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Australian Natural History



**Rapacious Raptors of
the Australian Wild**

**Robyn Williams and the
Gullibility Factor**

European Wasps Invade Suburbia

Female Rat-catchers in P.N.G.

**Reconstructing
Australia's Oldest Mammal**

**The Cassowary at his
Nest**

Winter 1985 Vol. 21 No. 9

The Australian Museum

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Australian Natural History

from the INSIDE

They are fearless, contemptuous of humans and dive boldly into the midst of barbecue groups, even carrying off pieces of sausage. The European Wasp is an aggressive exotic pest that has established itself in many parts of Victoria, Tasmania and New South Wales. The last few months have seen a rapid spread throughout parts of metropolitan Sydney. Read the full story inside.

The Australian Cassowary is a huge, flightless bird related to the Emu and is a member of what many ornithologists consider to be the most primitive group of

living birds — the ratites. North Queenslanders Clifford and Dawn Frith have studied this bird at length and photographed a male cassowary incubating eggs at his nest. This world photographic first is the subject for this edition's liftout colour poster.

Another highlight is our feature on raptors, or birds of prey. They are the archetypal symbol of war, violence and fierceness; their killing behaviour has been the stuff of legends since primitive times. As well, their grace, serenity and soaring flight are the essence of dreams.

What did Australia's oldest mammal look like? Have a look at artist Peter Schouten's reconstruction inside, which is based on considerable research of a mammal jaw found at Lightning Ridge. Read about that great palaeontological pastime, the reconstruction of fossil animals.

Rob Cameron, Editor.

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See Robyn Williams.

Stomann



Bulldog ant, *Myrmecia gulosa*. Photo: Leo Meier. Full story inside.

Cover: Wedge-tailed Eagle, *Aquila audax*. Photo: Ford L. Kristo.



Rapacious Raptors

by Ford L. Kristo

Raptors (birds of prey) have spurred man's imagination since the dawn of our consciousness. The duality we observe in their "psyche" is intriguing. On the one hand, the archetypal symbol of war, violence and fierceness, their aggressive killing behaviour has been the stuff of legends since primitive times. On the other hand, their grace, serenity and soaring flight are the essence of dreams and boundless elation.

Historically, raptors, along with most other predatory species, have been persecuted by man. This in itself is not unusual — interspecific rivalry between predators is a fact of life. However, in man's case, the intent and extent of this persecution are highly questionable. Add to this the effects of gross habitat alteration and destruction and the residual environmental toxins that have been freely dispensed over the past decades, and the bottom line may spell extinction for many species.

The biological adaptations of raptors, acquired through eons of evolution, enabled them to become an extremely efficient and successful group of animals. Potent hunters and excellent parents, their continued existence in a natural environment would be assured. But as we are all aware, natural environments are diminishing under the weight of human needs and wants.

The birds in question

Birds of prey can be divided into two large groups: diurnal and nocturnal birds. Diurnal raptors go about their lives in the daylight

"Female Peregrine Falcon Hunting Banded Lapwing". Reproduced here is part of a gouache painting by one of the world's top bird painters Richard Weatherly. Much of Richard's time is spent outdoors sketching birdlife near his home at Mortlake, western Victoria. Richard is a founding member of the Society of Wildlife Artists of Australasia.

hours. The group includes eagles, hawks and falcons. Owls generally work the nightshift (although the Powerful Owl has been known to hunt during the day). Each group possesses different adaptations appropriate to their respective lifestyles.

Visual acuity (sharpness of sight) in some raptors is eight times that of man. An eagle can spot a rat 1,500 metres distant. They are also able to scan the horizon without moving their eyeballs or head. Because there are few, if any, animals that might attack them from above, nature has equipped the top half of their retinas with the bulk of their allotted sensory cells. Some falcons have black feathers underneath their eyes that act to reduce reflected glare. Owls' eyes are immovably fixed in their skulls. In order to compensate, they have the ability to turn their heads through almost 360 degrees.

Barn Owls locate their meals by sound. By deciphering differences in arrival time of sounds at each ear, they are able to pinpoint the location of prey.

The wing shape of a raptor gives a fair indication of how and where it hunts. Owls need to be able to fly silently and with extreme manoeuvrability to take nocturnal prey. They are equipped with short, broad wings and "silenced" feathers. The feathers are soft, pliable and have downy surfaces. (Normally flight feathers are very rigid and have a hard "cutting edge". These features

create noise as the feather passes through the air.) Consequently, an owl's prey hears nothing of the attacker's approach — at least not until it's too late. Long, broad wings allow the Wedge-tailed Eagle to soar over open plains or rise on thermal air currents, covering great distances, while expending minimal energy. Goshawks have short, broad wings ideally suited to the split-second manoeuvring required when hunting in scrub and forest situations. Falcons have long, narrow-tipped wings enabling them to engage in high-speed pursuits and fast-contour flying (rapid flights one or two metres above the ground designed to catch unaware prey in the open). In high-speed dives, Peregrine Falcons have been known to exceed 300 kilometres per hour.

The talons of raptors are versatile, formidable weapons. Good for plucking food out of thin air, they are also invaluable for holding down larger prey items so that they can be dismantled using the beak. There isn't a great deal of difference in the shapes of beaks between the various raptor species because, no matter which bird they hang off, they are applied to the same basic tasks: ripping, tearing and picking.

Considering prey species in Australia, one might start with grasshoppers and frogs and work up to wallabies and small kangaroos, although records of a horse and a crop-dusting plane being assaulted by Wedge-tailed Eagles do exist. If carrion is taken into account, the

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Barn Owls, besides being able to use sight to locate their meals, also use sound. Photo: K. Ireland NPIAW.

prey spectrum is increased to virtually any beast capable of dying. This does not mean that any one bird of prey can operate over the entire range of possibilities: each species has its preferred range of prey in accord with the limitations imposed by its own size. And so it is that the Australian Kestrel (our smallest falcon and bird of prey) dines on mice, insects and small reptiles; the Black Falcon, a medium sized raptor, on rats, Rabbits, starlings and Galahs; and the Wedge-tailed Eagle, our largest, on Rabbits, wallabies and goannas. Each raptor species will attack anything they believe they are capable of killing, if the opportunity presents itself. One prey species so far not mentioned is man. An authentic record tells of how a young child was carried off from outside his hut and into a nearby tree by a New Guinea Eagle. If not for his brother climbing the tree to kill the bird and rescue him, the child would have gone into his next life as guano.

Why is it then, that these opportunistic birds, kitted out with such efficient adaptations for their role in life, face an uncertain future?

Putting the boot in while they're down department limiting factors.

In a natural, self-regulating ecosystem, population numbers are maintained at optimum levels by a number of built-in controls. For raptors the following limiting factors may be considered: the availability of suitable and sufficient habitat; the availability of suitable and sufficient prey; the ability to produce viable progeny; and predators. Positive or negative changes in these factors will produce corresponding increases or decreases in the bird population.

The Osprey, a type of fishing hawk, requires ledges on coastal cliffs, or tall trees with little or no canopy cover situated in relatively undisturbed estuaries, in order to nest. Extensive urban and industrial development on the eastern seaboard now occupies some areas of former Osprey habitat, and their numbers have correspondingly decreased. Presently, there are 14 known active Osprey nests on the northern New South Wales coast . . . not particularly impressive. However

the provision of artificial nest sites may improve the situation. One has been erected near Sawtell to replace a nest tree that had been removed because it posed a threat to nearby houses. Another is planned for the Byron Bay area.

The clearing of approximately 90 per cent of New South Wales rainforests has placed limiting pressures on the Pacific Baza (or Crested Hawk). Habitat alteration elsewhere has also introduced similar pressures on the Red Goshawk, Grey Falcon, Eastern Grass Owl and Sooty Owl populations.

DDT, a persistent pesticide, has been used in copious quantities on a world-wide basis. Being top-order predators, raptors are particularly susceptible to DDT accumulation in their body tissue. The ingestion of large sublethal doses of DDT causes raptors to become sterile, suffer serious behavioural changes, or lay eggs with very thin shells. If a bird attempts to incubate these thin-shelled eggs, its body weight crushes them, the result being that no young birds are recruited into the population to replace losses of older birds due to old age, predation and disease.

In this way, the numbers of American Peregrines have been decimated to an estimated five to ten per cent of the original pre-DDT population level. The Australian Bureau of Statistics has records of over 12,500 tonnes of this insidious chemical being spread over our countryside in the 20 years prior to 1982. The impact of this practice will be obvious for many years to come as this persistent toxin wends its way through out ecosystems. DDT is now perhaps the most widely distributed synthetic compound in the world. It has even been detected in the tissues of Antarctic penguins.

Other types of poisoning also affect raptor populations. Pesticides continue to be used deliberately (and quite illegally) in baits to kill birds of prey — as opposed to those legitimately applied in agricultural practice. Several cases of death due to lead poisoning as a direct result of consuming prey carrying shotgun pellets have also been reported.

The last limiting factor to consider is predation. Natural agents account for a minor proportion of

This Masked Owl has used its powerful talons to secure a rat for dinner. This is the Tasmanian variety, which is larger than the mainland form. Photo: D. Watts NPIAW.



The Eastern Grass Owl is considered vulnerable and rare due to habitat alteration and destruction. Photo: H. & J. Beste NPIAW.





The Australian (or Nankeen) Kestrel, Australia's smallest falcon and bird of prey, has just caught a small lizard. Photo: H. & J. Beste NPIAW.

raptor mortality. Some birds go down to parasites and disease, while small numbers may be killed by other raptors, mammal carnivores and reptiles. (Death in immature birds is usually the result of accidents caused by inexperience.) Predation by man is the ugliest and most avoidable cause of mortality.

Raptors are variously regarded as sheep, chicken and racing pigeon killers, or just good targets for vandals. Steel-jaw traps are set on fence posts (a favoured perch for raptors in open country). Birds landing on the traps score two broken legs and a slow death. It is thought by an officer of the Tasmanian National Parks and Wildlife Service that local bounties of between \$20 and \$50 are paid to trappers by pigeon racing devotees for dead raptors. One recent case involved a trapper who, using steel-jaw traps set around a live pigeon lure, caught and killed a Swamp Harrier (a type of hawk), a Tiger Cat and a Tasmanian Devil in one fell swoop. He in turn was caught by rangers, prosecuted and fined the paltry sum of \$225 for his offences. Trapping and shooting in Tasmania possibly kills 20 to 30 Peregrines and several hundred other raptor species annually.

Wedge-tails have long been regarded as "sheep killers". However, research studies indicate that they generally take sick or weak lambs (which would not have sur-

vived in any case) or feed on lambs already dead. Predation on live lambs accounts for one or two per cent of lamb mortality. Other studies indicate that feral pigs and, to a lesser extent, marauding dogs are the major predators of lambs, healthy or sick. Thankfully, whether due to the dissemination of this information or the introduction of protective legislation, the sight of dead Wedge-tails hanging on fences, once a standard feature of rural landscapes, is becoming less common. However, graziers in some parts of central and northwestern Queensland still go to great lengths to persecute Wedge-tails, including hunting them from light planes.

The humble egg collector is another limiting factor for raptor populations. Predictably, the rarer a species becomes, the more valuable are their eggs and, ironically, because of its "threatened" status, a species can be pushed closer to extinction. Among the 10,000 eggs recently confiscated from a New South Wales collector, were found 17 Peregrine Falcon and 38 Osprey eggs. The New South Wales National Parks and Wildlife Service estimates that in New South Wales alone collectors hold over half a million eggs of various bird species.

Illegal falconers can also be regarded as a predatorial threat. In order to obtain birds for hunting, raptor nests are robbed of young. This may be done legally under

licence in some North American States but, in countries where falconry is illegal, this practice places pressures on wild populations and is sometimes difficult to monitor.

Road kills can be a significant cause of mortality in some raptor species. Attracted to roadsides by dead animals killed by cars, they too become victims. Unfortunately, there seems to be no remedy for this type of carnage.

Legal eagle

Considering all these limiting factors, their proven and potential impact on raptor populations, it is obvious that the continued existence of some species might be threatened. Illustrating this is the fact that, of the 24 species of diurnal raptors in Australia, nine have been listed as "Vulnerable and Rare" under Schedule 12 of the *New South Wales National Parks and Wildlife Act 1974*. The list includes the Osprey, Pacific Baza, Brahminy Kite, Square-tailed Kite, Black-breasted Buzzard, Red Goshawk, Black Falcon, Peregrine Falcon and Grey Falcon. Of the eight species of owl found in Australia, four are also listed as "Vulnerable and Rare" (Powerful, Masked, Eastern Grass and Sooty Owls). One further species and two subspecies of owl are listed as "Species of Special Concern" (Rufous, Christmas Island and Norfolk Island Boobook Owls). The White-bellied Sea Eagle also comes into this category.

To briefly summarise the protective legislation pertaining to raptors is difficult due to the fact that each State has its own Fauna Authority, with its own laws and penalties. However, in most States all raptors have "Protected Species" status. The exception is Western Australia where an open season on Wedge-tails and Brown Goshawks exists.

It is an offence to take, kill, injure, restrain, or hold protected species. Many States extend this protection to specifically cover raptor young, parts of birds (skins, feathers, etc.), eggs and parts of eggs. In some instances it is an offence to disturb or molest birds. The Victorian Department of Fisheries and Wildlife closes the breeding areas of certain "Notable Species" during their breeding seasons. Rock-climbers, for example, might disturb Peregrine Falcons attempting to nest on cliff faces. South Australia has specifically legislated to outlaw falconry. New South Wales legislation provides a maximum penalty of \$4,000 and/or 12 months imprisonment for

offences against "Endangered Fauna". Victorian fines for offences against similarly protected species may be as high as \$5,000, with an additional \$500 for each additional animal or part thereof.

Lending a helping talon

Besides the passive assistance offered by protective legislation, other more active methods are being used to aid the raptors' survival.

In the United States, where the Peregrine Falcon population has been decimated through pesticide use, there has been a concerted effort by many groups and individuals to implement the options available to conserve threatened species. Highly successful captive breeding techniques and other relevant research are funded privately by the "Peregrine Fund Inc.", supported by hundreds of private contributors, institutions and

corporations. The best publicised activity of the Fund is the captive breeding and release of Peregrines on a nation-wide basis. The breeding technique involves "imprinting" young male and female Peregrines on human sexual surrogates to reduce the variables of natural mating, such as pair compatibility. The collection of semen and the fertilisation of eggs involve interludes between imprinted birds and their human "sexual partners". Imprinted females can lay up to 14 eggs, which can then be incubated artificially. Captive-bred birds have even been released from the top of high-rise buildings in Chicago and Minnesota. Approximately 250 artificially bred and raised Peregrines are liberated in the North American wilds, and not so wilds, annually.

In Australia, research is currently underway to investigate the possibilities for captive breeding of our native raptors. One such project,

presently only in its incipient stages, will hopefully develop and standardise artificial insemination techniques for captive breeding. The approach will differ from that used in the United States, insofar as the birds are not imprinted, the males being manually ejaculated — a technique borrowed from the poultry industry.

While no population of Australian raptor is threatened sufficiently to warrant the application of these measures, having the techniques perfected and personnel trained in their use, will greatly reduce the research lead in time should they ever become necessary. Other researchers have been working for some years on raptor breeding by simply allowing or inducing paired

The Brown (or Australian) Goshawk. An open season exists for Brown Goshawks in Western Australia. Photo: P. Klapste NPIAW.





"Female Peregrine Soaring", Sierra Gap, Grampians, Victoria, by Richard Weatherly. This painting is reproduced with permission from Macquarie Heritage Productions and will be incorporated later this year in a porcelain plate collection.

birds to mate under captive conditions. In this way, Peregrine Falcons, Brown Goshawks and Australian Kestrels have been bred.

Rehabilitation is another method used to assist raptor conservation. Training methods adapted from the practice of falconry are used on some species to bring injured birds (victims of collisions with vehicles, gunshot wounds, etc.) up to condition for re-release into the bush. Except where a species is highly endangered, rehabilitation probably does not influence the size of wild populations overall. These birds

service more important roles in education, scientific research and public relations.

Other conservationists are involved with various projects that entail the capture, banding and release of birds of prey. The information gained provides insights into territory requirements, juvenile mortality and dispersion, and other aspects of the birds' ecologies, and provides a basis for the sound management of their populations.

The Australian Raptor Association, with over 200 members, publishes a quarterly newsletter,

which serves to disseminate details of research projects and observations of raptor behaviour and ecology. The promotion of public interest and education regarding progress and problems in this area is essential. Most importantly, it must be emphasised that the responsibility for conserving our native fauna should not be heaped on the shoulders of a handful of individuals. Saving our natural heritage is the responsibility of us all, of this and successive generations. □



Sguminipe, ready for action. Photo: Steven Van Dyck.

“... she shall have murids wherever she goes”

RAT CATCHING IN PAPUA NEW GUINEA

by Steven Van Dyck, Queensland Museum

Male Telefomin of West Sepik Province of Papua New Guinea have a distinct revulsion for rats. They will neither eat nor hunt them — tasks that have been left to the women. This story is about one such woman, Sguminipe who, with able machete and nimble fingerwork, demonstrated her bushcraft in catching the juicy evening meal.



The village of Ofektaman, West Sepik Province, Papua New Guinea. Photo: Steven Van Dyck.

How quickly the first trip to Papua New Guinea brings soaring mammalogists firmly down to Earth! With heads swimming in preposterous dreams of its bizarre fauna and legs buckling under the load of modern trapping gadgetries, all soon twig to lesson number one; it is the people in whose villages we are guests that are the experts — the virtuosi of collectors and ecologists. It was little wonder that, on checking out our modest returns, they discretely scratched their heads and puzzled as to how Europeans ever became so plump.

In this context, it was an Ofektaman woman called Sguminipe, whose ability to catch rats made all our aluminium traps, our delicatessen of baits and our arsenal of weapons look like extravagant toys for spoiled children! In two days she caught (by hand!) more murid rodents than our combined efforts and paraphernalia had amassed in five weeks.

Her small village of Ofektaman, at approximately 1,500 metres, nestles breathtakingly into the side of the Donner Mountains about 15 kilometres north-west of Telefomin in the West Sepik Province of Papua New Guinea. The initial warmth and hospitality of the villagers of Ofektaman to our presence belied a disquiet among them that wasn't made known to us until the second morning. Willok, a young Telefomin man whom we had employed to hunt for

us, put it this way: "The people of this village are frightened. They have never had white hunters living and hunting with them. They are scared that if you have an accident you will return to your people and tell them that we did not look after you, and they will be angry with us. So we will go hunting today and you will stay here in the house. Don't be frightened, I have told all the others and no one will come and kill you."

Here was West Sepik diplomacy at its finest. Some of the old villagers may have shared this concern but those who had taken us out hunting the night before, who had seen us stumble around in the dark, who had heard the cracking and crunching generated from under what must have been jack boots on our feet, and who had listened to us retching for breath after the horrendous mountainside climbs, realised that, when it came to efficient hunting, we constituted impedimenta!

But, under our protests of anticipated boredom, Sguminipe, wife of the headman's brother, was prepared (and slightly embarrassed) to have us follow her while she searched for rats during the day. Rats are despised by menfolk and eaten by only women and children. This apparent male revulsion for rats extended even to rodents the size of *Hyomys goliath* which could provide a meal tipping the scales at about one kilogram and which produced

a single dependent offspring as big as a guinea-pig.

Equipped with her only tool, a machete, she strode away from the village to her family's taro garden a kilometre away. From there she (and we) scrambled down steep creek-bank slopes choked with bamboo and vines, until she located a small cryptic hole in the bank. A crypt indeed for rats! She slashed at a sapling with the machete and made a short, sharp digging stick. Then she began to widen the 60 millimetre hole and rip the soil from above its tunnel. As she followed the tunnel along she loosened the soil by stabbing with the stick, she hacked roots with the machete and tore away the overburden. After following about two metres of straight, unbranching tunnel she plunged her arm up the passage and announced "Ilam". Her flashing grin precluded something noxious and reptilian but her withdrawing hand gripped only a bunch of dry bamboo leaves. In our artless excitement we urged her to go back and pull out whatever lived in there. But instead she blocked the passage with a clod and began to clear away all the leaf-litter and sticks from the area immediately above where the dry bamboo leaves had come from underground. When a few square metres had been carefully and completely cleared she pointed to a tiny hole, no wider than a walnut, about a metre away in the

Sguminipe, excavating a rat burrow. Photo: Steven Van Dyck.

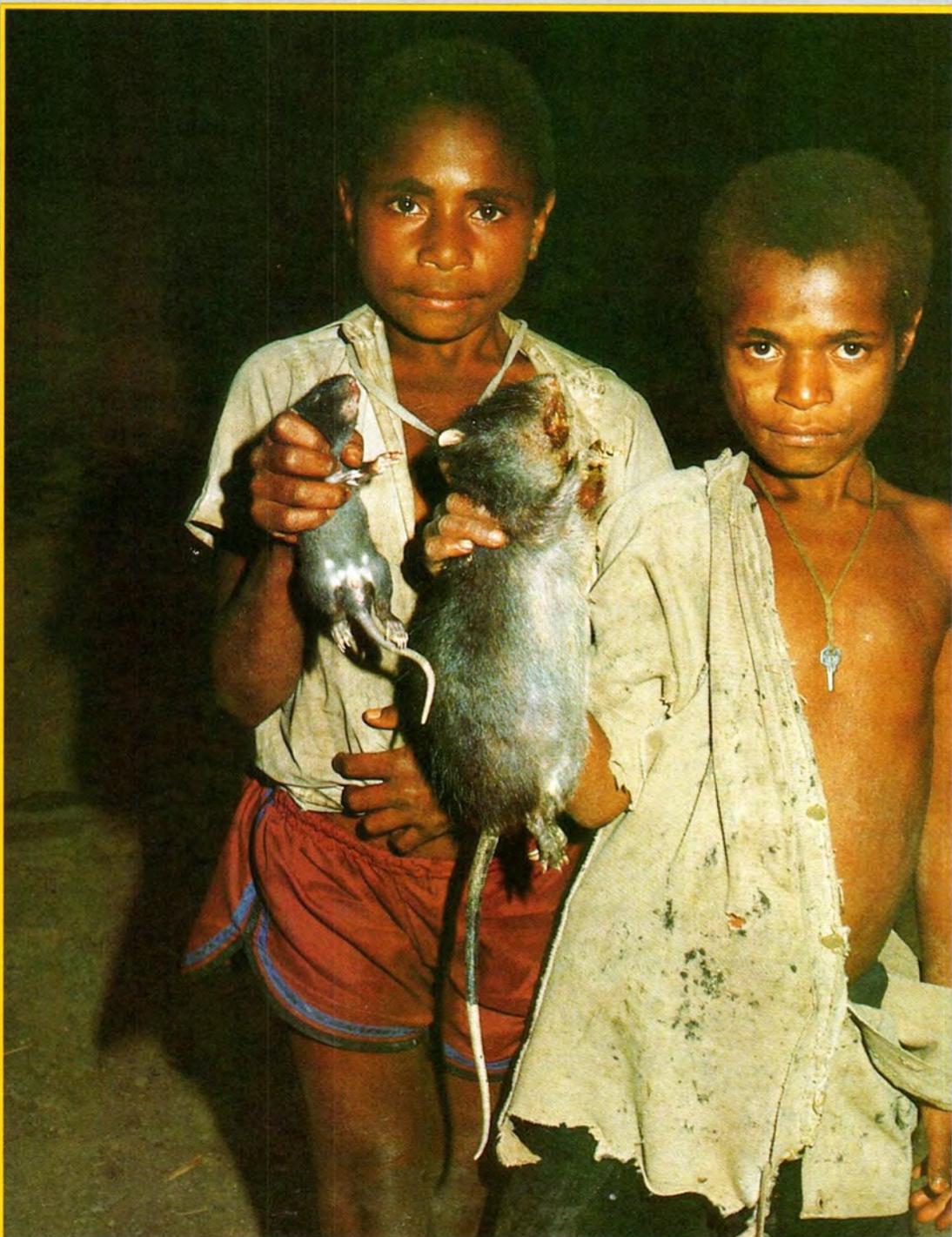
soil. Paying it no further attention she unplugged the main tunnel and thrust her left arm in. For the next minute, Sguminipe's twitching biceps and changing facial expressions told the tale of the battle going on underground. But her eye caught signs of activity at the walnut-size hole, whereupon her free right hand slammed down on a rat as it popped out through the escape exit. She hovered over the hole for a while, but when no more appeared she withdrew the other hand that had plugged the main tunnel. We expected the twitching escapee to be reunited with its nest-mate possibly coming up in the left hand, but in true Dagwood Sandwich style the left hand paraded five throttled rats, one dangling between each finger and the fifth crushed into the palm by the others.

Altogether in that single leafy nest were five adult males and one adult female *Pogonomys sylvestris*, a medium-sized, semi-arboreal rat of forest and disturbed areas. Sguminipe repeated the procedure on the opposite bank catching a female with two furred but suckling young. (The squeaking babies were kept alive to be given as playthings to children back at the village.) By the end of the day, she had caught 28.

That night Sguminipe ate the rats, but we ate humble pie.□

Tim Flannery (Australian Museum) and Martin Krogh (University of New South Wales) accompanied me on this expedition to Papua New Guinea, which was financed by the National Geographic Society and the Linnean Society of New South Wales. Mike Archer (U.N.S.W.) obtained the National Geographic Society grant. Don Gardener (Australian National University) couldn't have done more to help bridge our cultural and language gaps and Robert Attenborough (A.N.U.) was a tower of moral support. Dan Jorgensen (University of Ontario) and Tony Friend (Telefomin) also helped us greatly.

Ofektaman boys with freshly caught rats (*Hyomys goliath*). Photo: Steven Van Dyck.



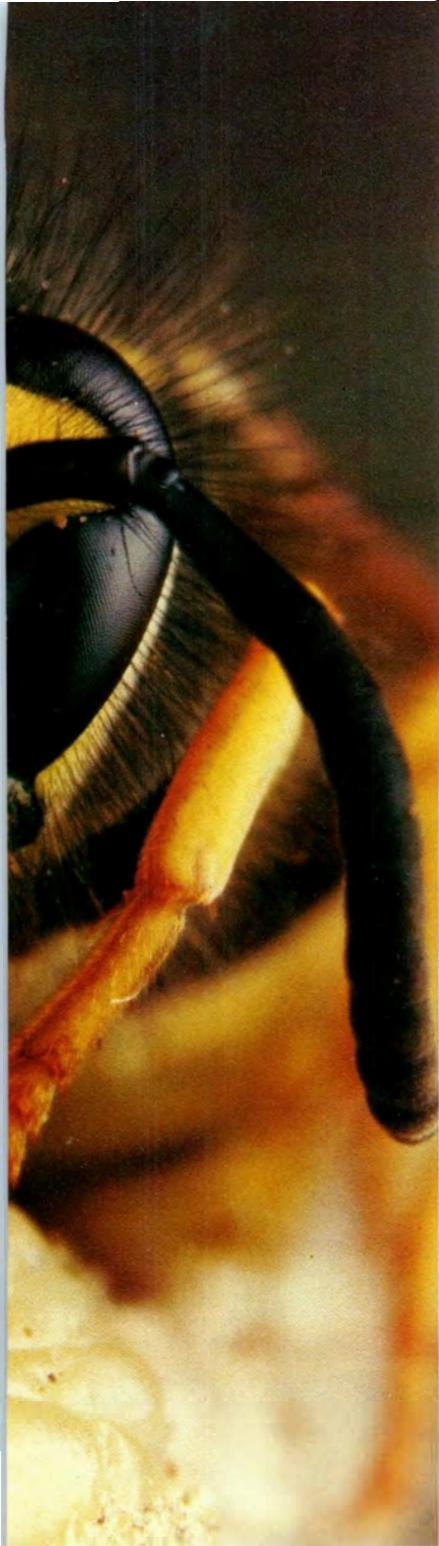


THE SWEET-TOOTH INVADER

European Wasp Spreads at Alarming Rate

by Geoff Holloway

They are fearless, contemptuous of humans and dive cavalierly into the midst of barbecue groups, even carrying off pieces of sausage. They have quickly established themselves in many parts of southern Australia and in recent months have spread quickly throughout metropolitan Sydney. The European Wasp is an exotic pest that is having an impact on the honey industry and is a major social pest in open-air situations. Mainstream media has labelled this aggressive insect a killer. No human deaths have yet occurred in Australia and the number of reported stinging attacks has been remarkably low. Wasp expert, Australian Museum entomologist Geoff Holloway receives hundreds of phone calls each week from distressed Sydney-siders whose residences have become home to this sweet-tooth invader. Geoff reports on the latest developments for Australian Natural History.



◀ A queen (on the left) and worker. The worker is in the process of feeding a larva. Photo: Otto Rogge.

Wodonga and a nest was recently found in Canberra.

It is believed the wasp was first introduced to Australia from New Zealand cargo, arriving in Tasmania in 1959. The first Sydney sighting was in 1975, and for Melbourne and Perth 1977.

This introduced insect, which is native to Europe, north Africa and temperate Asia, has flourished in Australia because of the amenable climate. In Europe, the harsh winters wipe out most nests each year, leaving only the dormant queens to re-establish the colony in spring. With the milder Australian climate, the nests can survive and grow from year to year.

The European Wasp is a social insect, living in large colonies with female wasps minding the brood that is not their own, opening the way for division of labour. Some members of the colony forage for food, some forage for nesting material, others clean and maintain the nest. The colony possesses a caste system where individuals are physically different according to their role in the colony.

Bees, ants and wasps have a mechanism for sex determination that is well suited to this caste system. Usually, for most insects, only

fertilised eggs hatch, producing male or female offspring according to their sex chromosomes. Bees, ants and wasps, however, produce females from fertilised and males from unfertilised eggs. It is necessary for the founding female or queen in a social colony to store sperm she receives at mating in a small sac attached to her oviduct. The queen then releases the sperm as required to produce male or female eggs. The life of the wasp colony is regulated throughout the year by the queen's control over the sex of her offspring. Unlike the common Honey Bee, there is more than one queen in the wasp colony; towards autumn there are often more than 1,000 reproductive females.

European Wasps construct large nests, up to 60 centimetres in diameter, usually underground, and occasionally in buildings or in hollow trees. In their native habitat, European Wasps build their nests in the ground and are subject to natural predators such as hedgehogs and parasites, while a related species, *V. vulgaris*, construct their nests in buildings and trees.

In Australia there are no natural predators to attack and feed on the wasp. Authorities here are monitoring New Zealand experiments where a parasitic insect has been introduced in an attempt to control wasp populations.

The European Wasp is a strong flier. With its legs drawn in towards the body it returns to the nest carrying either food for the larvae or nest-building material between its mandibles. Photo: Otto Rogge.



Recent sightings by the public of the European Wasp (*Vespa germanica*) suggest a rapid colonisation into New South Wales. While last year 184 nests were reported throughout the State, for the first three months alone in 1985 there have been 187 sightings. The majority of these were from the Sydney metropolitan areas around the Georges River/Port Hacking, the inner city and northern suburbs.

The European Wasp is now widespread in Tasmania, southern Victoria and Sydney south to Wollongong, south-west to Bowral, Mittagong and north to Gosford. New South Wales and Victoria have also experienced isolated outbreaks in Forbes, the Riverina, Goulburn, Sunraysia and

The worker wasps often take strips from meat to feed
▼ to the larvae. Photo: Otto Rogge.



To overcome the cold and severe winters of Europe, the wasp nest is deserted in late autumn and the queens hibernate over winter in woodpiles, roofs, sheds, under bark or motor vehicles and even in the folds of curtains. Few queens survive the European winter due to predators, lack of food and unsuitable nest sites. Queens that do survive construct the initial cells of the nest on a small stalk or peduncle in much the same way as their relatives, the Paper Nest Wasps, do in Australia.

The initial 10 to 12 cells are con-



▲ The European Wasp colony at its peak may consist of 20,000 or more individuals. The cells covered by white caps contain pupae, and those uncovered reveal the larvae. Photo: Otto Rogge.

◀ The hexagonal cells are usually capped when the occupant is in the pupal stage. Here the cells have been opened to show the pupae in different stages of development. Photo: Otto Rogge.

structed from chewed wood with a fertilised egg layed in each cell. Each larva is progressively fed by the founding queen until they enter the pupal stage. The queen limits the quantity of food she supplies to the larvae such that the adult females emerge from the pupae smaller in size than the queen and sexually incapable of producing eggs. These are the workers which take over nest construction, cleaning, foraging for food and nesting

materials, feeding the larvae and defence of the nest.

Often the workers are the only individuals outside the nest, although queens may be seen during late summer to early winter in the warmer parts of Australia.

During autumn, the queens lay unfertilised eggs that develop into males. The only duty of the male is to mate with the queen. The majority of individuals produced from spring to early autumn are workers and queens, the workers outnumbering the queens by a ratio of up to 20:1.

The larger cells for the development of queens and males are found on the lower tiers of the papier-mache nest, with about 500 to 900 cells per tier and usually

seven to eight tiers constructed in a season. The papier-mache jacket that covers the nest consists of timber taken from trees, paling fences and even telegraph poles. This is masticated and mixed with saliva.

By working in the same direction as the grain the wasp rolls up the stripped timber with its mouth parts and flies back to the nest. After being chewed to a pulp the timber is added to the nest. The entrance is usually at the bottom of the nest.

Both in Europe and Australia males are produced in large numbers in autumn. In Australia, however, the queens may not leave the nest at this time to hibernate over the winter. It appears the queens leave the colony after the third year. By this time the original colony numbers some 20,000 or more individuals, over 1,000 being queens.

The workers forage for protein food and will often be found on meat, fish, mature fruit, sweet foods as well as being attracted to soft drinks, fruit juices and beer. Having gathered sufficient food or nesting

material the workers will usually fly in a direct path back to the colony. The nest can often be found by observing the flight path.

When present in large numbers, wasps are aggressive pests, especially when feeding on ripe fruit or in weak bee hives with depleted numbers. Being a voracious feeder, the European Wasp represents a serious threat to the honey industry by robbing the hive of its contents. The wasps will also enter houses, factories and shops and disturb pets while they are feeding. Several animals have died after being stung in the mouth.

The wasp will usually only sting human beings when the nest is disturbed or if foraging workers are threatened. In some areas of Australia, however, they have threatened the outdoor tradition of the Aussie barbecue. A wasp may enter an opened soft drink or beer can and, not surprisingly, may be ingested with the owner's next sip. If the wasp stings the mouth or throat, swelling usually results which can impede breathing.

European Wasp venom is a mixture of histamines and other active chemicals and is injected under the skin by means of the ovipositor on the posterior end of the female wasp. Unlike the common Honey Bee, which loses its stinging apparatus, wasps can make repeated stings. A red mark will appear at the site of the painful sting. Swelling may occur and linger for a week or so. The pain may last for several hours.

Some victims will show an allergic response to the venom, causing general puffiness of the skin well beyond the site of the sting. An asthma-like condition may develop and medical advice should be sought as soon as possible.

The Department of Agriculture in each State is monitoring the distribution of the wasp as well as reviewing control methods. All sightings of nests should be reported to local councils and advice on control measures can be obtained from the Department of Agriculture in your State. □

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BULLDOG ANTS

Beware their painful stings and powerful bites



by John Freeland

Most people seem to think there are two kinds of bulldog ants: the "reddies" and the "blackies". They argue about the relative severity of their stings and children put different kinds in a jar, shaking them to make them fight . . . Result? Two dead ants. However, there may be 50 to 100 species of bulldog and jumper ants in the genus *Myrmecia*, all confined to Australia except one in New Caledonia. The largest species are called "bulldogs" because of the tenacious grip with their mandibles, though they sting from the rear end, and because they emerge like a pack of dogs to defend their nest. The term is often abbreviated to "bullants" or "bulljoes". In Tasmania the large species are called "inchmen" and the smaller ones "jack jumpers". Some of the small kinds have a skipping movement when excited, hence the nickname "jumpers".

The genus, until recently, vied with another Australian one, *Amblyopone*, for the honour of being the most primitive ant group available for study . . . a typical example of the Australian biological inverted snobbery! In 1978 Dr Robert Taylor of the CSIRO rediscovered *Nothomyrmecia macrops* in South Australia.

This species had been known for about 40 years from two (only) dead specimens in the Museum of Victoria. It is thought to be even more primitive and is yielding valuable information for Dr Taylor. It has enabled him to postulate changes to the family tree of the ant subfamilies. Ants are believed to have evolved from solitary wasps and *Nothomyrmecia* is very wasp-like. Next come *Amblyopone* and *Myrmecia*. However, because of their usually large size, often diurnal foraging, their aggression and alert-looking movements, the bulldogs and jumpers are the most wasp-like to the casual observer. Though they are morphologically and behaviourally very generalised, their specialised mandibles and some of their habits (to be described below), together with the fact that a few species are parasitic on other *Myrmecia* species, suggest a degree of derived specialisation. Therefore, they are probably an early side branch of ant evolution.

Before we can be sure about the number of species of *Myrmecia* there are, much research will be needed using morphological, statistical and even biochemical and chromosomal techniques. Without

At the ready! This *Myrmecia gulosa* worker may have been alerted by vibration of the ground or by an "alarm substance" from the mandibular glands of nest mates. Photo: Kathie Atkinson.

such work, it is often difficult to tell whether one is looking at geographical variation within one species or several species resembling each other very closely. This is further complicated by Mullerian mimicry.

The common form of protective mimicry is Batesian mimicry, whereby an innocuous species looks or smells to a would-be predator like a distasteful or a dangerous one. In Mullerian mimicry, however, both the mimic and model are hazardous prey, and they engage in mutual advertising. ("If you've encountered something like us before, you'd be wise to leave us alone.")

Consequently, in a given locality, several species of bulldog ants can look very much alike at a casual glance. There are examples where one species can vary from jet black through dark, reddish-brown to bright brick red, orange or even yellowish, according to what other *Myrmecia* species are in the vicinity.

Thus there may be a non-varying model species or three or four species may *all* mimic one another.

A few *Myrmecia* species are very stable for colour and can be recognised promptly. One example is the common, red, diurnal *M. gulosa* (pictured) of the sandstone areas of coastal New South Wales and Queensland. It builds conspicuous nest mounds "decorated" with *Eucalyptus* fruits, leaves, twigs, pebbles, charcoal fragments, etc., and is the kind that usually attacks picnickers.

Another constant for colouration is *M. tarsata*, the common metallic green-blackish one with yellowish mandibles and an orange tip to the abdomen. It tends to occur near iron bark eucalypts in Wianamata Shale. This species is often mimicked by a few others which, however, lack the detailed colouring just described.

Many species are predominantly nocturnal or dull weather foragers. So these and the more timid, smaller kinds are often unnoticed by the layperson. All *Myrmecia* species capture and sting insects or other arthropods and take them home, placing them on the piles of larvae

in their nest chambers. The larvae puncture the prey with their tiny mandibles and suck out the body juices. Workers, queens and males may then join in the feast.

Species vary in the kinds of prey selected. Some, like *M. gulosa*, being very generalised, and some others probably rather specialised in their tastes. They also take moist matter, such as water and exudations from plants or sedentary, plant-sucking bugs, for example, lerps, waxes and scales. They will drink the sap of a gum tree where a cicada has fed and flown away, leaving a wet patch on the bark. It is also likely that they would imbibe the juice of damaged, succulent fruits.

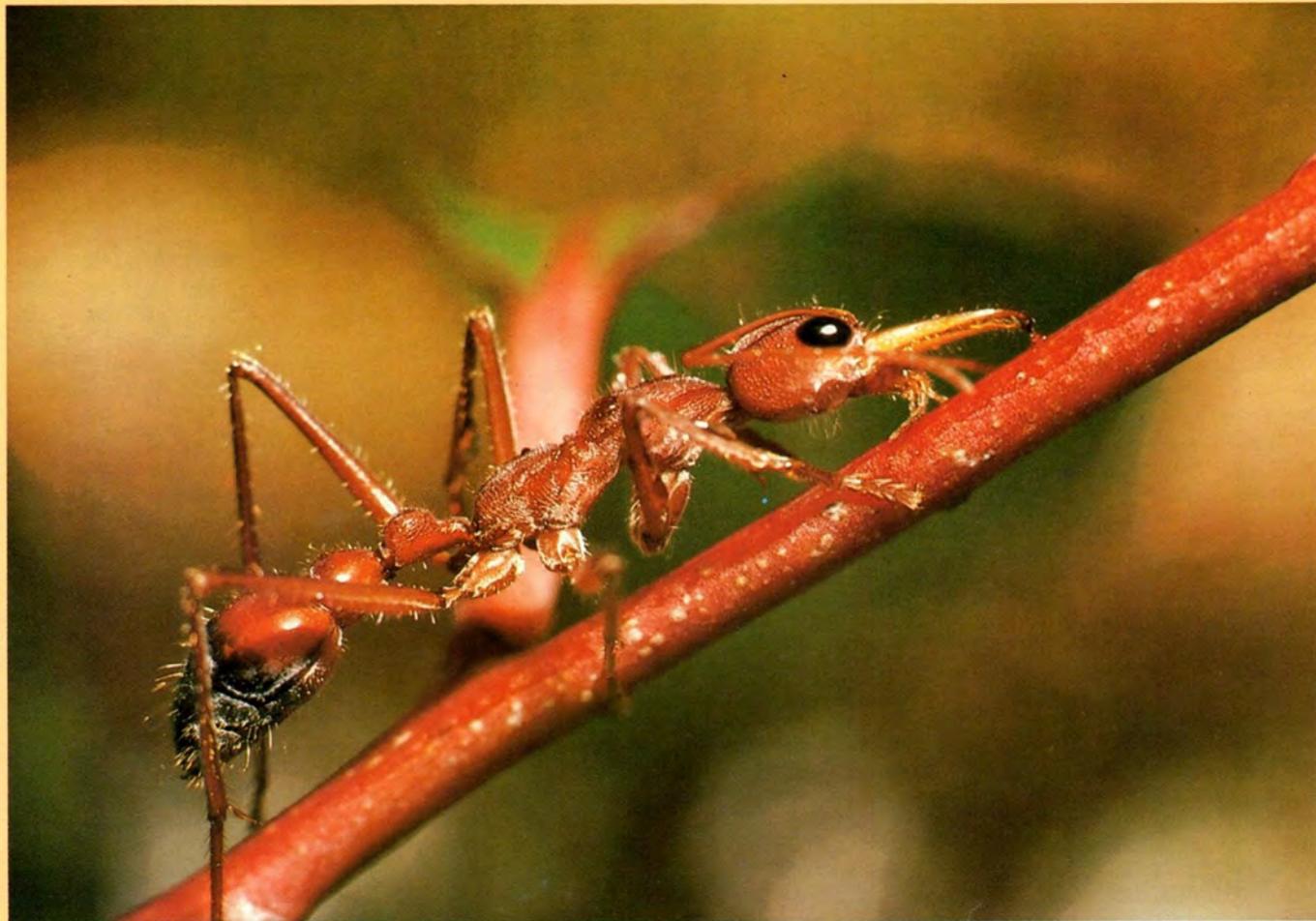
All foods pass into the crop before going into the stomach proper. In the higher ants, food is regurgitated from the crop to larvae, queens or other adults. This and mutual grooming probably pass chemicals of workers, brood and queen, as well as food, throughout the colony. This possibly provides colony odour for colony recognition. It seems to account for the fact that individuals of the same species, but different colonies, are usually expelled. At the University of

New South Wales, research is being carried out into the origin of colony odour.

In *Myrmecia*, instead of regurgitation, workers and queens of many species lay soft eggs that they deliver with their own mandibles and present to the larvae or are taken with or without prior solicitation by other adults. Solicitation consists of antennal stroking about the head of the hopeful donor and palpation ("licking" with the palps) of its mandibles. The supplier then doubles its abdomen forward between its legs and the recipient takes the egg material with its mouth parts and consumes it.

It has long been believed that though some *Myrmecia* species did feed from the crop, it was a poorly developed process compared with that of the more highly social ant groups. In some ways *Myrmecia* colonies seem less tightly knit than those of the higher ants. However, my unpublished notes show that ingluvial (crop) feeding is very highly developed indeed in at least *M. brevinoda* and *M. pyriformis* when studied in observation nests. Queens and workers can regurgitate enough liquid or viscous matter to

A bulldog ant, *Myrmecia gulosa*, shown imbibing moist matter using its palps. The moist matter may be a sweet exudation from a passing, sap-sucking bug. Photo: Kathie Atkinson.





feed up to at least six small to medium larvae at once. This food is held by surface tension between the mandibles whilst the larvae poke their mouths up into it. Two or three adults may simultaneously feed from a nest mate. These two species also very rarely practise solicitation for egg material. Alimentary eggs, by the way, could be media for chemical dispersal through a colony. I suspect that the mandible shape for some species is somewhat specialised to retain a large amount of

regurgitated matter for food transference. Other factors for determining different mandibular patterns within the genus could relate to predation preferences. Ant mandibles are used for digging, gripping, carrying, biting, manipulating brood and various other functions. They may even rival the versatility of an elephant's trunk!

As is true for science generally, certainly what we know about *Myrmecia* mostly highlights what we don't. And, with so much of what we

The two large compound eyes render *Myrmecia* species much more responsive, visually, to movement than most other ants. The many setae (false hairs) seem mainly sensory. Photo: Kathie Atkinson.

know being more suspicion than certainty, the need is clearly great for more research into many genetic, physiological, anatomic, ecological and behavioural aspects of these dramatically appealing beastsies. □

RARE & ENDANGERED

THE BLACK-STRIPED SNAKE

The Black-striped Snake, *Neelaps calonotus*, is one of the smallest Australian representatives of the front-fanged, venomous land snakes that comprise the family Elapidae. It is an oviparous species, producing two to five eggs in December/January. *Neelaps calonotus* belongs to an assemblage of small, brightly coloured species and is one of the most distinctively marked Australian snakes. It is characterised, as its descriptive name suggests, by a black head and a bold, black vertebral line that extends from the neck along the entire length of the body and tail. In some individuals the vertebral stripe may be discontinuous. The background body colour is bright pinkish-orange, fading laterally to a cream belly. Apart from the head and neck, the dorsal body scales have a white spot resulting in an intricately reticulated overall body pattern.

Although technically venomous, it is doubtful whether the size of the venom fangs or strength of the jaws is adequate to cause harm to man beyond causing mild local swelling.

The Black-striped Snake is indigenous to Western Australia

where it is restricted to a narrow belt of coastal scrub in the south-west of the State from Lancelin in the north to Safety Bay south of Perth. The total known range of this species is approximately 160 kilometres. Specimens are occasionally recorded within metropolitan Perth. There is a record in the Western Australian Museum of a specimen collected at York, 100 kilometres east of Perth. This may suggest an isolated population east of the Darling Ranges; however, as there is no other record of *N. calonotus* from this area the population may no longer be extant or possibly the original locality information is erroneous.

The preferred habitat of *N. calonotus* appears to be deep, white coastal sand that supports *Banksia* woodland. The Black-striped Snake is well-adapted to its fossorial (burrowing) habit, which is further facilitated by the sandy soil in which it occurs. The food habits of *N. calonotus* also reflect its fossorial existence, the exclusive prey items being slender-bodied, burrowing scincid and pygopodid lizards belonging to the genera *Lerista* and *Aprasia* respectively.

The Black-striped Snake is protected by Western Australian legislation under which it is gazetted a rare species. It is also included among taxa recognised by the Australian Council of Nature Conservation Ministers as endangered fauna. The principle threat to the conservation of *N. calonotus* is loss of habitat caused by residential and rural development. A secondary pressure threatening this species is unregulated, illegal collecting. Owing to its gentle nature and great beauty, this small snake is popular amongst owners of terraria and is keenly sought by amateur and professional collectors alike. Because of its limited geographic distribution, which coincides with a region in Western Australia of greatest human population density, *N. calonotus* must be regarded as vulnerable to any change in land use that may reduce even further the extent of suitable habitat. □

Robert Jenkins
Canberra College of
Advanced Education

The Black-striped Snake, *Neelaps calonotus*, from Lancelin, Western Australia. Photo: Hal Cogger.





ROBYN WILLIAMS

The Gullibility Factor — Sheldrake's Morphogenetic Field

A.B.C. RADIO SCIENCE SHOW

My heart sank when I saw it. I knew there would be trouble but there was no way I could avoid him now. Sheldrake. Rupert Sheldrake and his "New Science of Life". There was the tape, on my desk — an interview with the man himself, stating his case in clear and reasonable phrases. Broadcast it I must, whatever my own reservations. The journal *Nature* had recommended that Sheldrake's books be burned and I was sure the scientific establishment would be cross if I gave his cause more thrust. But more than that, I knew we would suffer that most dreaded of consequences for ABC broadcasts: a reaction. Letters would flood, phones would go beserk, we'd be swamped in demand for information. And all because of "morphogenetic fields".

Sheldrake, you see, claims that biology cannot provide an adequate account of how complex organisms grow from single cells (fertilised eggs) into adult bodies with various organs and tissues. Each cell has the same genetic complement, so how can some become nose cells and others knee, bone or blood? I was always taught that the egg itself has an uneven distribution of certain matter, which then gets separated unequally in daughter cells, which thus gain differentiation from each other. Even the site of penetration by the sperm sets up polarisation. But the theory of classical embryology is not sufficient to explain the awesome precision of the process. Nor does it account for odd manifestations such as the slime moulds, which can spend some of their time as free-living cells then group together to form a multicellular body with substantial differentiation. How does the single cell know where to go? How does it know what role to play?

Sheldrake says it's a question of habit! The cells "know" where to go because zillions of cells have done it that way before and there's a kind of groove worn in the firmament of the universe. Nature need not have absolute laws like we know; they could be completely different. According to Sheldrake it's a case of doing something once and so creating a precedent. He also claims experimental proof for all this. Show rats a maze, let them learn to find their way in it, then take other rats that have no way of knowing the puzzle or its solution, and they'll

solve the problem more quickly than their predecessors. But why? Because, says Sheldrake, there's a kind of universal vibration as a result of the new knowledge. Innocent (naive) rats pick up this information like iron filings react to a magnetic field. Sheldrake calls it a "morphogenetic field". Things grow the way they do because other plants and animals have done so before.

But how do you know you're supposed to grow like a person and not like a beetroot? And how do you know which is the correct solution to a problem and not the countless wrong ones?

Put in another way: Phillip Adams wrote after the broadcast to say he'd had doubts at first but then, later in the afternoon, he'd gone yellow and discovered he spoke Chinese. A fair comment. If a quarter of the Earth's population is from China you'd expect, if Sheldrake's theory is correct, that we'd all tend toward the common type. Nature would favour conservatism and reject variety. Global vibrations of Chinese thought would dominate, there being a quarter of the Earth's population sending out a "I-have-learned-Chinese" message and Mandarin would quickly become the world's easiest language to learn.

Sheldrake, who's a Cambridge don (Clare College) and lectures in botany, has conducted some large-scale experiments in Britain and western Europe using television. A strange pattern is shown and the audience invited to discern a hidden form. The results of correct guesses are noted. This first showing, according to Sheldrake's hypothesis, has made the picture more learnable or detectable so, when shown a second time elsewhere to an audience without any previous experience of the image, they nonetheless

score higher. Like the rats in the maze, the audience learns more quickly because the effort has been made before and the world is somehow changed.

What about embryology then? Well, Sheldrake claims that developmental processes, once established, become almost routine. Proteins fold that way or the other because they've done so before. The laws of Nature are habits. The universe is like it is because God does indeed "play dice" with it. Einstein would be furious but quantum mechanics, the ultimate lottery, would seem to support the idea — except, in my opinion, when you push it too far. This is always the test for way-out or challenging theories. Do they try to explain simply the gaps that current scientific knowledge cannot fill? Or do they leap to cover every gap in sight: the world, the future and everything? Ask Sheldrake whether he thinks his theories account for ESP, reincarnation and the rest of the "paranormal" paraphernalia and he'll say "yes". Start with morphogenetic fields and you end up with fairies.

I quite like fairies, actually, but not in science. I took quite a deep breath to put Sheldrake on the Science Show, too. I did so because his ideas are a legitimate speculation in biology and have been mentioned, however harshly, in the best journals. But then, here's the point: the audience reaction was far greater than for nearly any other subject we've covered this year. Are people gullible? Do they desperately want to believe in fairies? Or do they simply enjoy a bit of romantic lateral thinking?

As usual, in a broadcast, I hedged my bets and, raising one eyebrow, noted that "Clare College has a strong religious tradition!". Very naughty. □



FORUM

Whitehouse: Image Update for National Parks?

It appears that conservation will take a high profile in the next few years of the Wran Government. An indication of this can be seen in the recent appointment of 32 year old John Whitehouse as Director of the New South Wales National Parks and Wildlife Service. A keen bushwalker, Whitehouse has had a meteoric rise to the top of the public service ladder. His early mentor was the late Paul Landa, for whom he worked as special advisor from 1976-1980 when Landa was a particularly active Minister for Planning and Environment. From that posting, Whitehouse rapidly rose through the ranks to become Assistant Director of the Department of Environment and Planning, at the ripe old age of 30. Whitehouse is also a member of the N.S.W. Heritage Council and Commissioner of the N.S.W. Water Resources Commission.

In this interview with A.N.H.'s Rob Thorman, Whitehouse discusses many of the contentious issues that face the N.P.W.S. in the lead up to the next State election.

Large areas of rainforest were reserved during the period under which Don Johnstone was Director of the New South Wales National Parks and Wildlife Service (N.P.W.S.). Do you have any goals for further acquisition of parklands while you are Director?

The question of expanding the Service in this State is a very important one. In many cases, the next five years will present the last opportunity in which we can make substantial additions to the park estate. Because development is proceeding at such a rate, particularly in the coastal part of the State, if we don't act soon, the opportunity will be forgone completely. In eastern N.S.W. the major expansion will occur in the Macleay Gorge country. The Government announced very recently its commitment to establish the Oxley National Park east of Armidale, constituting one of the remaining large areas of available country in eastern N.S.W. In coastal areas there are already a

number of reserves. Major scope exists for expansion of the park system into the west of the State.

What are the big gaps in habitat protection in the national parks system in N.S.W.?

There are significant gaps in the tablelands, slopes, plains and Western Division. But it depends on whether you're looking at individual species or broad plant communities. There are major gaps not merely in species terms but also in community terms in the western part of the State.

Some of the animals in the western district of N.S.W., such as the Mallee Fowl, require large areas of land to maintain viable breeding populations. Are N.S.W. national parks large enough to conserve species? A lot of clearing is still going on out in the west. Could a more integrated system of management take place, incorporating other landholders rather than just acquiring lands for national parks?

We certainly can't rely just on parks and reserves to meet all our conservation objectives. A number of other tools are available. Firstly,



Thirty-two year old Director of N.S.W. National Parks, John Whitehouse,

there is the wildlife refuge system — a voluntary system involving the protection of wildlife on private farming property. Secondly, there are arrangements with Government agencies for the co-operative management of other public lands, such as the Forestry Commission, Crown Lands Office and local councils that together own large quantities of natural country. Thirdly, there are other arrangements with Crown authorities for the controlled development of private land, such as the Department of Environment and Planning, local councils or the Western Lands Office.

The N.P.W.S. in N.S.W. has been under attack recently for its handling of the kangaroo harvesting industry, where it is in the position of policing a commercial operation. What do you think should be done to clean up the industry?

It's important to recognise that our role in the kangaroo industry is one of conservation only. We are interested in maintaining a viable population of kangaroos throughout N.S.W., thereby avoiding problems that would result from their uncontrolled slaughter by farmers and graziers or those due to commercial interests. The maintenance of viable kangaroo populations requires some management intervention — we must reduce population peaks, which have increased artificially and dramatically since European settlement. I'd like the Service to be removed, as far as possible, from the commercial aspects of the kangaroo industry.

Aboriginal communities have been discussing the possible establishment of an Aboriginal Heritage Commission to take over control of Aboriginal sites in N.S.W. Do you think such a handover is likely, and do you agree with this increase in Aboriginal control?

The Service, at present, is responsible for the management and protection of Aboriginal sites and I see this situation continuing. I can't see how sole responsibility for

Aboriginal sites can be transferred to any other organisation in a feasible way. The Service has a major on-the-ground field staff that spends a lot of its time in cultural resource management, and it would be very difficult to duplicate those arrangements in another agency.

The N.S.W. Government nominated the rainforests of N.S.W. to the World Heritage List. What are the benefits of listing rainforests on the World Heritage List rather than as national parks?

The major benefit lies with international recognition. It also provides for increased protection by virtue of the Commonwealth Government's obligations under the International Convention for the Protection of the World's Cultural and Natural Heritage. But primarily it's a question of recognising the outstanding conservation significance of the rainforests: that they are rare and unique on a world level.

While the rainforests aren't on the World Heritage List is there still a danger to them as they are not protected from State politics? If there was a change of Government could the rainforests be logged if protection was overturned?

At present State Government declaration of national parks can be reversed. Listing on the World Heritage List provides a degree of international protection for these rainforest parks and reserves. But I know that the overwhelming public support for the protection of rainforests is such that no Government would consider reversing those decisions or logging rare areas of N.S.W. rainforest.

The N.S.W. Government forwarded the nomination to the Federal Government at the end of last year. However, the nomination did not reach Paris by the January 1985 deadline. Was there a good reason for holding it up?

Well, the nomination reached the Commonwealth Government in November last year, around the time of a Federal election and Christmas, and sometimes things just don't go

through bureaucracies as speedily as we might hope. I'm sure the matter is now receiving adequate consideration by the Commonwealth.

Were the people in the Department of Environment and Planning and the N.P.W.S. in this State disappointed to have the nomination held up at Federal level?

Certainly we were disappointed that the nominations didn't proceed as there had been a great deal of effort put into preparing a most comprehensive and detailed nomination form.

Are you going to develop policies on wilderness in arid areas?

I hope that, within the next year or so, we can outline some of the options of the philosophy of wilderness in arid areas, and open public debate. There's been much discussion on the application of wilderness in the forested areas, and I hope we get a similar response from conservation groups, particularly the Wilderness Society, for the application in arid areas.

The national parks set-up in Australia is fragmented into States. Do

On the setting up of an Aboriginal Heritage Commission: "I can't see how sole responsibility for Aboriginal sites can be transferred to any other organisation in a feasible way."

A.L.P. national policy supports a National Wilderness Reserve System as a result of the last National Conference. What developments are there within the N.S.W. conservation movement to deal with wilderness management, and what interaction is there with other States to ensure that we have such a National Wilderness Reserve System?

Wilderness conservation has featured very prominently in N.S.W. since the publication of the Helman Report in 1976. Twenty major wilderness areas in eastern N.S.W. were identified, most of which, since then, have been declared national parks. The Service is also trying to apply the concept of wilderness to the arid parts of N.S.W. We've concentrated on the concept of wilderness in eastern Australia — the forested and timbered country on the tablelands, escarpment and coast. We now must look at the concept of wilderness in western N.S.W. as well. I think that N.S.W. has already made a major contribution towards wilderness conservation nationally.

you ever see a truly (that is literal) national parks organisation developing in Australia?

I think the States' constitutional responsibility for managing national parks will continue. We have more than enough to keep people busy in N.S.W. — and State governments have traditionally exercised those responsibilities.

Do you see a role for the N.P.W.S. in broad conservation issues that aren't necessarily confined to N.S.W.? For example, the conservation of the Murray River — looking at the river as a system rather than as a small pocket of River Red Gums protected by a park.

We have a responsibility for nature conservation and cultural conservation throughout the State. Our primary focus is on our parks and reserves for which we have management responsibility. But we provide policy advice to the Government on all conservation issues throughout the State.



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Letters

Koala Disease — Significance Misinterpreted

The article by Brown and Carrick, "Koala Disease Breakthrough" (ANH, Vol. 21, No. 8, 1985) gives the impression that chlamydial infections, perhaps aggravated by stress, have been responsible for drastic declines in Koala populations and endanger the survival of the species. It is possible (and, on ecological considerations, probable) that the authors have put the cart before the horse. A high incidence of disease may be the result of having too many Koalas in a particular area.

White Australians feel guilty for having slaughtered Koalas in the late 19th and early 20th centuries but it was because of their earlier activities that the species became sufficiently abundant to support a fur trade. Prior to European settlement, Koalas were preyed upon by the Aborigines and Dingos but, as the settlers displaced the Aborigines and reduced the Dingo populations, the density of Koalas increased in the areas of open forest that came under European domination. Between about 1860 and 1880 they became so abundant that, for the first time since settlement, it was economic to shoot them. It was also from about this time that we have the first records of epidemic disease.

What happened to the Koala was by no means peculiar. When an herbivorous species is released from predation, its population density increases until starvation, disease, stress, a decline in fertility, or any combination of these factors halts the expansion. Generally speaking, the welfare of a species is much more secure under a regime of steady predation than in

its absence — when populations tend to oscillate wildly, building up to intolerable peaks then either crashing dramatically or surviving at some intermediate level with a high incidence of disease and/or stress. In such circumstances, a species is not helped by medical intervention: this merely moves the population-limiting factors in the direction of starvation (as we have seen in many Third World human populations).

My unpalatable point is that complete protection of the Koala is not in the best interests of the species. In the absence of natural predators, we need to keep the populations below critical levels by a programme of culling. This does not necessarily mean killing. Surplus animals can be relocated in other areas but, obviously, this cannot go on forever: we must eventually run out of suitable vacant habitat.

Although we do not yet have sufficient information, it seems that those populations that are subject to a high incidence of disease live in well-forested areas that are seldom subjected to natural disasters. Where drought, bushfire or severe tropical storms periodically wreak havoc, Koala populations appear to be kept in check and thus avoid either starvation or a high level of infection.

I do not deny the scientific value of research on chlamydial infections of the Koala. I merely suggest that the significance of such infections may have been misinterpreted.

— Ronald Strahan
Australian Museum

poster

AUSTRALIAN CASSOWARY

The Australian (Southern or Double-wattled) Cassowary belongs to the group of large, flightless birds known as ratites. Approaching two metres in height, it runs second in size among Australian birds only to the Emu, but outweighs it with an average adult female weight of 60 kilograms. It is covered with coarse, hair-like, double-quilled, black feathers, which lack the barbules that give the feathers of most non-ratite birds their characteristic shape. On top of its head it carries a large, bony cas-



A male Australian Cassowary, abandoned by the female, sits on his nest, incubating the pale green eggs. This is the first time that a male cassowary has been photographed at his nest in the wild. Photo: Clifford and Dawn Frith.

que, which may be used to part vegetation and to protect the bird's head, as it runs through thick scrub. It is somewhat indicative of the bird's age.

Tropical rainforests are the favourite habitat of these birds. In Australia they are found only in the extreme northeastern area of Queensland but extend throughout much of Irian Jaya, Papua New Guinea and the Aru Islands.

Cassowaries are scavengers, depending mainly on fruit that falls from the rainforest canopy. This includes figs, quandongs, laurels, lilyplily, etc. Many of the greener, immature fruits that the birds eat pass through the cassowary intact and thus cassowaries are an important means of dispersing rainforest plants. Some leaves and insects are also ingested and cassowaries will eat fungi, snails, even dead birds, rats and other small carrion. During food shortages, they have been known to make forays from the rainforest in search of cultivated fruit (such as mulberries and bananas) but citrus fruits are refused.

Like other ratites, but unlike most birds, the roles of the sexes are reversed. The female cassowary is taller, heavier and more brightly coloured than the male and is dominant over him. At the onset of the breeding season in June, the female becomes tolerant of his presence and, after a courtship dance, copulation takes place. The female lays up to five large, pale green eggs in a shallow scrape in the ground, after which she abandons the male to incubate the eggs for two months and to care and raise the young for a further nine months. Females will accept more than one mate each season and each time she abandons him to care for her young. □

— Georgina Hickey

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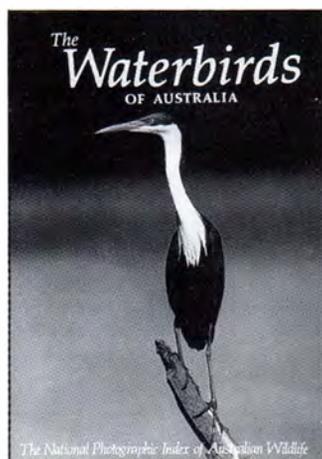
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The Waterbirds of Australia

The National Photographic Index of Australian Wildlife. Angus and Robertson, Sydney, 1985, \$60, 331pp.



This is the second volume in a proposed series of ten (the first, *Wrens and Warblers*, appeared in 1983), that will eventually cover all the birds of Australia. The whole project is to be complete by 1988 in celebration of the Bicentenary.

Based on the impressive resources now available in the N.P.I.A.W., this series of books has been created in order that the most outstanding of bird photographs can be made more generally available. It is unusual for a book of this type to arise from the illustrations and not the text. However, it is not just a picture book, but makes a serious contribution to pictorial representation of each species.

"Waterbirds" includes grebes; herons, egrets and bitterns; the Black-necked Stork; ibises and spoonbills; swans, geese and ducks; rails, crakes, gallinules and a coot; and finally the cranes. In all, 67 species are mentioned including vagrants. Commendably, the Woodhen of Lord Howe Island is included, when so often it has been ignored in recent works of this type.

Regrettably, the R.A.O.U.-recommended English

names for Australian birds have not been used for the series, with about a third of them at variance in this volume. This decision perpetuates the confusion already existing for those new to birds.

I have misgivings about the inclusion of some photographs taken overseas — a problem arising from the need to illustrate vagrants. The illustration may not represent a bird of a population likely to be involved as a visitor to Australia. I also see no reason to include photographs of regular Australian species other than those taken in Australia, because in some instances this could lead to representation of individuals differing from those present in Australia.

It is clear that the text is a synthesis from existing popular sources and suffers inevitably from the repetition of inaccuracies inherent in these standard references and once again enshrines them as fact. More reliable information could have been assembled by more careful vetting of the text and wider consultation with those familiar with the species concerned. While not greatly in error the text on Woodhens should have been more accurate in some details and certainly more up to date.

However, it is the photographs that count and it is clear that reproduction is of the highest standards. The selection allows for three to four, sometimes more, pictures for each species (except vagrants) and often contains evocative and original portrayal of the subject. I liked them all and only wished that more could have been printed.

I heartily recommend this book for the illustrations alone, but suggest the text be read with caution. All in all a splendid showcase for the work of the Photographic Index and as such

a useful contribution to any ornithological library.

— Dr P. J. Fullagar

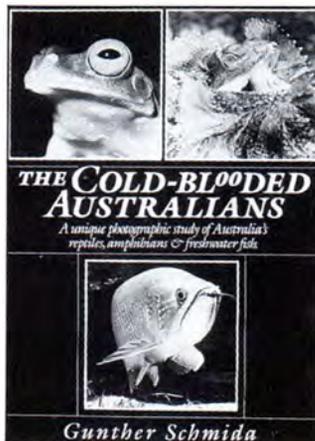
The Cold-blooded Australians

Gunther Schmida. Doubleday Australia Pty Ltd, Sydney, 1985, \$24.95, 208pp.

This book is a prose and photographic account of a selected but representative cross section of Australian freshwater fishes, frogs and reptiles. It is an excellent piece of work and establishes its author as one of Australia's finest natural history photographers.

The book begins with a general introduction to the natural history of the major groups of "cold-blooded" vertebrates in Australia. It then considers selected species in eight regions of Australia, defined primarily on drainage characteristics but also conforming to other important natural features. It finishes with technical advice and insight into natural history photography.

The heart of the book is comprised of the eight regional chapters. In each, the author provides a map and thumb-nail sketch of the country, covering, in turn, the major water bodies, landforms, climate and vegetation. This sets the context for the selected photographs of the region's habitats and their fish, frog and reptile

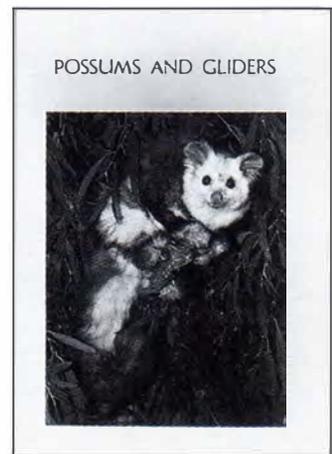


species. The photographs are not only technically excellent but also capture the biological individuality of the habitats and their species. Clearly, the author knows both his craft and his subject. It is this rare combination of technical skill and biological insight that makes this book exciting and informative — and hence highly recommended.

— Dr Allen E. Greer

Possums and Gliders

Edited by Andrew Smith and Ian Hume. Surrey Beatty, Sydney, 1984, \$63.95, 598pp.



This book brings together most of what is known of the general biology of possums and gliders. The Koala, although fitting neither of these categories, is also included. All Australian possums and gliders get a mention but several — the cuscuses, Rock Ringtail and Little Pygmy-possum — receive no more than that. As is true for most symposia, the treatment is uneven because input is limited to what the seventy-odd contributors wished to communicate rather than what readers might wish to know. A general introduction of four or five pages to each of the families treated would have transformed the work from a series of separate research

reviews into a handbook of much greater value.

These criticisms aside, and disregarding some inconsistencies of treatment (for example, just what families are included within the Phalangeroidea and why was one group of authors permitted to refer to brushtails as phalangers?), the book is an invaluable collection of information and an indication of "the state of the art". Twenty-one colour plates, a diagnostic key and a ten-page field guide add to the utility of a publication for which the Australian Mammal Society, the editors and the adventurous publisher are to be congratulated.

— Ronald Strahan

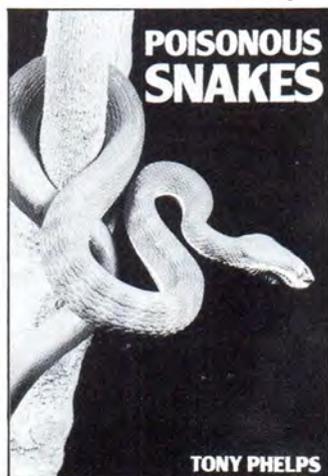
Poisonous Snakes

Tony Phelps. Blandford Press, Dorset, 1983. 237pp.

The sensible approach towards poisonous snakes is to leave them entirely alone, and the same can well be said for this book on the subject.

Poisonous Snakes is a survey of the venomous snake fauna of the world, depicting habits, distribution, behaviour and toxicity. It is a poorly-researched and badly-written effort.

All the data on Australian snakes has been skimmed from the original edition (1975) of Cogger's *Reptiles of Australia*. Phelps purports to list all the Australian venomous species but is woefully ignorant of the major taxonomic changes



since 1975 — including the rediscovery of the Fierce Snake (*Oxyuranus microlepidota*) and the description of a new species of death adder (*Acanthophis praelongus*), black snake (*Pseudechis butleri*) and whip snake (*Demansia simplex*).

Phelps' confused and clumsy writing shows evidence of some very muddy thinking. For example: "Because most snakes exist within certain levels of tolerance with regard to habitat it follows that the majority of species can be termed locally abundant." (page 133) and "It can then be concluded that the criteria for consistent breeding potential is the maintenance of the actual bodily condition in females." (page 141). What is one to make of these statements?

Phelps writes with an obvious passion for his subject matter but it is not enough to sustain interest in this shoddy work.

— Timothy Low

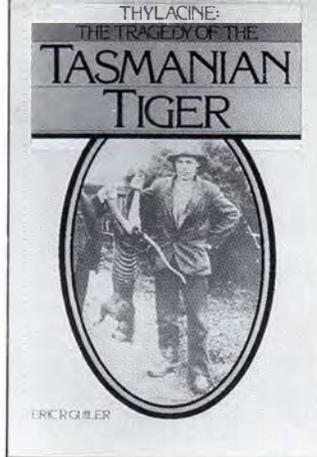
Thylacine: The Tragedy of the Tasmanian Tiger

Oxford University Press, 1985, \$25.00, 207 pp.

A comet, Fred Whipple once said, is the closest to nothing something can be and yet be something. The Thylacine is an animal about which the closest to nothing is known, while yet we do know something. We know that it did exist but beyond that, as Eric Guiler shows, we know very little.

This small volume summarises what is known (disappointingly little) and what may be conjectured (slightly more) about the Thylacine. It recounts tales about the Thylacine and alleged sightings from the mainland. It discusses the history of European interaction with the Thylacine, and the attempts over the past 50 years, involving sometimes heart-breaking difficulties, to locate living animals.

Guiler freely admits that he believes Thylacines still



roam Tasmania, but the book's arguments convince only the converted. No account is taken of the fallibility of human memory, so well demonstrated by recent psychology, nor of the difficulties attendant on dealing with reports of sightings, as are well understood by birders. The account suggests that Thylacines underwent a rapid increase in numbers in the 1880s, but this is based on numbers of carcasses — numbers more simply explained as kills of larger and larger proportions of the existing population. The assertion that overseas scientific institutions are to blame (in part) for the decline of the Thylacine through not taking a more active role in its conservation in Tasmania, seems quite unjustified. The tragedy clearly implicit in this book is not only that there is no evidence that the Thylacine still survives, but that so little is reliably known of the beast and that there is still so little willingness to admit to its extinction. The price is unwarrantably high.

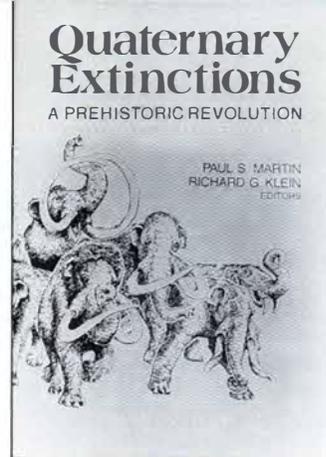
— Dr Ralph E. Molnar

Quaternary Extinctions A Prehistoric Revolution

Ed. by Paul S. Martin & Richard G. Klein. University of Arizona Press, Tucson, 1984, \$US65, 892 pp.

Quaternary Extinctions is the most comprehensive account yet compiled of the demise of the large fauna of the world between two million years ago and the present. As such, this book is essential reading both for scholars involved in researching this topic and the interested public.

The grouping of chapters under topic headings has been particularly well



done and allows for quick access to information relating to particular theories or geographic areas.

Some of the most informative and fascinating chapters are those dealing with the bizarre and extinct faunas of Madagascar, New Zealand and the smaller Pacific Islands. The subject of these works include lemurs the size of ponies, strange pigmy aardvarks and hippos, and gigantic birds (the moas of New Zealand and elephant birds of Madagascar). Because the extinctions discussed in these chapters occurred so recently, they can be analysed in greater detail than in other sections. The hand of man is strongly implicated in all of these extinctions and it is somewhat depressing to discover how much we have impoverished our natural heritage.

The one great disappointment for me in this otherwise useful book is the two chapters dealing with the extinction of the Australian megafauna. Both are somewhat superficial and the chapter by Horton, in particular, has many inaccuracies and is guided by what I consider to be an untenable hypothesis. Added to the poor understanding of the Australian fauna by most overseas authors, this makes for a very unsatisfactory treatment of Australia in general.

Overall, however, the publication of this book represents a great step forward in understanding the nature of Quaternary extinctions. The editors are to be congratulated in producing such a well set out and comprehensive volume.

— Dr Timothy Flannery

Spider Fishing in the Snowy Mountains

by David W. Inouye

Department of Zoology
University of Maryland
U.S.A.



Even before I came to Australia to work on pollination biology in Kosciusko National Park, I had heard about the biting March flies and the low esteem with which they were held by summer tourists and researchers in the alpine. I had heard tales of how people would tie live flies on the end of a string and then let them fly around in circles. Thus it seemed that tying them on the end of the fishing line would be another appropriate use of the flies.

As it turned out, the trout in the Snowy River weren't interested. They apparently had no shortage of other aquatic prey and didn't take a fancy to March flies. I did, however, find another use for March flies as bait, but for a rather different animal.

In my work on Mt Stillwell, near Charlotte Pass Village in Kosciusko National Park, I frequently noticed holes in the ground, about two to four centimetres across. Inquiries to some of the local naturalists led to the information that these were the residences of wolf spiders. Occasionally I would catch a glimpse of a spider moving back down its tunnel in response to my movements near its hole. It was not difficult to see why little is known about the biology of these alpine wolf spiders, since they are so secretive. In fact, they were only taxonomically described in the last decade.

These wolf spiders are carnivores. They catch their prey by ambushing them while hiding in their tunnels. I once saw a spider come out and grab a passing grass-

hopper and so it occurred to me to put my fishing technique with March flies to use.

I captured live March flies, as they attempted to feed on me, and tied them on the end of a piece of thread. With a little persuasion the flies could be forced down the entrance of a wolf spider hole, where their buzzing would often attract the attention of the resident. The success of the technique was ascertained when the fly stopped buzzing and the line began to disappear down the tunnel.

The spiders usually grab their prey and proceed to bite it, injecting poison to kill it. The potency of their poison was attested to by the speed with which the flies stopped moving.

By pulling gently on the end of the "fishing line", I discovered that it was possible to pull the spider to the entrance of its hole, where it was clearly visible with the fly in its grasp. In fact, by continuing to pull, I could usually coax the spider completely out of its tunnel and occasionally even lift it up in the air. Once I had the spider in mid-air it was possible to weigh it using a spring balance. I could also correlate the weight of the spider with the size of its tunnel.

Granted, the rewards of a successful spider fishing trip were quite different from those of a trip to the nearby Snowy River for trout. Even though the results were not as edible, they still provided an interesting insight into the inhabitants of those small alpine tunnels and an alternative use for March flies. □



A March fly has been tied to the end of a piece of string as bait for wolf spider fishing. Photo: David W. Inouye.



Success! This wolf spider is securely "hooked" to the March fly bait and fishing line. Photo: David W. Inouye.



POSSUMS and GLIDERS

Ed. by **A. Smith and I. Hume**
Uni. of N. England, Armidale, NSW, Aust.



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THE CASSOWARY AT HIS NEST

A photographic first

by Clifford and Dawn Frith

A male cassowary at his nest in the wild is a special sight to behold. It is a situation rarely observed — let alone preserved on film. Clifford and Dawn Frith share their experience with Australian Natural History. See also the giant colour poster in this issue.

The Australian Cassowary, also known as the Southern Cassowary or Double-wattled Cassowary (*Casuarius casuarius*), is a huge, flightless bird closely related to the more widespread, and thus more familiar, Emu (*Dromaius novaehollandiae*). Cassowaries, together with the kiwis of New

Zealand, rheas of South America, Ostriches of Africa and our own Emu, are members of what many ornithologists consider to be the most primitive group of living birds — the ratites. Ratites are large, heavy-boned birds with strong, relatively enormous legs and feet and rudimentary wings. In the case of the

Southern Cassowary, which is found in tropical rainforests throughout much of Irian Jaya, Papua New Guinea, Aru Islands and extreme

A male Southern Cassowary, *Casuarius casuarius*, with his one day old chicks. Photo: Clifford and Dawn Frith.

northeastern Queensland, Australia, the wings are almost non-existent and are represented only by three to five long and strong wing quills, which extend along and curve around the side body contour where they apparently protect the bird's flank as it travels through thick vegetation. The glossy black, tail-less plumage is extremely thick and coarse. It looks more like a heavy, stout-haired coat than feathering and also protects the bird against abrasion.

There are three living species of cassowary but the other two do not occur in Australia. These are the Single-wattled Cassowary (*C. unappendiculatus*) of the northwestern lowlands of New Guinea (including Irian Jaya) and the Dwarf Cassowary (*C. bennettii*) of New Guinea, its islands and (possibly by human introduction) New Britain, occurring predominantly in the hills and uplands. The Australian population of the Southern Cassowary occurs from Paluma, just north of Townsville, Queensland, to the tip of Cape York Peninsula in suitable tropical rainforest along the eastern coast.

Probably as a result of dwelling in the dark, shadowy world of the tropical rainforest floor, where bright colours provide more readily visible social signals, the cassowaries have developed far more colour than other ratites. The bare skin of the head, neck and wattles are pigmented with many bright to subtle hues of reds, purples and blues. All cassowaries have a curious growth atop the head called the casque, which is, in fact, a bony but very light-weight protrusion of the skull. It has been suggested that this odd growth is a physical adaptation against damage to the bird as it runs through dense vegetation. However, because the casque grows slowly through immature life and because younger birds are most prone to such pedestrian damage, this explanation as to the casque's sole value seems weak. In all probability the casque is also indicative of age and dominance in a cassowary social context. Its shape and size is different in each of the three species, that of the Southern Cassowary being by far the largest.

An adult female Southern Cassowary may stand as tall as an average woman and weigh up to 60 kilograms, whereas the male birds are shorter and lighter. They are almost exclusively fruit eaters, feeding upon the great diversity of tropical rainforest tree and vine fruits that fall to the floor. Some fruits may



The Single-wattled Cassowary, *Casuaris unappendiculatus*, is found in the northwestern lowlands of New Guinea (including Irian Jaya). Photo: Clifford and Dawn Frith.

also be plucked from lower vegetation and fungi and the odd dead animal may also be swallowed.

As is the case for some other ratites, it is the male cassowary that performs the nesting duties and is somewhat over-ruled by the larger females. While males appear to defend territories in which they feed and from which they evict other males, females wander at will from one male's territory to another, feeding wherever they please. During the breeding season, predominantly from June to October, males initiate courtship by repeatedly attempting to approach a female until she permits him to feed close to her. This is followed by performing a courting dance around her while uttering low rumbling sounds. Females will accept more than one mate each season, each male being left to incubate her eggs in his individual nest. The nest consists of a shallow scrape in the ground augmented by a few leaves only. Up to five eggs in a clutch have been recorded but very rarely have so many chicks been seen with the parent male.

Until these accompanying photographs were obtained in September 1984, no cassowary had ever been photographed at the nest in the wild. Indeed, it is an established fact that, historically, very few nests have ever been found. The famous and avid Australian bird egg collector, H.L. White, for many years offered large sums of money for clutches of cassowary eggs, but to no avail; even Aborigines "appeared able to secure only odd eggs", he wrote. In 1911 White engaged a skilled bushman

Cassowaries: a gut-rending tale

Cassowaries are equipped with powerful legs and long, strong claws. The claw of the innermost of the three toes is elongated to a dagger-like spike, 120 millimetres long and 30 wide at the base. This claw is a deadly weapon in combat when the cassowary leaps feet first at its adversary. Most of the time, however, cassowaries are shy and if encountered in the wild will turn and flee. Usually it is only when encountered or cornered while caring for chicks that a bird will hold its ground and defend itself.

In many areas of Papua New Guinea, young cassowaries are treated as pets. Natives seem unconcerned that as the birds mature they may become aggressive. One report tells how, in 1946 on the lower Brown River in P.N.G., a seven year old boy was playing with the village pet, a two year old Bennett's Cassowary. It lashed out with its powerful claws and ripped a 30 centimetre opening in the boy's abdomen. The boy miraculously recovered. And in 1952 another Bennett's Cassowary "without warning" attacked and nearly killed a middle-aged woman in Kup, P.N.G. The bird in question was also responsible for one death and two severe assaults. Even after its fourth human attack, the bird continued to run free.

Numerous human deaths have resulted from confrontations with cornered cassowaries in P.N.G. and the last record of a person killed by a cassowary in Australia was in 1926 at Mossman, Queensland. There is also a vague account of a man who, after pinching fowl eggs from the Single-wattled Cassowaries' enclosure at Taronga Park Zoo in the 1950s, fell victim to one of the formidable, clawed weapons. He managed to carry himself and his entrails to the nearby wharf but apparently bled to death on the ferry. □

for the best part of the year in prime cassowary country. He managed to find two nests and stated that the parent bird invariably deserted the nest when disturbed at it. We were, therefore, very fortunate to be informed of a nest at Mission Beach,



The Dwarf Cassowary, *Casuarius bennettii*, is found in New Guinea, its islands and New Britain, occurring predominantly in the hills and uplands. Photo: Clifford and Dawn Frith.

Queensland, on a forested hillside not far from human activity. As a result the male attending the nest was, to some extent, used to people or, at least, constantly within earshot of their activities. Sadly, this nest was within 500 metres of bulldozers clearing rainforest for residential development — a move that was to destroy the nest site before the next nesting season. It is forest destruction and fragmentation, as well as dogs and road traffic, that seriously threaten these birds in the southern part of their range.

Fortunately we had several weeks available to work at this nest and, as a result, were able to slowly move our photographic hide closer to the nest without disturbing the male who sat continuously during the day on his clutch of eggs.

Four eggs hatched during the very early hours of Sunday 9 September and the young were still damp at 9 a.m. They remained in or about the nest, becoming increasingly competent on their legs and picking at pieces on the ground, when not pushing themselves into the warmth and security of the male's plumage. He remained on the fifth egg until it hatched the next day. We found the late hatchling still damp beside its fluffy, dry siblings at 6.50 a.m. The egg shells had been trampled to tiny fragments by the male's feet. However, the huge egg membranes, containing much jelly-like substance, were apparently of some nutritional value to the male: he was seen swallowing several whole while still (to our knowledge) not having eaten anything else.

At 7 a.m. on the following Tuesday, the male and his five chicks had left the nest and he was found sitting on them about 25 metres downhill. The next day he was certainly not within a 250 metre radius of the nest. On Saturday 15th the entire family appeared in a nearby household rainforest-edge garden, about 500 metres from the nest. The male helped the young feed by pecking at food thrown to them by the householder before they ate it. In the same garden on 6 and 7 October the male appeared with three chicks and on following

Close up of the eggs of the Southern Cassowary, *Casuarius casuarius*. Photo: Clifford and Dawn Frith.



days with four. Subsequent reports suggest that only two chicks survived to see 1985.

These photographs were shown to well-known, 79 year old Mission Beach resident, Mrs Jorrisen, who has carefully watched and studied

the cassowaries for many years by individually identifying them from casque and facial characteristics. She immediately recognised the nesting male as a bird she has known since it first appeared as a chick in her garden 19 years ago. □

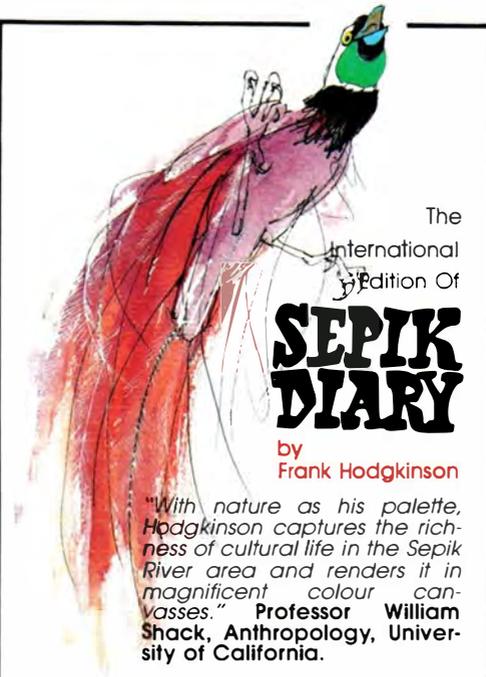
The cassowary-sister: a New Guinea myth

This story begins with a brother and a sister. One day the brother went hunting, leaving the sister to weed their garden, but first telling her not to throw the rubbish into the nearby river. However, she disobeyed him. An old man was sharpening his axe at the water's edge further downstream. He saw the rubbish floating down the river, picked it out and sniffed it, and he thought, "It smells of the hands of men or women". He followed the rubbish upstream, putting the weeds on top of stones as he went, as signs to his children that he had been there. He traced the weeds until he came to the garden, crept up on the girl and grabbed her by the neck as she bent down to weed the crops. She struggled and cried out. Her brother heard her, hurried back and shot the old man with his bow so that he fell down dead. The brother and sister butchered the man and cooked him, together with the taro and other vegetables from their garden, in an earth-oven by the stream. First they put his head in the bottom oven pit; then they put his legs and arms higher up; and his trunk they put in the upper part of the oven. [This is the same way that cassowaries are cooked.]

The children of the old man waited for him to come home. They went down to the river and saw the signs he had left and followed them. The brother saw them coming so he taught his sister how to shoot with bow and arrows. The old man's children finally came to the ovens by the bank of the stream. They began taking the food out of the oven and eating it. First they took the flesh of the trunk and the limbs in the upper parts of the oven; and they continued until they got to the bottom of the oven and found the old man's head. Recognising the head they then realised they had been eating their father. On sighting the brother and sister up the hill, they decided to take

revenge. They began to fight but the brother and sister slew them. Then they killed pigs and exchanged gifts, but although the sister gave the brother greensnail shells and axes and other good gifts, the brother only gave the sister very poor things. After this the brother and sister competed to see who could shoot arrows the furthest [a popular pastime and form of archery practice in which people walk along a track and fire arrows ahead of them as they go]. The brother moved on ahead of the sister and, when he came to a pig and wallaby pit-trap on the track, he covered it up with leaves and the sister, following him, fell into it. The brother went to make a shelter [of the kind used by hunters when they sleep or cook game in the forest] and, when he returned to the pit, discovered that his sister had fallen in, had turned into a cassowary and had laid a clutch of eggs, which soon hatched.

The cassowary-sister and her young walked about, pecking the wild foods of the forest and defecating. From her excrement grew all sorts of good food plants. The brother, deciding to take advantage of this, made a *gawb* [jew's harp] and hung it in a tree so that the wind would make it sound and the cassowary-sister, hearing it, would return to the house and defecate on his garden. One day two women from another settlement were in the forest, collecting edible leaves for cooking at the *smy* [dance festival]. They heard the *gawb* and, being curious as to what was making the noise, climbed the tree, found it and broke it. The cassowary-sister followed the two women back to their settlement. When their kin folk saw her, she was pursued with bow and arrows and, after a long chase and many wounds, was killed and eaten . . . [Modified from I.S. Majnep and R. Bulmer (1977) "Birds of my Kalam country".] □



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To be or not to be? A cassowary or a bird?

The Kalam people of the Upper Kaironk Valley in the Schrader Mountains of New Guinea place all flying birds and bats in the group *yakt* and the cassowary in the contrasting group *kobty*. Why, to the Kalam, is the cassowary not a bird?

The cassowary's large size, extreme reduction of wings, flightlessness and "terrestrial" mode of life, the heavy "human-like" leg bones, unique cranial structure (bony casque) and unusual hair-like plumage, and the fact that males (unlike other New Guinea birds) boast a penis, are among the characters that contribute towards the cassowary's lonely classification.

Despite these morphological and behavioural features, some other New Guinea highlanders still place the cassowary in the same category as birds. In order to understand, then, why in Kalam classification the cassowary is not a bird, one must appreciate the complex and special status this forest-dwelling creature occupies in the totality of Kalam life. A clue to this understanding lies in the rule-ridden activity of cassowary hunting.

Anyone who kills or eats a cassowary is *asn* (ritually dangerous or unclean) and should not plant or go near taro crops for a month. (To kill a man also makes one *asn*). Live cassowaries must similarly be kept away from taro, otherwise the crops will not flourish. Taro is the cultivated vegetable valued most by the Kalam. It is a seasonal crop and is essential to the celebration of the *smv* (Kalam's most important ceremonial festival, which acts mainly as a rite of passage for youths). The Kalam language itself emphasises the significance of the plant: taro is said to die (*kum-*), the same word being used in reference to man and animals; other plants merely rot (*kuy g-*) or wither (*mlep g-*). The forbidden association of forest-

dwelling cassowaries with cultivated taro crops dictates that cassowaries may not be domesticated. This is in marked contrast to many other New Guinea highland societies where they are kept as pets.

The hunter who has killed the cassowary must eat its heart. Similarly, if one kills a man, a pig is killed and its heart eaten. In this sense, the cassowary is equated with man — to kill a cassowary is to commit homicide.

When hunting and cooking cassowary, one must "practise avoidance". That is, one must use a substitute language, called "pandanus language" or *alnaw mnm*. Pandanus language is also used during harvesting and cooking of *alnaw* pandanus nuts (a valued seasonal forest crop which, when eaten, also renders one dangerous to growing taro) and when one speaks to a cross-cousin of the same sex. In pandanus language *kobty*, the cassowary, is known as *wjbeke nmev*, "mother of game mammals". It indicates clearly that cassowaries are seen as allied to other kinds of terrestrial and arboreal game, rather than flying birds.

The myth in which a woman turns into a cassowary suggests an appropriate metaphor for the relationship between the cassowary and man as the Kalam people understand it: cassowaries are the sisters, cross-cousins and their descendants to men. In Kalam life brother and sister are mutually dependent but a sister is under the control of her brother who marries her out (often to his advantage). Cross-cousins are more important than even brothers or sisters. They are the people with moral claims over you; you can't keep them out of your inheritance or your taro gardens (unless you are considering homicide or suspect witchcraft); they must be treated with respect and must not be referred to

by name. It is only natural, therefore, that the Kalam treat their metaphorical and mythological cross-cousins, the cassowaries, with due respect when they've been killed, and ensure that they never go near their taro.

In summary, then, the cassowary's unique standing in Kalam classification can only be appreciated if we understand that there exists an elaborate antithesis between the uncultivated forest (the prime elements being the cassowary and *alnaw* pandanus nuts) and cultivation and civilisation (based on the special value ascribed to taro). This required separation between the forest and civilisation is also linked, mythologically, to the problems of brother-sister relationships and of relationships between one's cross-cousins.

For whatever reason, the instinctual compulsion to interpret the nature of or to systematise objects is universal. Names and classifications are essential for ordering thoughts and actions in relation to the non-human universe, and facilitate communication between people. Different groups of people use different criteria for classifying groups into hierarchical or ordered systems according to the particular relevance and meaning these classifications may have for the people who use them. Not surprisingly, the purposes served by taxonomic systems, and thus the taxonomic systems themselves, differ between societies. The higher categories in Kalam classification, for example, are not simply statements about similar morphology but statements concerning their particular social status. To group flying birds with bats or frogs with rats is meaningless to the scientific biologist. Similarly, to the Kalam, a cassowary is a cassowary is a cassowary and to suggest that it is a bird is ridiculous. □

— Georgina Hickey

RECONSTRUCTING AUSTRALIA'S OLDEST MAMMAL ▶

Reconstructing fossil animals is a great palaeontological pastime. For many years adults and children alike have marvelled at the insights that reconstructions provide about the life of past epochs. However, there is much misunderstanding about how such reconstructions are made. Indeed some creationists have been quick to exploit this misunderstanding and cite such works as attempts by scientists to mislead the public. The reconstruction presented here (drawn by Peter Schouten) is the result of considerable research and the story behind it illustrates how scientific reconstructions are made.

The most important thing to realise about this drawing is that it is an hypothesis. It is based as much on the inferred relationships of the fossil animal as it is on the actual fossil jaw fragment, containing three teeth, found at Lightning Ridge (see following story).

The group of palaeontologists currently working on the Lightning Ridge mammal jaw agree that it represents a monotreme and that it probably belongs to a group of animals ancestral to the only living monotremes — the Platypus and echidnas. This is the single most important piece of information used in guiding our reconstruction. Its importance lies in the fact that it indicates, in a very real way, that the Lightning Ridge mammal is not extinct — it has simply changed. The living echidnas and Platypus are the descendants of the group to which the Lightning Ridge fossil belonged. Thus its genetic material has been handed down, generation after generation, for over 120 million years.

But how do we determine which features of the Platypus and echidnas were present in their common ancestor (represented by the Lightning Ridge fossil) and which have developed since? Some features of monotremes are unique among mammals and were presumably present in their common ancestor. Such features include presence of a skin-covered bill, rich in nerve endings, and the presence of a spur on the hind foot. These structures are present in both the Platypus and echidnas (although the bill is specialised in both forms). If they

were *not* present in the common ancestor of both families, then we must assume that these otherwise unique structures were independently developed in both the Platypus and echidnas. This is highly unlikely and it is much more probable that these features were present in the ancestral monotreme.

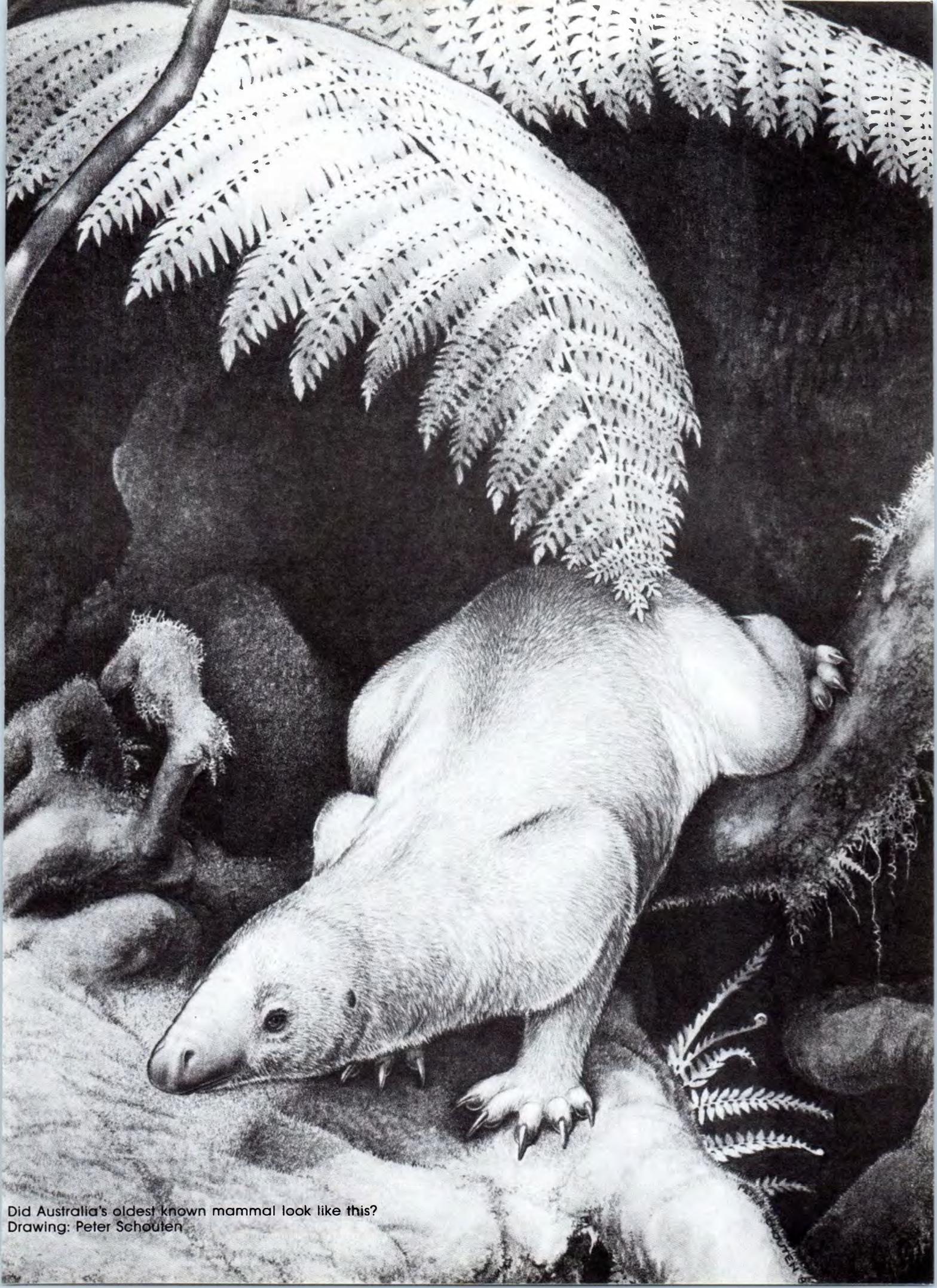
This kind of deductive reasoning can be used to determine the *probable* nature of many aspects of our fossil beast. We have, for instance, used such information to reconstruct the snout, eye, ear, tail, stance and limbs of the Lightning Ridge mammal.

Of course there are aspects of the fossil mammal's form that we cannot know. For instance, did it possess horns? It is possible that it did but, because its descendants all lack such structures, we have no evidence for their existence and thus have not included them. And because we have not included features (such as horns) for which we have no data, this reconstruction is a conservative estimate of what the animal might have looked like. It includes only the features likely to have been present in the ancestral monotreme.

And what about the one piece of hard evidence that we have — the jaw fragment? Of course all of our information about the animal's relationships is derived from this specimen. It also tells us the animal's approximate size, a little about the shape of the snout and something of its diet. All of this information (except that relating to diet) is included in the reconstruction.

The reconstruction, therefore, represents a visual summary of the palaeontologists' knowledge of the animal's relationships. The fossil jaw itself provides only a small piece of direct data used in the drawing. It is what the jaw tells us about the kind of animal that possessed it (in this case a primitive monotreme) that is important. Only with the discovery of more complete fossils can we rigorously test this hypothesis. However, it is clear that alternative hypotheses of relationships could lead to different reconstructions. □

— Dr Timothy Flannery



Did Australia's oldest known mammal look like this?
Drawing: Peter Schouten

OPAL FOSSILS

FLASHES FROM LIGHTNING RIDGE

by Alex Ritchie, Head of Earth Sciences, Australian Museum

There are many gaps in our knowledge of Australia's geological record and the animals and plants that lived here. Some of the gaps may be filled in rather unexpected fashion. A good example concerns the recent discovery of this continent's oldest mammal, one of the most important Australian fossil finds of the century.

Over the last 20 years scientists searching for fossil mammals in Australia have come up against a dead end. No mammal remains have been recovered from rocks older than 24 million years (m.y.), whereas on other continents fossil mammals are known from rocks up to 200 m.y. old. By international standards the Australian mammal record is poor.

From our knowledge of continental relationships in the past it is virtually certain that mammals have been in Australia for much longer than 24 m.y. and probably since the Mesozoic Era, the Age of Reptiles (235 to 65 m.y. ago), when dinosaurs roamed the Earth. Two mammal groups, the monotremes and marsupials, may even have originated here.

During the Cretaceous (135 to 65 m.y. ago) a shallow sea crossed central Australia from north to south. Most of inland Australia is underlain by thick Cretaceous marine sediments that now form the rocks of the Great Artesian Basin. Cretaceous rocks are exposed at the surface in many places but most lie buried

and inaccessible under a cover of more recent (Cainozoic) lake and river sediments. These Cretaceous rocks often contain abundant molluscan fossils but remains of backboned animals are rare. Fossil remains of large bony fish, marine reptiles (turtles, ichthyosaurs, plesiosaurs) and land reptiles (dinosaurs) have been recovered from Australian Cretaceous rocks but most represent large animals whose solid bones survive erosion better and are more readily spotted when weathering out at the surface.

Fossil remains of some smaller Cretaceous animals come from the opal fields of New South Wales and South Australia. The opal present in the Cretaceous sediments formed

This tiny opalised jaw fragment, only 28 mm long, is the first Mesozoic mammal discovery from Australia. It comes from Early Cretaceous rocks of Lightning Ridge opal field, N.S.W. and is part of the right lower jaw, seen from the outer surface. The three, well-preserved molar teeth reveal it to be an early monotreme.

Photo: John Fields.



millions of years afterwards, in early Cainozoic times. Drastic fluctuations in the water table led to the concentration of silica-rich solutions, which accumulated in cavities and fissures to form opal. The best known opal fields are Lightning Ridge and White Cliffs in N.S.W. and Coober Pedy and Andamooka in S.A.

Because of the brittle nature of opal and the patchy, often unpredictable way it forms, until recent years most opal mining was carried out by hand. Little escapes the notice of a good opal miner (the smallest flash of colour may lead to a saleable gemstone). So, in these circumstances, it is hardly surprising that even very small fossils are found.

Although most opalised fossils consist of common opal (potch), some display the flashing colours of precious opal. Precious opal fossil specimens have often been cut up and polished for their gem content, regardless of their significance or value as scientific specimens, sometimes through sheer ignorance but more often in the belief that a polished stone will be more saleable than an opalised fossil. Opal miners know from personal experience that, while Australian natural history museums are keenly interested in acquiring such specimens for their collections, few have sufficient funds to compete against commercial

opal buyers, private collectors or even overseas museums.

In 1977 Dr Ralph Molnar, now of the Queensland Museum, and I visited Lightning Ridge to examine opalised fossil specimens in private collections. Lightning Ridge, in northern N.S.W., is of especial interest to palaeontologists. Unlike the other main opal fields, which mainly produce remains of extinct marine reptiles, Lightning Ridge fossils represent an assortment of marine, freshwater and terrestrial animals, suggesting the sediments accumulated in a near-shore or estuarine environment.

During our visit we inspected a collection belonging to opal miners Dave and Alan Galman. Over many years they had accumulated a large collection of opalised plants, shells, bones and teeth. Many different types of animals were represented in the material but only detailed examination by specialists could determine what kinds were present and, more importantly, how many were new to science. We identified fish, turtle, crocodile, dinosaur and possible pterosaur (flying reptile) bones in the Galman collection. Although they wouldn't part with the collection they let us photograph and even cast some of the specimens for study.

Then, seven years later in early September 1984, the bush telegraph informed us that the Galman collec-

tion was up for sale and that an overseas opal dealer was arriving shortly to consider buying it. Although it is illegal to export such fossil material from Australia without official approval, the law is difficult to enforce given the small, portable nature of most opal specimens.

I got in touch with the Galmans immediately and reminded them of the Museum's interest in the collection. They were sympathetic and expressed a wish that it should stay in Australia, preferably in a public museum. They estimated they had spent at least \$65,000 over 15 years acquiring the material and were asking \$80,000 for the whole collection containing several hundred specimens. Several weeks later, in November 1984, the Museum funded the Galman brothers to bring the entire collection to Sydney for detailed examination and evaluation.

I visited them in their motel shortly after their arrival and couldn't resist a quick look at the material, most of which I recognised from earlier inspections. Suddenly I spied a small specimen I hadn't seen before and took it over to the light for a closer look. The hair literally stood up on the back of my neck. I could hardly believe my eyes. I was holding part of a small lower jaw with three teeth still in place — and each tooth had *several* sharply pointed cusps!

Some opalised Cretaceous plant specimens from the Galman collection, now in the Australian Museum, showing a range of large and small cones and a slice through a branch or stem. Photo: John Fields.





A selection of opalised fossils from Lightning Ridge. Top row, left to right: three molluscs (a gastropod and two bivalves); pterosaur (flying reptile) limb bone; dinosaur (sauropod or brontosaurus) tooth; plesiosaur (marine reptile) tooth. Middle row: three reptile vertebrae and rear portion of a reptile (turtle?) braincase. Bottom row: foot (or hand) bones from a dinosaur and three smaller reptiles. Photo: John Fields.

Although my own special field of research is ancient fishes and I am not an expert on "higher" back-boned animals, I had no doubt what I was holding. The multi-cusped teeth were those of a mammal and came from an animal about the size of a small cat. The jaw and teeth were completely opalised. The opal-bearing rocks at Lightning Ridge are of Early Cretaceous age, dated at over 100 m.y. old, but the earliest known fossil mammal in Australia was a mere 24 m.y. old. I was holding the palaeontological equivalent of the Holy Grail!

As soon as I got home I phoned a colleague, Dr Michael Archer, from the University of New South Wales, one of Australia's leading authorities on fossil mammals. "How much would you be prepared to pay for an Australian Cretaceous mammal jaw with several teeth in it?" I asked him. "It would be priceless", he replied, after getting his breath back. He later estimated that, over the past eight to ten years, he and his students and several colleagues in other States would have spent at least \$90,000 in support grants searching for such a specimen but without success.

Next morning Mike Archer arrived in the Museum, accompanied by one of his students, Dr Tim Flannery, now mammalogist in the Australian Museum. He took one glance at the three centimetre long specimen cradled in my hand. "It's like *Obdurodon*", he gasped. "It's a monotreme, not a marsupial."

One of the strangest aspects of the fossil record of mammals in Aus-

tralia is the scarcity of remains of monotremes, the egg-laying mammals represented today only by the Platypus and the echidnas. It was not until 1972 that some small and very unusual isolated teeth from 14 m.y. old sediments in the Lake Frome and Lake Eyre areas of central Australia were identified as belonging to an extinct type of platypus, now called *Obdurodon*. Closer examination of the teeth in the Lightning Ridge jaw revealed that, although they resembled *Obdurodon* teeth, they differed in many details.

The Lightning Ridge mammal jaw tells us several things. Firstly, by confirming that mammals *were* present in this continent over 100 m.y. ago, it revives hopes that fossil mammal faunas older than 24 m.y. await discovery somewhere in Australia. The structure of its teeth also indicates that monotremes (Australia's unique egg-laying mammals) and marsupials (pouched mammals that are also known from other continents) are more closely related than had been previously thought.

News of the Cretaceous mammal discovery spread rapidly through Sydney's scientific community and many scientists visited the Museum to examine the opalised jaw personally. All agreed that it was one of the most important Australian fossil finds of the century. The Galman brothers, although taken aback to discover their collection housed such an important scientific specimen, were relieved that it had been discovered before they had sold the collection to an opal dealer or private collector, in which case it

might never have come to light. They also made it clear that, despite the recognition of such an important specimen, their asking price for the collection was still the same — but *only* to the Australian Museum.

Although the purchase price was one of the largest sums ever required by the Australian Museum for a major acquisition, the Museum Trust moved swiftly. An approach to Esso Australia for financial support brought a major contribution towards the purchase price, crucial sponsorship matched by a grant from the N.S.W. Government and supplemented by Australian Museum Trust funds.

In the middle of December 1984 the entire Galman collection was acquired by the Australian Museum and scientific studies started immediately on various parts of it. A preliminary paper on the all-important mammal jaw has been submitted for publication. Dr Molnar is studying the various reptile bones (turtles, crocodiles, dinosaurs and pterosaurs); and Dr Anne Kemp, also of the Queensland Museum, is studying several well-preserved lungfish teeth. The Galman collection contains a fascinating variety of fossil plant specimens, including several types of opalised cones, providing invaluable clues to the vegetation of the area. The whole collection provides a unique insight into the flora and fauna of what is now northern N.S.W. over 100 m.y. ago.

An important by-product of the Australian Museum's acquisition of the Galman collection is that opal miners can no longer assume that Australian natural history museums are unable to find the funds necessary to acquire unique fossil specimens. Perhaps this purchase will at least encourage opal miners, dealers and collectors to let museum experts inspect all potentially important fossil finds from Australian opal fields *before* such specimens are cut up or sold overseas. Had this happened to the opalised mammal jaw from Lightning Ridge, *all* Australians, not just scientists, would have been the losers. It was a close-call.

Those of us fortunate enough to be able to work on such exciting relics of Australia's distant past are well aware of widespread public interest in this field. We welcome, and are grateful for, corporate and private support in our search for long-extinct animals and plants. The potential for exciting new discoveries in this still poorly-known continent is enormous. □

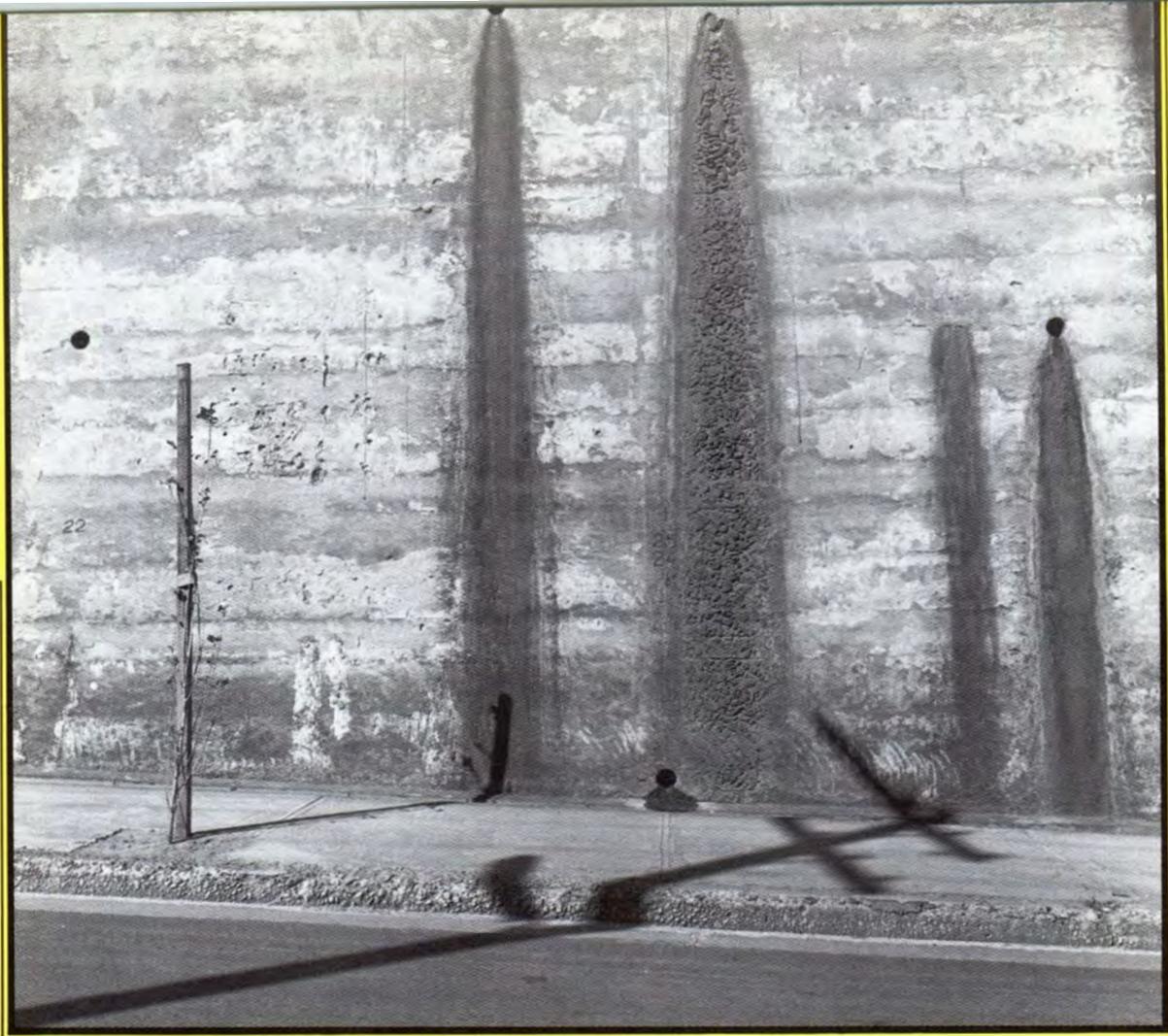
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AUSTRALIAN NATURAL HISTORY



The Urban Tree

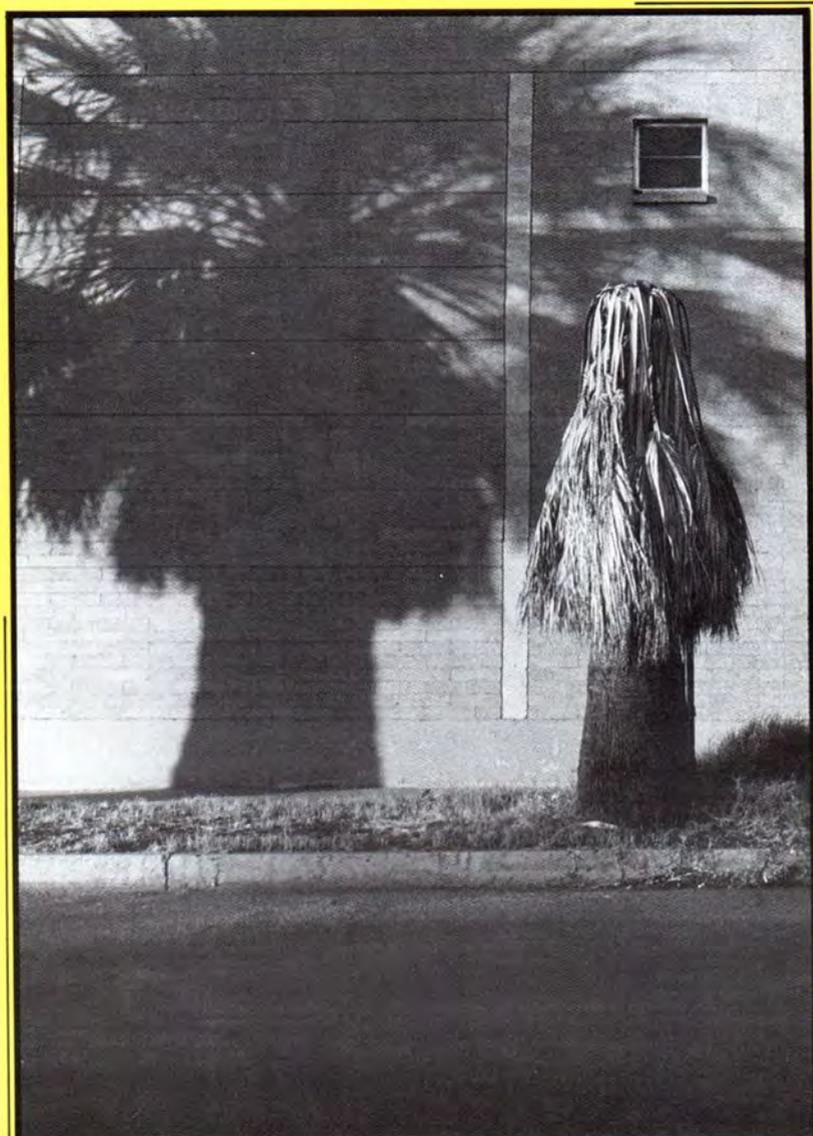
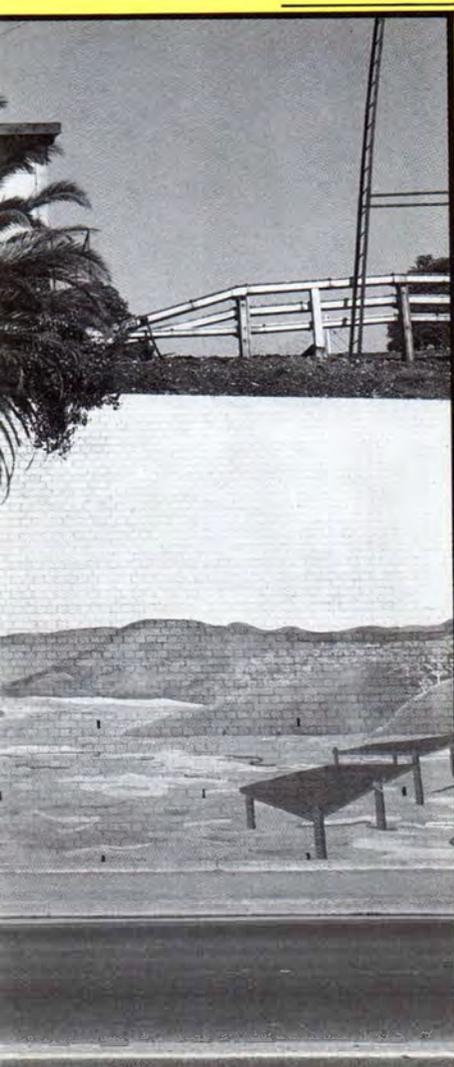
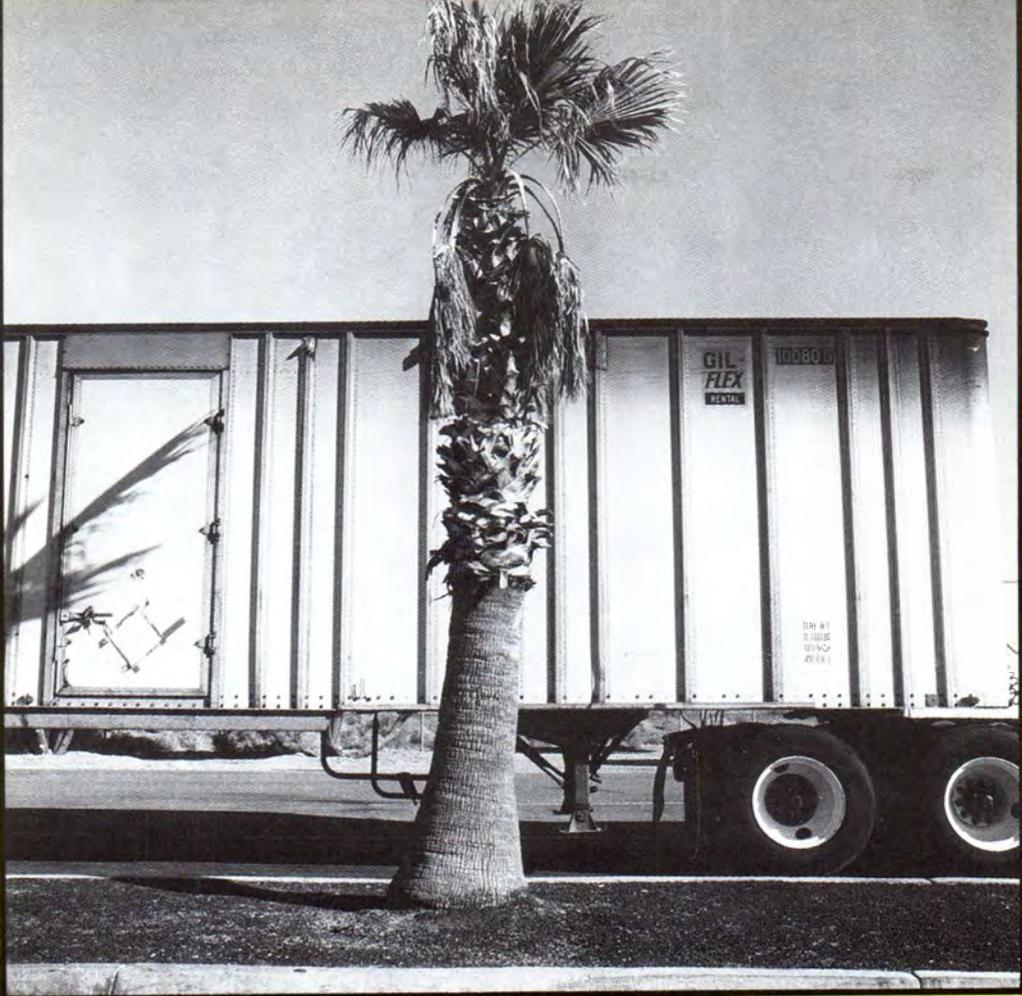
Ingoborg Tyssen emigrated to Australia from Holland in 1957. For the last ten years she has been actively photographing both in Australia and overseas. Her photographs are frequently exhibited and held in all major art collections of Australia.

This series takes a wry, somewhat quirky look at the "urbanised tree" — that strange creature, hardly noticed by the human inhabitants of the city but which always seems to have its own individual personality when examined closely.

As Ingoborg Tyssen herself says "These photographs examine the role of the tree in the urban environment and the constraints which man has imposed upon it and its immediate landscape.

The definition of 'tree' does not even begin to approach the complexity of our relationships with them. Throughout human history the tree has had a number of symbolic meanings beyond its physical presence and utility".







Densey

A SPIDER THAT'S GOT THE DROP ON INSECTS

One of my most memorable moments was the discovery of the Net-casting Spider, *Dinopis subrufa*, weaving her casting net in my garden shrubbery.

Once you've ventured into the miniworld of insects and spiders such moments of discovery come often. A discovery doesn't have to be an "original" one in the narrow sense of the word. A personal first sighting is no less novel just because someone else got in first with the naming or the describing.

You come across something strange in the bush or in your garden. A vague memory stirs. "Didn't I read something . . . ? Wasn't there a photograph . . . ?"

You stop in your tracks for a closer look and you're hooked.

Yes, in such an alien-seeming world it's useful to have a few introductions. And make no mistake, there's still much behaviour that's unknown, still a whole lot of gaps waiting to be closed by observant visitors from our megaworld.

But how, in my own garden where every nook and cranny and — as I thought — all inhabitants were known to me, had I missed seeing *Dinopis* before? Well, the focus up to then had been mainly on insects. My heady love affair with spiders was only just beginning.

Anyhow, there she was hanging

upside-down in the bushes — a slender, long-legged Net-casting Spider, herself the colour of a dead leaf. I wouldn't have seen her if my torch hadn't lit up the shining, blueish-white silk of her net. It lit up something else, too — a splodge of white faeces on the ground directly below her. I thought nothing of it at the time.

Over the next few years I got to know this spider rather well. I found that she (embracing he) has a most distinctive life style and I managed to fill in a few of its details.

There are several things that set this remarkable spider apart from her fellows — her eyes, for one thing. She has eight of them like most of her kind, but two "front" eyes are enormously big and round, set in a fringe of ginger "eyelashes" like the eyes of a friendly Hereford cow. There the resemblance ends. *Dinopis* is no gentle, myopic herbivore but a rapacious predator with a keenness of vision unmatched amongst her kind.

Most of the spiders we see around at night trap their victims passively in webs, sensing them solely by touch. *Dinopis* is an active ambusher. She relies on acute night vision and hair-trigger reactions to catch not flying insects but walking ones.

A photographer might see a parallel in this spider with one of those photo-electric devices that set off flash and camera when a bird or insect crosses the beam. *Dinopis* is set off when a walking insect crosses her line of sight. She's down there in a split second and it's in the bag.

But that's just the final coup. There's a lot of preparation. Every night — sometimes several times in one night — the spider must make a new net. She weaves it from a complex kind of fuzzy silk that only a few spiders can produce.

Spider silk is a glandular secretion, drawn out through the finger-like spinnerets at the tip of the body. The silk *Dinopis* uses for

◀ The Net-casting Spider, *Dinopis subrufa*. The weaving of the net begins. Photo: Densey Clyne.

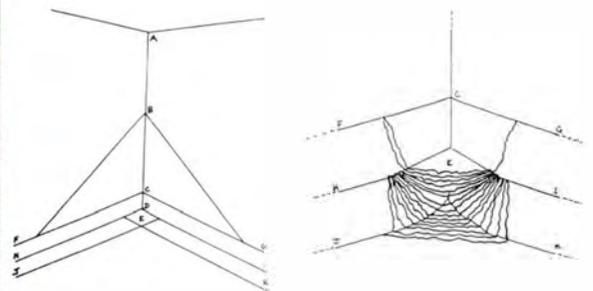


Elyne looks at.....

The last thread of the net is in ▼place. Photo: Densley Clyne.



to bring scavengers to the scene? Or is the spider just making herself comfortable before she settles down? Who knows for sure? As I said, there are lots of gaps still waiting to be closed. □



▲Diagrams of the scaffolding (left) and the finished net (right).

she does so. You'd think the net would drop but it doesn't because *Dinopis*, hanging from her own safety line, has a firm hold of the framework. Next she reaches down with her long front legs and measures the distance between the net and the ground.

Back in position, the spider now grasps the corners of the net with her four front claws and tests it by flinging her feet apart. The net shows remarkable elasticity, stretching to several times its apparent size.

There's just one more task. Very often before she bunches up the net and goes all quiet and still and watchful, *Dinopis* flips her abdomen over and drops that splodge of white faeces directly underneath her.

The ambush spot isn't chosen at random. It may be over a stick on the ground or a horizontal stem on a shrub. Sometimes the spider angles her structure against a vertical surface — a tree trunk or fence where insects are likely to be crawling.

Sooner or later, some wandering insect crosses the spider's magic beam. Instantly she drops, flinging the net wide. Stopping her fall at exactly the right distance, she wraps the net around the insect, scoops it struggling but helpless into the air and delivers the fatal bite.

And what of that white "marker" the spider sometimes drops below her at the ambush site? Is it just that, a kind of sight-board to show up her passing victims? Is it a bait

her net comes out of a different structure, the cribellum or "little sieve", named for its peppering of tiny holes. To draw out this special silk she has a pair of elegant little combs, one on each of her two hindmost legs.

The finished net is a fragile and beautiful artefact. It takes a long time to make and it's easy to see. Not so obvious but just as important is the larger structure of "ordinary" silk threads from which the spider operates. It's a combination of watch-tower, trapeze, launching platform and weaving frame. The threads of this structure are too fine to show up well in a photograph, so I've drawn some diagrams.

Although proportions and angles may vary according to where the spider sets up, the basic design can usually be traced.

Soon after dark *Dinopis* moves out of hiding and suspends herself upright by her first and second legs, grasping lines AB, FC and DG. This is her net-making position. While she combs out the silk threads with her two hindmost legs, the claws of the third pair of legs grasp the threads and weave them together. The net starts off as a narrow ribbon. As it grows the two ends turn upwards. Finally the hollow in the centre is filled in to make a rectangle. Some minor framework threads are cut, some vertical attachment threads are added, and that's it — but there's more to do yet.

The spider moves to a head-down position, cutting through the vertical thread BC as

▼Two lovely black eyes belong to *Dinopis subrufa*. Photo: Jim Frazier.





THE HAWKESBURY

A river under threat

by Alan Jones

Invertebrate Zoology, Australian Museum

"The whole future of the Hawkesbury lies with us today. By reasonable foresight and careful planning, backed by the conditioning of public opinion, we may yet save for the future generations what could prove to be this State's greatest tourist asset." (Mr O. H. Wyndham, President of the National Trust, 1956.)

"Environmental planning for future activities in the Hawkesbury basin is probably of greater importance than for any other river basin in New South Wales, and possibly in Australia. The importance arises from the proximity of the basin to Sydney, its great area, its high recreational and scenic qualities, its historic interest and the substantial resources of minerals, water and forests which it contains." (The Hawkesbury River Valley Environmental Study Background Report, 1973.)

These quotes exemplify the importance of the Hawkesbury region, an importance that will burgeon with the rapidly growing population. Despite this, however,

during the drought of 1980-81, the water flow in some areas was predominantly sewage effluent; we continue to change the river physically with little knowledge of the effects; and we also continue to use the river in mutually incompatible ways.

This article briefly outlines the status of major environmental issues, discusses their management, and suggests some courses of action that should be taken.

MAJOR ENVIRONMENTAL ISSUES

Sewage disposal and eutrophication

By 1980, the Hawkesbury-Nepean basin was served by 56 sewage treatment works with most of the effluent being discharged into the river system. Because of expected population increases, effluent volumes should double by 1990 and treble by 2000. All treatment plants currently provide secondary treatment, which produces a clear, colourless effluent. Although

this may seem harmless, the concentrations of dissolved plant nutrients, such as phosphorus and nitrogen compounds, can be very high. These nutrients may cause explosive growth of duckweed, algae and other plants whose respiration and decomposition cause deoxygenation of the water. This process of over-enrichment is called eutrophication.

The consequences include fish kills, problems with irrigation and potable water treatment, and diminished aesthetic and recreational amenity. The water quality of about 100 kilometres of river has been affected, particularly South Creek near Windsor and the sections below the Camden and Penrith treatment plants. The extent and severity of eutrophication depend on river flows and dilution rates. The State Pollution Control Commission has developed hydrological models that predict nutrient distribution under different flow rates. High rainfall and floods dilute the effluent rapidly. However, low to medium flow conditions occur at least 70 per

ent of the time and, at the height of the recent drought, sewage effluent comprised virtually all the river flow in some areas and intolerable eutrophic effects were widespread.

sand and mining

The river and its flood plain are major sources of sand and gravel for construction purposes. Although flood plain deposits greatly exceed those in the river bed and banks, most extraction has been from the river bed between Argyle Reach and Yarramundi. Although extraction started in 1882, and today about 2,000 cubic metres of sand per day are removed, very little is known about the effects on the river. This state of affairs reduces management to empiricism and guess work.

Mining too close to the river banks may cause their collapse or destabilisation. Macrophytes such as ribbon weed, which grow in the shallows, would be lost. These plants provide essential habitat for a rich variety of fish and invertebrates. The Australian bass, for example, breeds in the upper estuary and the juveniles depend on the ribbon weed for food and shelter during their upstream migration. There is evidence that the bass population has already been affected.

The mining of the deeper river bed can also have varied physical and biological effects. Not only is the benthic community of invertebrates temporarily destroyed, but deepening the bed in one area can have interactive effects on other areas as the river finds a new equilibrium between erosion and deposition. Bed-deepening also promotes the upstream intrusion of saline tidal waters, causing problems with crop irrigation.

Another effect of sand mining is the creation of deep, turbid pools that favour blooms of blue-green algae, especially when flows are low and nutrient loads high. These algae produce metabolites that are toxic to humans and livestock. Severe illness can follow swimming in or drinking infected water. Unsightly settlement ponds and a high level of truck traffic with its associated noise, dust and traffic hazards, are also costs of sand mining – costs that must be borne by the community.

Dams

The Hawkesbury-Nepean river system supplies potable water to Sydney, the Illawarra urban areas and Gosford-Wyong, as well as towns on the river. Lake Burragorang

(Warragamba Dam) is the main reservoir and others exist on the Avon, Cordeaux, Nepean and Cataract Rivers and Mangrove and Mooney Creeks. Nine irrigation weirs occur between Menangle and Wallacia on the Nepean and, in addition, about 6,500 hectares are irrigated along the Hawkesbury, Wollondilly and lower Colo Rivers and South Creek.

Dams and irrigation reduce the flow of fresh water. Because a high proportion of the commercial fisheries value comprises species that are estuarine-dependent, reductions in freshwater inflow have been implicated in lowered productivity and fisheries returns. The school prawn is an example of an important commercial species that is adversely affected by reduced freshwater flow. Some of the hidden costs of dams may thus be borne by the fishermen and also the buying public if supply-and-demand factors force prices up. Lowered river flows also exacerbate eutrophic effects, reduce recreational amenity and permit increased intrusion of tidal saline water. The last caused a problem for the irrigation of citrus fruits, particularly during the droughts of 1980 and 1981.

Dams can also hinder or prevent the movements of species that migrate between fresh water and the sea (for example, bass, grayling and eels). The construction of fish ladders has solved this problem for jumping fish such as salmon in the Northern Hemisphere but little is known about their efficacy for Australian fish.

Wetlands

Wetlands comprise the zone between permanently submerged areas and dry land. They are particularly well-developed where tidal ranges are high and are often vegetated with swamp plants, salt-marshes and mangroves. These habitats are highly productive and provide food and shelter for migratory birds, juvenile fish and invertebrates, some of which are commercial species. Wetlands also mitigate flooding by acting as giant sponges; reduce erosion and turbidity by trapping sediments; and provide aesthetic, scientific and educational opportunities for people. All these functions require little or no expensive human maintenance and they are sustainable in that they will continue so long as we do not damage the environment.

Unfortunately, however, these aspects of wetlands have rarely been appreciated. Instead, wetlands are too often perceived as wastelands, with draining and filling for housing, tourism, industry and agriculture the result. The marshlands of the coasts of Connecticut and Massachusetts in the United States have been filled in gradually so that only half remain. This slow and steady encroachment, called the "tyranny of small decisions", is also destroying Australian wetlands.

MANAGEMENT PRINCIPLES

A central ecological concept is that various components of ecosystems are interrelated. The conse-

Extraction of sand and gravel from the Hawkesbury River in the Yarramundi area between Richmond and Penrith. Photo: courtesy Department of Environment and Planning.





Excessive plant growth (duckweed, ferns and phytoplankton) due to eutrophication in the Nepean River near Penrith. Photo: State Pollution Control Commission.

quence for management is that we can never do one thing and one thing only. Every action will start a chain reaction that may ramify in surprising ways. Major ecosystems must be managed as a unit, not in small pieces. The Hawkesbury-Nepean drainage basin comprises such a unit because it is a single large catchment area. Water is the great connecting agent in ecosystems: it transports many compounds in solution; and it erodes and physically transports materials such as sediments or detritus.

Another environmental management principle, related to the first, is that of minimum intervention. This means that humans should adapt to the natural pattern of the ecosystem rather than imposing grand development projects that may cause irreversible damage or high remedial costs. These effects are especially likely where our understanding of the system and its interrelationships is inadequate. Where more knowledge is available, it is particularly important to evaluate *all* the major physical, biological and social consequences of development *early* in the planning process. This will provide a basis for decision-making, subsequent planning and promote efficient resource use.

WHAT SHOULD BE DONE?

Firstly, a regional environmental plan should be prepared. This is necessary because some uses are

mutually incompatible and the river is already overstressed. Because high water quality is the prime requirement, only activities compatible with the maintenance of high water quality should be permitted. A regional planning emphasis is necessary because of the interactive nature of many activities and the connecting role of water. For example, both sewage disposal and sand mining affect water quality many miles downstream.

Secondly, a mechanism enabling effective co-ordination between government bodies is needed. Over 25 such bodies exist, each with narrowly-defined areas of responsibility. Good regional management will not flow without good co-ordination.

With respect to individual issues previously discussed, the following suggestions are made.

Sewage disposal can be improved in several ways. Firstly, the effluent could be pumped elsewhere. The coast or inland of the Blue Mountains has been suggested. This option is expensive and removes large volumes of water from the catchment area permanently. Secondly, more effluent could be used for irrigation. This idea is attractive because it follows the ecological recycling principle and water would not be lost. The excess nutrients could go into useful production rather than creating eutrophication. If this could be developed on a sufficient scale, demand on river water

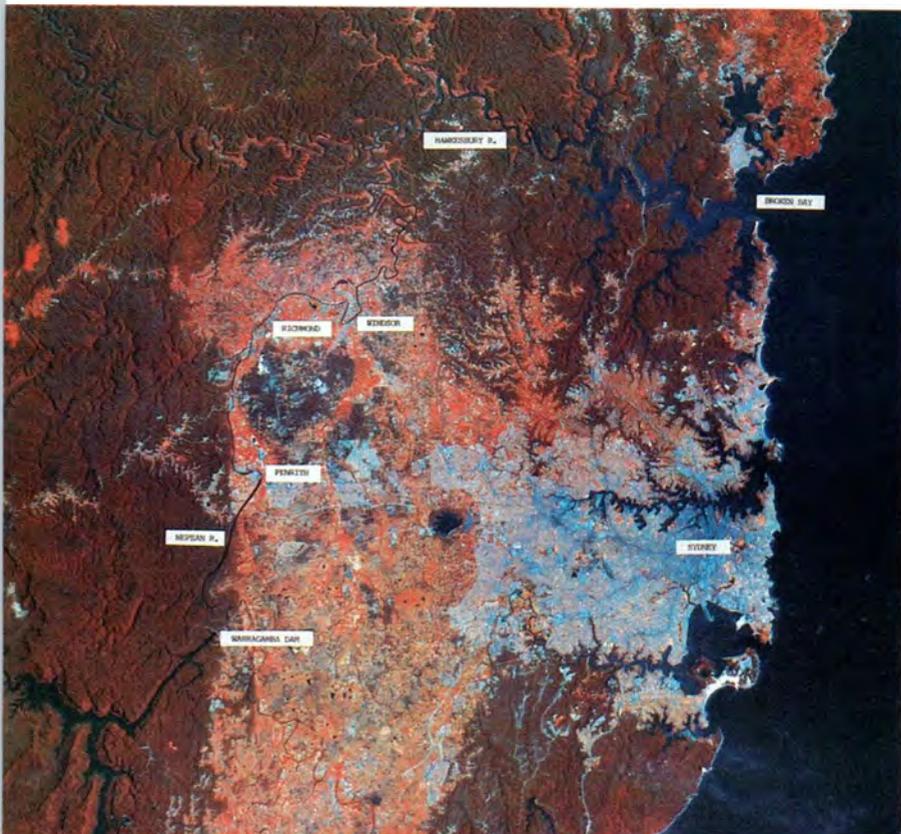
for irrigation would fall. Sewage sludge could also be used for composting. The third major option involves upgrading the level of treatment, thereby removing nutrients. A combination of the second and third options may well prove satisfactory.

Because the side effects of mining the river bed for sand are either uncertain or undesirable and because terrestrial reserves far exceed those in the river bed, mining the river bed should be phased out. Terrestrial sources could be favoured wherever possible and extraction should be concentrated into fewer larger sites to reduce overall scenic degradation and enable better planning control. A prime example of the latter is the Penrith Lakes Scheme. This scheme seeks to extract sand and gravel from 2,000 hectares of the Castle-reagh flood plain near the Nepean River. It would also rehabilitate the area after extraction by creating a lake system suitable for recreation and wildlife.

The controlled release of water from dams would guarantee at least some water flow below the dam. This should ameliorate the previously-mentioned problems usually associated with dams. However, the need to release water would be greatest during droughts when the need to conserve it is also greatest. Thus we need either additional sources of water or more efficient use with less consumption. Further impoundment of the basin's rivers to provide more water is a receding option. Only the Colo and Macdonald Rivers remain free-flowing but both have high recreation and wilderness values. External sources such as the Shoalhaven River are already being tapped. Increased efficiency and decreased consumption would require appropriate pricing policies and public education. Water is the key resource in the region. Ultimately, the major challenge in water management is to live within our means.

Wetlands and their buffer zones should all be placed under protective environmental zonings. Where development is proposed, the onus should be on the developer to demonstrate it is in the public interest to proceed. Particular attention should be given to the prevention of accelerated silting of lakes due to soil disturbance. The public ownership of significant wetlands may ensure their protection best.

Recreation is forecast to become the dominant use for the



Infra-red satellite image of the Hawkesbury-Nepean river system and surrounds. The infra-red light causes healthy vegetation to appear red, rolling grassland pink, urban areas blue and water blue-black.

Hawkesbury-Nepean region. The capability of different areas to accommodate recreational activities varies greatly. The protection of vulnerable areas, such as high sandstone ridges and river banks, is crucial and a recreation capability map would be a valuable guide. Recreation would be promoted by resolving the sewage disposal problem, phasing out river bed sand mining and guaranteeing river flows by controlled release of water from dams.

CONCLUSION

Environmental problems in the Hawkesbury are serious and, in the absence of remedial action, will worsen due to the increasing population. The next major drought will see a return to the intolerable eutrophication of the early 1980s. More than half the length of the river between Camden and Broken Bay will suffer excessive plant growth. This will diminish aesthetic appeal and create problems with irrigation and drinking water. Deoxygenation of the water and ammonia toxicity will kill many animals and some areas will be unsafe for swimming.

Recommendations for rectifying this situation have been made by the National Trust, the Department of Environment and Planning, the State Pollution Control Commission, and other bodies. The need for co-ordinated, regional management is clear. The political action to implement this is the next step and is urgently needed. It would be a fitting bicentennial project. □



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Bunyip Surfaces in TV Series

A TV series now in production explores claims of bunyip finds in the 19th century. The documentary series, *Australia's Improbable Animals*, shows "evidence" of the existence of buniyps dragged out of the Murrumbidgee and Hawkesbury Rivers.

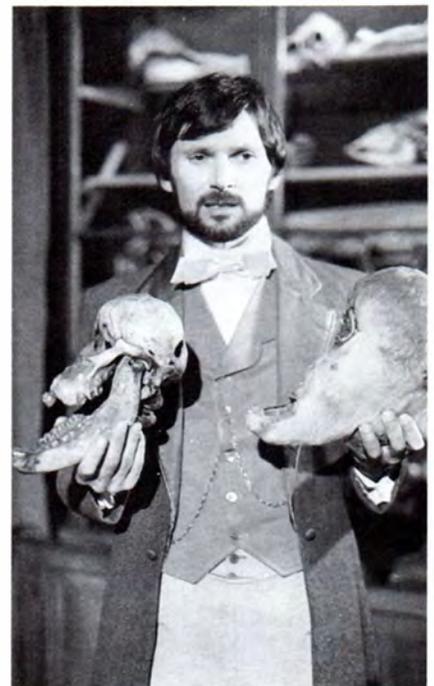
The story of these bunyip finds is contained in a letter to the editor of the Sydney Morning Herald on July 5, 1847, by W.S. Macleay, Esq. (the original owner of Elizabeth Bay House). The "Hawkesbury monster" was found in 1841 and Macleay described it as "a true Cyclops". The skin of the head and the skull are still held by the Macleay Museum at the University of Sydney. An extraordinary skull found in the Murrumbidgee River in 1846 was exhibited as a "bunyip" at the Colonial Museum in Sydney.

Australia's Improbable Animals uses the bunyip stories to show attitudes of the notebook naturalists of the 19th century. The first part of this four part series shows the discovery of Australian animals by navigators, explorers and early settlers. The second part, titled "The Drifting Museum" will show why

Australia's animals are so different from those of the rest of the world. It will show the "new immigrants", such as bats and rodents, that found their own way here, and the "intruders", animals introduced in the last 200 years, and the impact they have had on native wildlife.

Australia's Improbable Animals is being produced under the Australian Government's taxation incentive scheme for production of Australian films. Under this scheme investors can claim up to 133% of their investment as a tax deduction. The series will be designed for distribution overseas. Part one has been completed, part two is in production, parts three and four are 50% funded. Executive producers and distributors, Channel Communications, have given a distribution guarantee of a minimum 50% return to investors. The series is being produced and directed by Gary Steer.

Further details can be obtained from Channel Communications, 11 Kellett St, Kings Cross, Sydney, 2011. Tel. 358 3976 or 358 3442.



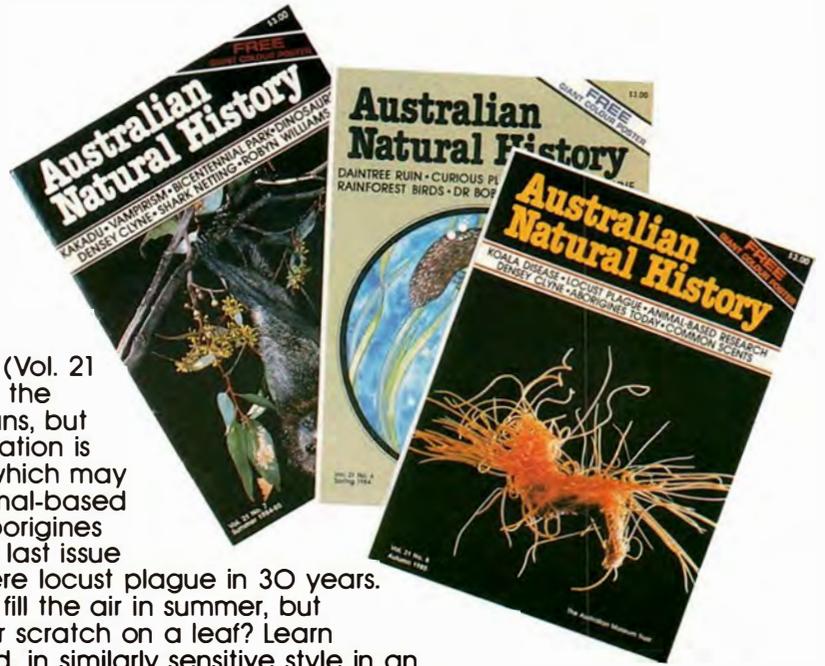
A skeptical museum curator (played by Michael Long) displays the skull and stuffed head of an 1841 bunyip, the "Hawkesbury Cyclops". It was later announced the skull was of a foal grossly deformed by hydrocephalous.

Read the Natural Authority

The autumn issue of *Australian Natural History* (Vol. 21 No. 8) looked at Australia's very own Koala – not the cute and cuddly furball familiar to most Australians, but the scraggy, disease-ridden animal whose population is fast dwindling. A vaccine has been discovered which may be the Koala's saviour. Besides a debate on animal-based research, a photographic essay on Australian Aborigines today and a colourful look at marine worms, the last issue also includes an account of Australia's most severe locust plague in 30 years.

Most of us have heard the insect sounds that fill the air in summer, but have you ever heard a moth hiss, or a caterpillar scratch on a leaf? Learn about these sounds and how they are made and, in similarly sensitive style in an article entitled *Common Scents of the Bush*, let your olfactory glands be stimulated with a nostalgic walk through Sydney's bush.

In previous issues we looked at vampires (the facts and the fiction) and the status of Queensland's flying foxes. Tourism in Kakadu National Park is critically evaluated and the existence of the Thylacine in Tasmania is questioned.



WATCH OUT IN COMING ISSUES ...



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