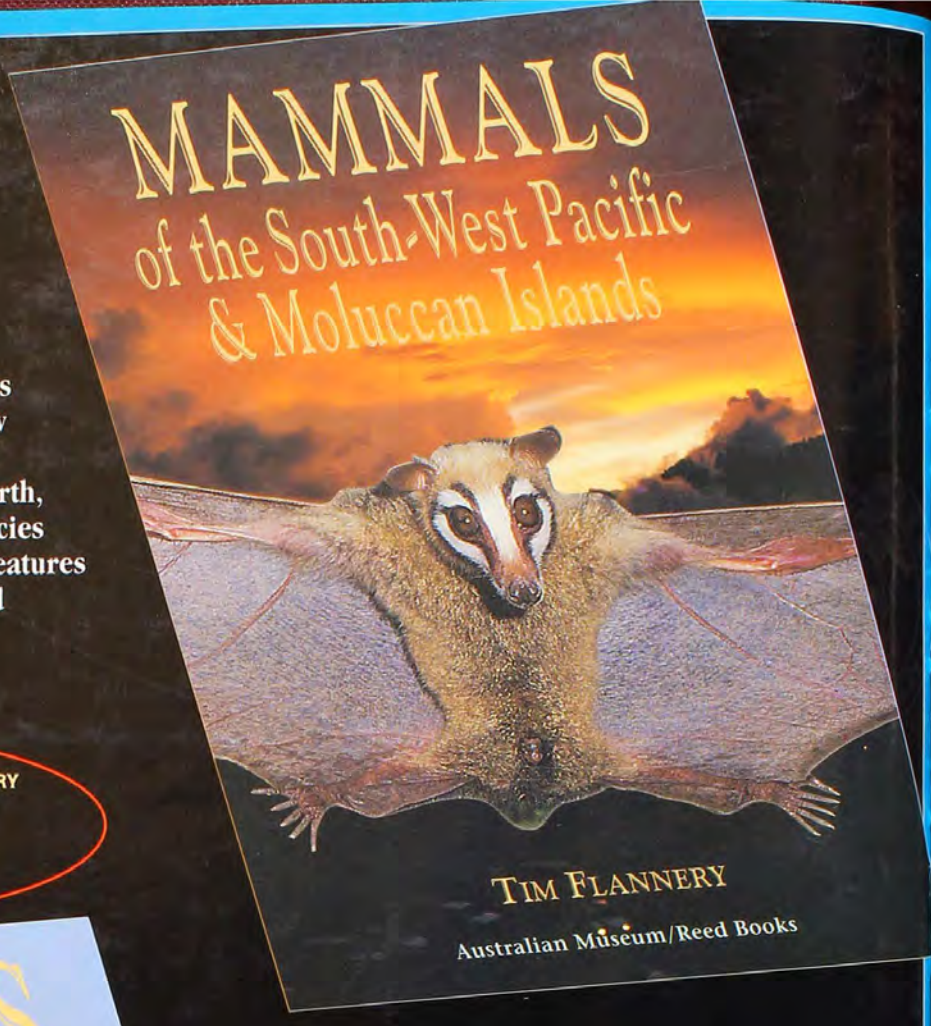

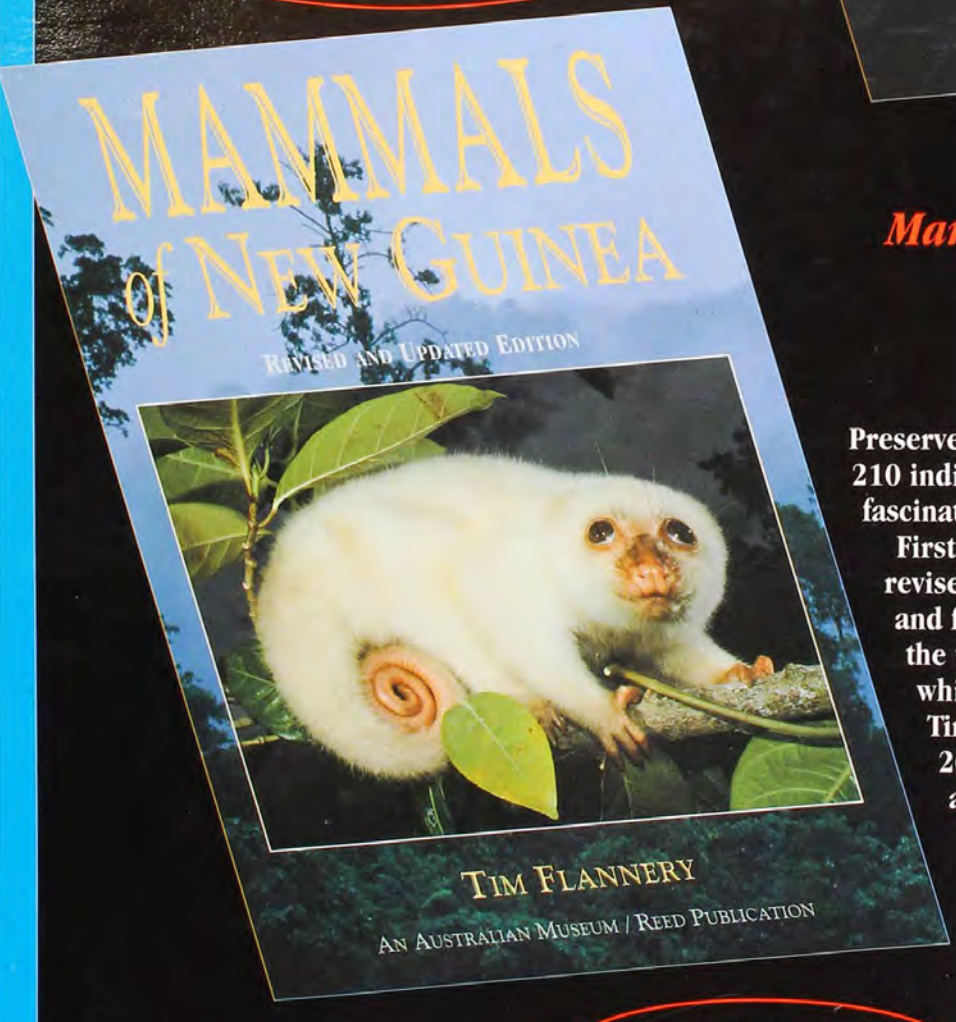

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