SEPTEMBER 15, 1952.

The AUSTRALIAN MUSEUM MAGAZINE

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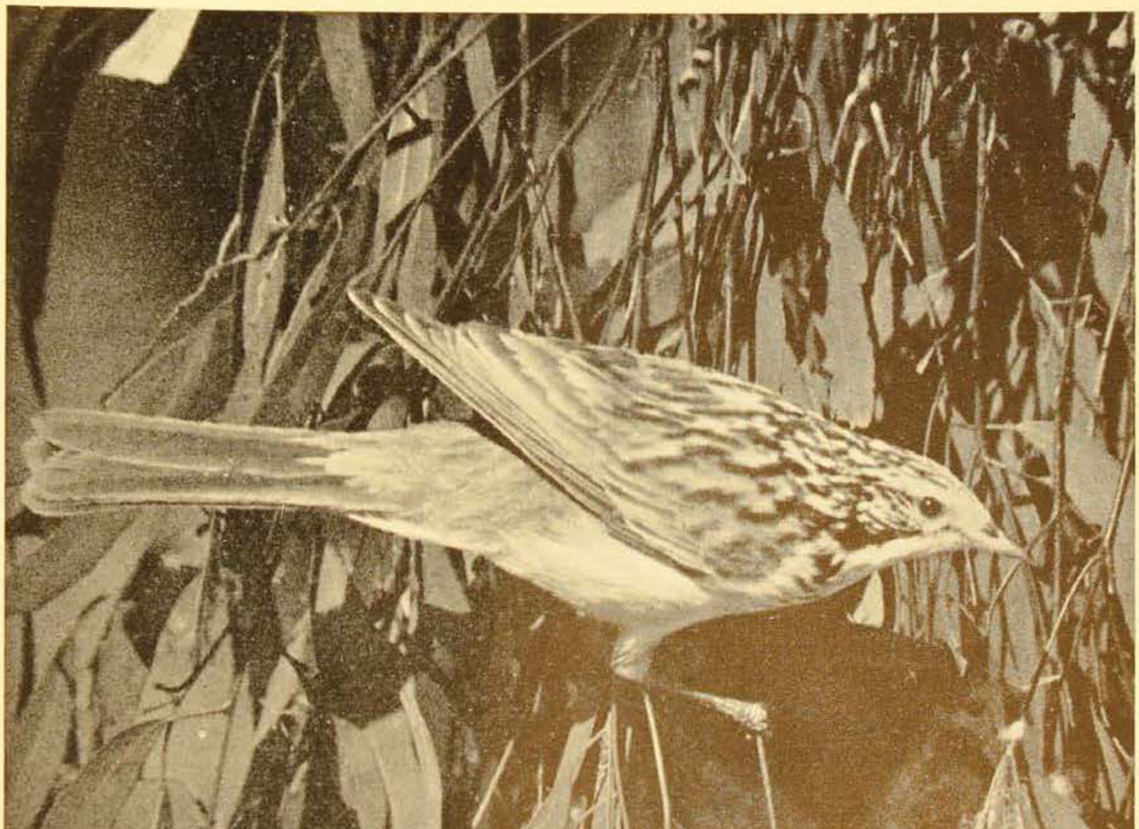

Striped Honeyeater.

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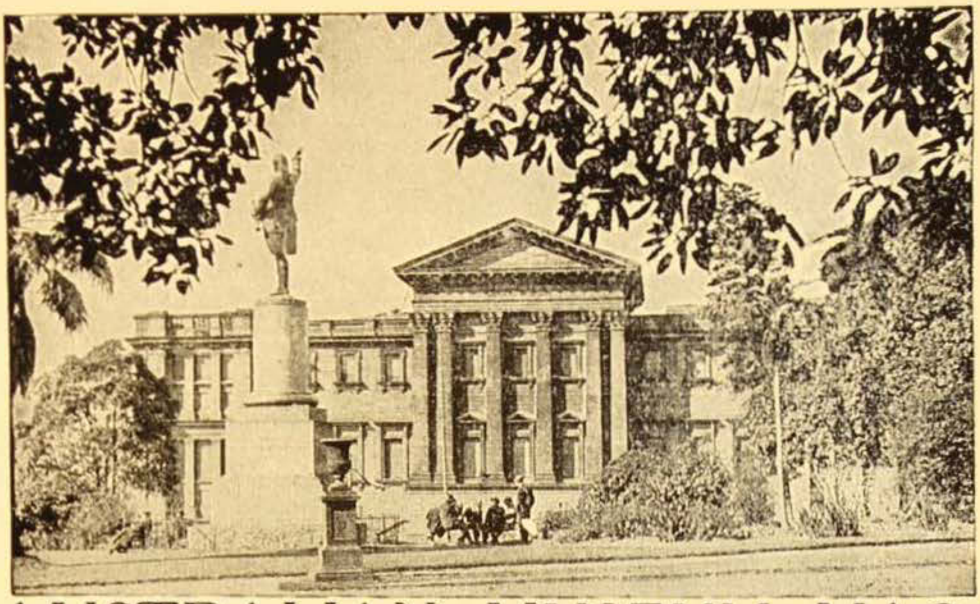
THE AUSTRALIAN MUSEUM

HYDE PARK, SYDNEY



THE AUSTRALIAN MUSEUM MAGAZINE

(*Photography, unless otherwise stated, is by Howard Hughes, A.R.P.S.*)

● OUR FRONT COVER. The Striped Honeyeater (*Plectorhyncha lanceolata*) is one of the many species of Honeyeater to be seen in the New South Wales Mallee in a good season when blossoms are abundant. See article on page 343.

Photograph—N. Chaffer.

VOLUME X, NUMBER 11. SEPTEMBER 15, 1952.

A Spotted Nightjar on its nest—a fine example of avian camouflage.

Photo.—N. Chaffer.

THE AUSTRALIAN MUSEUM MAGAZINE

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VOL. X, No. 11. September 15, 1952.

Birds of the New South Wales Mallee

By ARNOLD R. McGILL

IN the central-western and south-western parts of New South Wales there are fairly extensive tracts of Mallee. R. H. Anderson (*The Trees of New South Wales*) briefly defines such vegetation as "small-growing Eucalypts, generally with a large bulbous root-stock which throws out several comparatively thin stems." There are about ten species in the western parts of the State, most common in the southern half of the Division. Mallee is regarded as important in checking soil erosion by wind action and in providing useful shelter for stock. Some species are of value for honey production and others for the essential oils they yield. Interspersed through such areas "are tracts of heather-like scrubs of great variety, *Melaleuca*, *Banksia*, *Grevillea*, *Casuarina* and *Acacia*, with belts of pines (*Callitris*), and sweeping grassy plains, according to the local nature of the soils, which range from dark or tawny-coloured sandy loams to almost pure dune sand".[1] Dominant undershrubs are "spinifex" (*Triodia*), blue-bush (*Kochia*) and saltbush (*Atriplex*). It is in its widest sense that the ornithologist usually refers to the Mallee.

The Mallee of north-western Victoria is extensive, and numerous articles have been written about its avifauna. A recent discussion on the bird-life of the region has been published by A. H. Chisholm.[2] A comprehensive bibliography of almost fifty relevant titles is appended. There are also accounts of the birds of similar areas in South Australia and in Western Australia. In New South Wales Mallee country extends for a considerable distance north of the Murray River and it is the haunt of most of the same species of birds that occur in the Mallee of the other States. However, there does not appear to be any published summary of the bird-life of such a habitat in New South Wales.

In recent years much of the Mallee has been cleared for wheat farming, though considerable stretches still remain. The 1951 Camp-out of the Royal Australasian Ornithologists' Union at Lake Hattah, Victoria, and a car journey from Sydney along the Mid-western Highway, presented a brief opportunity for me to appreciate this type of country and its interesting and specialised avian inhabitants.

The Mallee Fowl, or Lowan (*Leipoa ocellata*), is probably the most distinctive of the Mallee birds. This species places its eggs in a large mound of sand and decaying vegetation and incubation is effected by the heat of the sun. Although

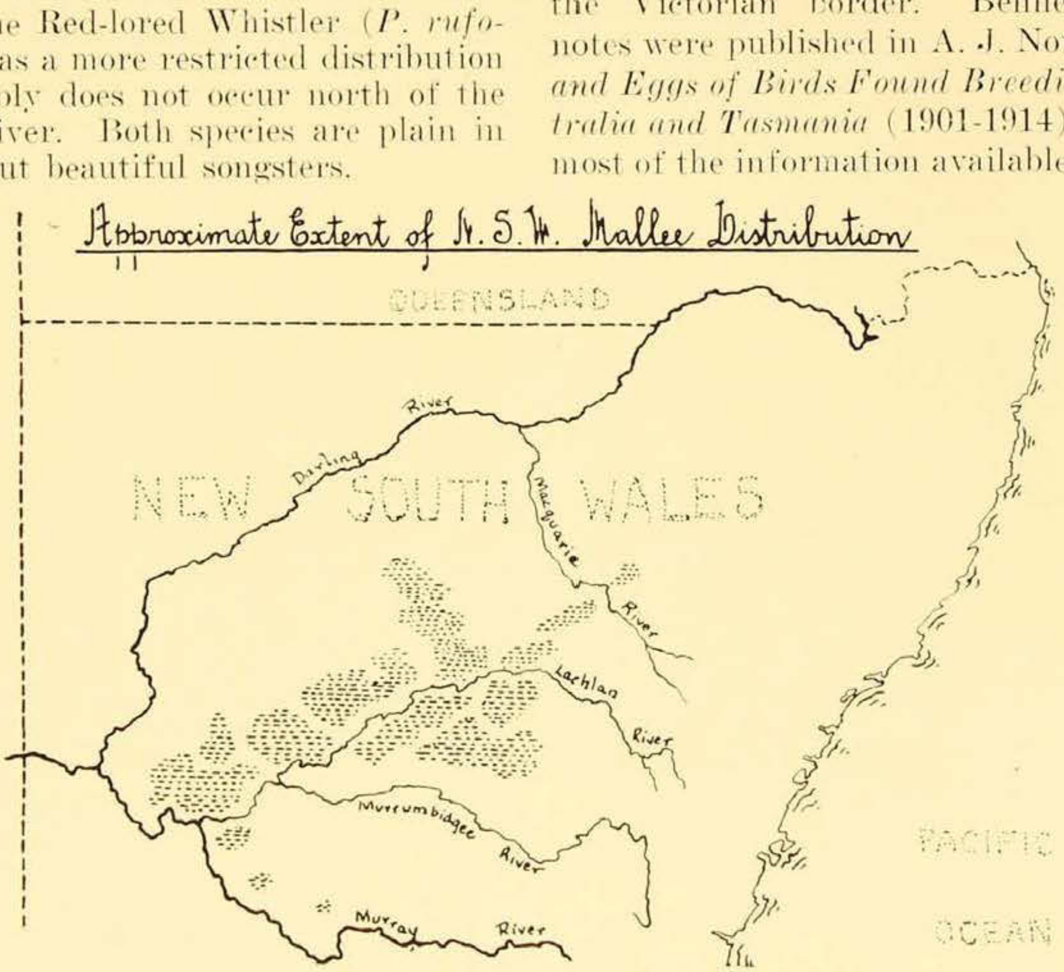
[1] A. G. Campbell, *Emu*, vol. 33, p. 195.

[2] *Emu*, vol. 46, pp. 168-186.

A nesting mound of the Mallee Fowl in course of construction in typical Mallee country.
Photo.—K. A. Hindwood.

found wherever suitable habitats exist, it is becoming rare and needs all the protection it can be given, including the control of the fox, probably the greatest enemy of this shy bird, especially as it digs out the eggs from the mound. The Gilbert Whistler (*Pachycephala inornata*) is another typical Mallee bird, but little is known of its occurrence in New South Wales. Its close relative, the Red-lored Whistler (*P. rufogularis*), has a more restricted distribution and probably does not occur north of the Murray River. Both species are plain in plumage but beautiful songsters.

The Chestnut Quail-Thrush (*Cinclosoma castanotum*), a conspicuously-marked ground bird, seems well-dispersed, as is its companion of the leaf-strewn Mallee "floor", the Southern Scrub-Robin (*Drymodes brunneopygia*). Both were found breeding by K. H. Bennett in the Mossgiel district, New South Wales, well north of the Victorian border. Bennett's field-notes were published in A. J. North's *Nests and Eggs of Birds Found Breeding in Australia and Tasmania* (1901-1914). In fact, most of the information available on Mallee



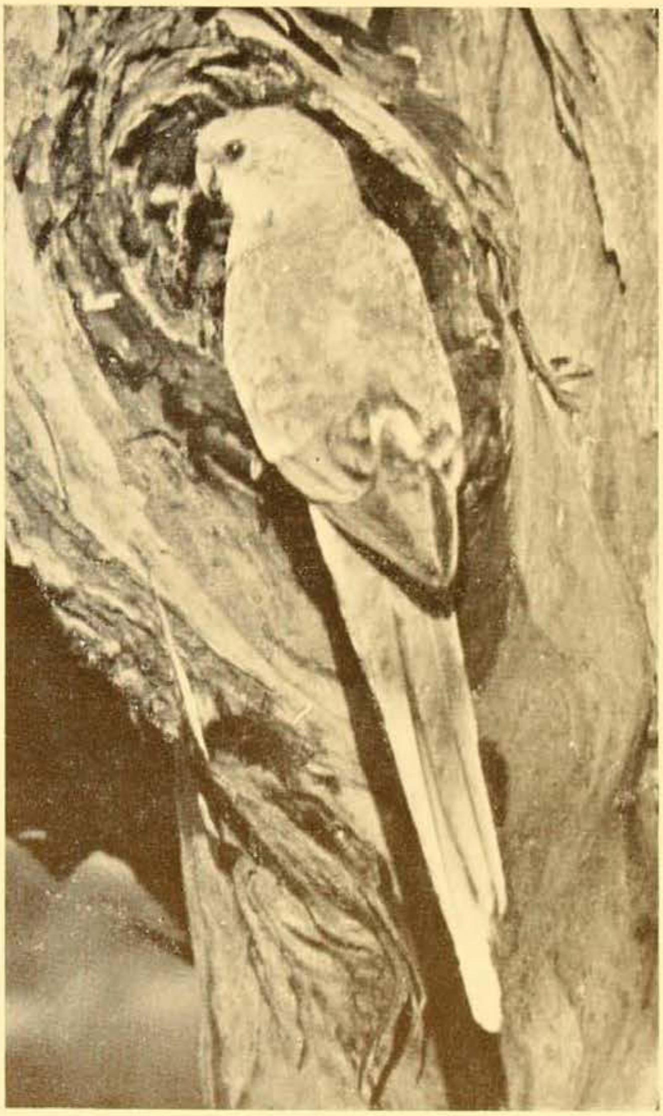
birds in New South Wales is from that source, and also in a few useful local lists of western areas published in *The Emu*.

The Shy Ground-Wren (*Hylacola cauta*), a near relative of the Heath Wren (*H. pyrrhopygia*) found near Sydney, has been noted in a few localities. The Striated Grass-Wren (*Amytornis striatus*) and Thick-billed Grass-Wren (*A. modestus*) both occur, but are timid and rare and can only be seen to advantage if the observer is fortunate enough to find a carefully hidden nest, or the young birds. The adults then lose much of their shyness. Several fairy-wrens occur in the Mallee, the Black-backed Wren (*Malurus melanotus*) being typical. The beautiful blue plumage of the adult male amongst the drab browns of the undergrowth is a sight to remember.

Honeyeaters are usually nomadic and in good season, when blossoms are abundant, many species are to be observed. The Yellow-plumed Honeyeater (*Meliphaga ornata*) is possibly the most widely-distributed member of the family in such areas, but the Brown-headed (*Melithreptus brevirostris*), Striped (*Plectorhyncha lanceolata*), Black (*Myzomela nigra*), White-fronted (*Gliciphila albifrons*), White-eared (*Meliphaga leucotis*), Spiny-cheeked (*Acanthagenys rufogularis*) and the noisy Red Wattle-bird (*Anthochaera carunculata*) are all conspicuous, although by no means confined to Mallee.

Parrots are plentiful and varied. The swift flight of Regent Parrots (*Polytelis anthopeplus*) over the stunted trees, when the late afternoon sun turns their plumage to black and gold, is a glorious sight. However, that species is infrequently recorded in New South Wales as it chiefly lives "south of the border". The Ringneck (*Barnardius barnardi*), Mulga Parrot (*Psephotus varius*) and Yellow Rosella (*Platycercus flaveolus*) are all fairly common, while the beautiful Pink Cockatoo (*Kakatoe leadbeateri*) adds further colour as it flies slowly over.

The Yellow-tailed Pardalote (*Pardalotus xanthopygus*) and Red-rumped Thornbill (*Acanthiza albiventris*) are small birds of the outer foliage. They are usually considered Mallee or inland representatives of the Spotted Pardalote (*P. punctatus*) and Brown Thornbill (*A. pusilla*) respectively, although there are noticeable differences in plumage and call-notes. I observed a pair of Black-winged Currawongs (*Strepera melanoptera*) in Mallee country near Balranald. No published record of this bird in New South Wales is known, though Norman Favaloro, of Mildura, has seen it occasionally north of the Murray. It has been suggested that this bird is a subspecies of

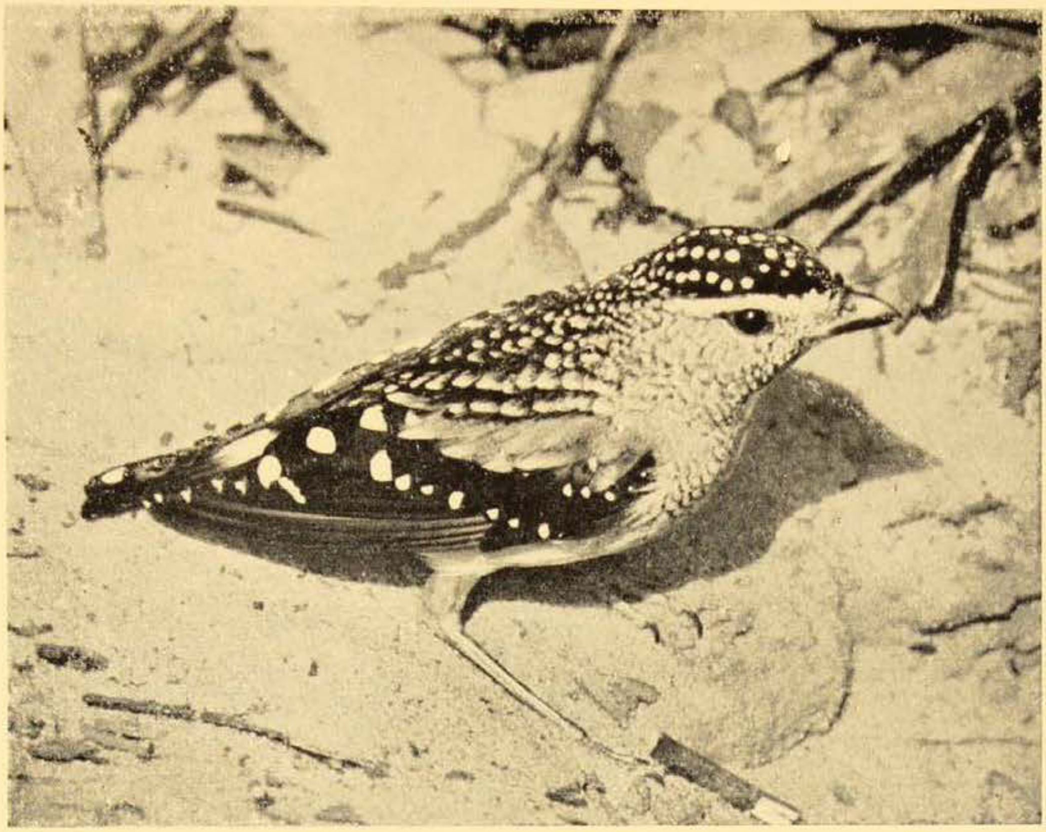


A Mulga Parrot, one of a number of species of parrot found in the Mallee.

Photo.—N. Chaffer.

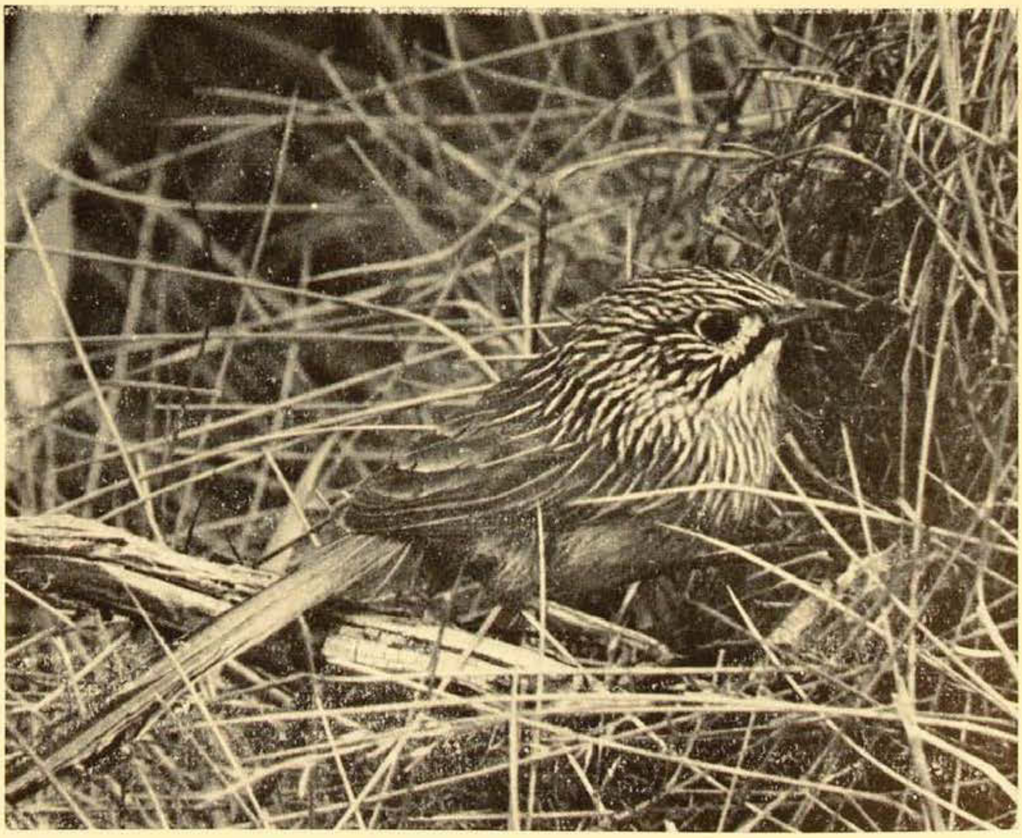
the widespread Grey Currawong (*S. versicolor*), linking the eastern and western populations, but it differs both in plumage and voice.

Several species of Mallee birds occurring in northern Victoria have not yet been recorded from such a habitat in New South Wales. These include the Red-lored



The Yellow-tailed Pardalote (*Pardalotus xanthopygus*). Its nest is built of bark at the end of a short tunnel in the ground.
Photo.—N. Chaffer.

Whistler, previously mentioned, Mallee Emu-Wren (*Stipiturus mallee*), Dusky Miner (*Myzantha melanotis*), Samphire or Dark Thornbill (*Acanthiza iredalei*) and Rufous Field-Wren (*Calamanthus campestris*). A subspecies of the last-mentioned, however, was described by G. M. Mathews from Broken Hill, which is probably an extension of some South Australian population. A considerable area of country between the Murrumbidgee and Darling rivers, south of Mossgiel to the Murray, has apparently never been ornithologically investigated. Such a survey would obviously reveal much of interest and, perhaps, several of the above species.

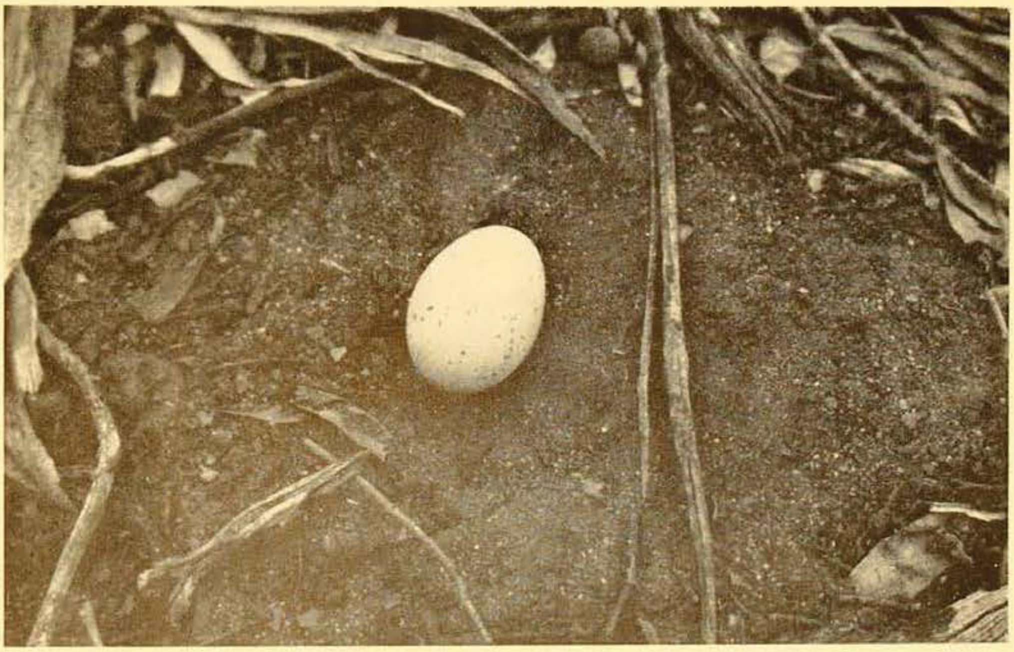


The Striated Grass-Wren (*Amytornis striatus*) is timid and rarely seen. It nests in grass close to the ground.
Photo.—N. Chaffer.

The bird life of Mallee areas is plentiful and varied, but many of the species are probably just as common in other habitats. In this respect brief mention might be made of such birds as the Purple-crowned Lorikeet (*Glossopsitta porphyrocephala*), which only doubtfully occurs in New South Wales, Spotted Nightjar (*Eurostopodus guttatus*), Brown Weebill (*Smicrornis brevirostris*), Crested Bellbird (*Oreoica gutturalis*), Chestnut-crowned Babbler (*Pomatostomus ruficeps*), Black-capped Sittella (*Neositta pileata*) and Little Crow (*Corvus bennettii*).

There is reason to believe that no Mallee-frequenting species of bird has as yet been exterminated in New South Wales. Nevertheless, as more of the area becomes settled, there is a possibility of such a calamity. The obvious remedy is the formation of sanctuaries embracing much of the Mallee areas that still remain, and the control of introduced pests such as the feral cat and the fox. Victorians are justly proud of large areas in the north-west of their State which have been proclaimed as national parks. Nothing of a similar nature has been established in New South Wales.

Mallee country is often considered useless from an economic viewpoint and is largely thought to be without appeal by the uninitiated. However, naturalists think of such areas, with their peculiar and distinct forms of plant and animal life, as places of unusual interest and, at times, enchantment.



The egg of the Spotted Nightjar in situ.
Photo.—A. R. McGill.

Lagoons, such as the one shown above, where water plants are abundant, are ideal for collecting freshwater molluscs.

The Shells of Rivers and Lakes—I

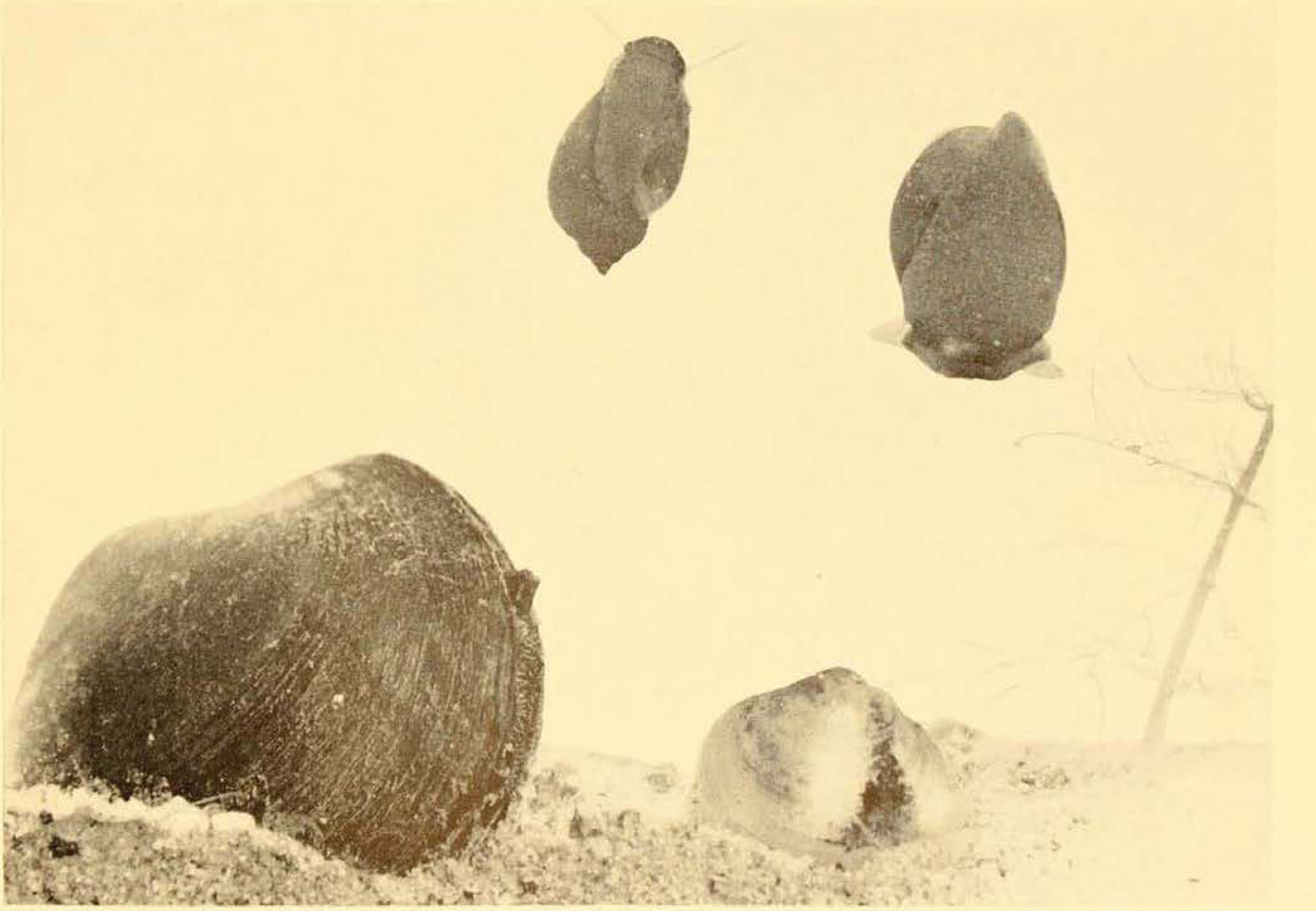
By DONALD F. McMICHAEL, B.Sc.

BY far the greater number of so-called shellfish, or molluscs, live in the sea, and most people will immediately associate shell collecting with a visit to the seashore. However, in the freshwater lakes and ponds, rivers and creeks, several types of molluscs are found, sometimes in great numbers, and these can provide interesting shell collecting for those who can visit the beach only occasionally.

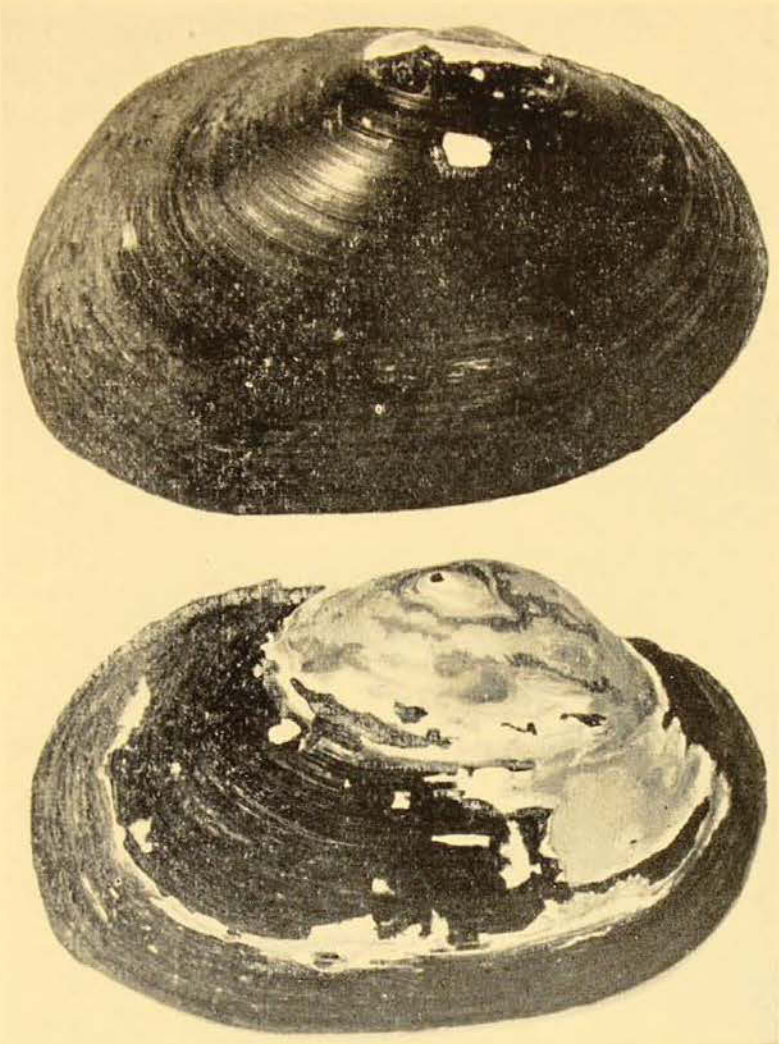
In the sea where the molluscs are believed to have evolved from some primitive worm-like creature many ages ago, five major groups of shellfish are now found, each differing somewhat from the others, yet retaining a few important common characteristics, such as the presence of a shell at some stage in their life history. These groups are the Gastropods, which have snail-like shells, the Loricates or Coat-of-Mail shells, the Scaphopods, or Elephant's Tooth shells, the Cephalopods, including the Squid and Octopus, and the Pelecypods, which have a bivalved shell of two more-or-less similar halves. Of these, only the Gastropods, and the Pelecypods have managed to conquer the freshwater environment, and only the Gastropods, have conquered the land, where they are abundant as land snails and slugs. Some of the other groups are found in brackish coastal lagoons, or in river estuaries, but they do not occur in truly fresh water.

Freshwater shells are found all over the world, with the exception of the great deserts, such as the Sahara and the Gobi. Why then are molluscs so rare in fresh water as compared with the sea, and why are only these two groups represented? It is not known why the Cephalopods and the other groups have been unable to invade fresh water, but probably they have been unable to withstand the lower salt concentration, which tends to cause water to pass into their bodies, a danger which the gastropods and bivalves have been able to overcome. The rarity of fresh water species is because of the rigorous and variable nature of the fresh water environment. The prime necessities of molluscan life seem to be lime, for forming the shell; a place where they can live without the danger of being washed away and where they can crawl about freely in search of food; and finally, the food itself.

The greater part of the shallow sea is populated by some molluscs who find there what they need for existence. Throughout the world sea water is alkaline and contains an abundance of lime, sufficient even for the giant clam shells. Food is always plentiful, consisting mainly of the microscopic unicellular algae and the larger seaweeds, as well as other smaller animals for the carnivorous types. Conditions are such that each species can find a home where it can search for food without being washed away, except in stormy weather, when great numbers are killed by the pounding surf, and washed onto the beaches. Some certainly live on the rocky coasts where they are subject to the battering of the waves but these have a specially strong foot with which to cling on to the rocks, and often a thick shell as an added protection. But fresh water is vastly different. It starts as rain, and contains little or no



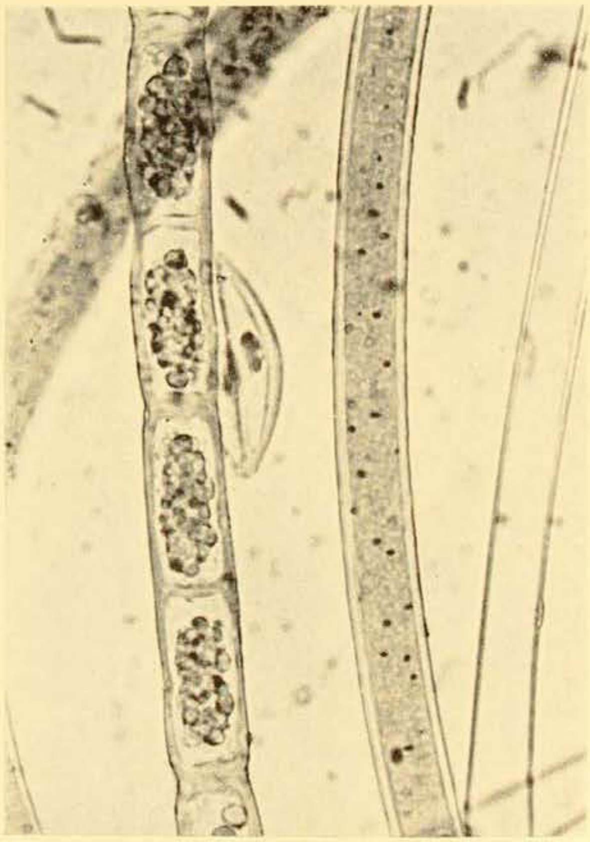
Some common Sydney freshwater molluscs. Burrowing in the sand are, left, a fresh water mussel, *Velesunio transitus*, with its siphons extended between the valves, and a smaller bivalve, *Corbiculina australis*. The snails are typical of the two commonest families. On the left is *Lenameria gibbosa* (Family Bullinidae), which has a sinistrally coiled shell, narrow tentacles, and a small foot; the larger snail on the right is *Peplimnea opima* (Family Lymnaeidae) which has a broad triangular foot, broad short tentacles and a dextrally coiled shell (x 1½).



Specimens of the common inland New South Wales mussel, *Velesunio balonnensis*. The shell above is smooth, showing little erosion and probably grew under fairly constant conditions. The lower shell is heavily eroded and has a large growth ridge which is also eroded about ½" from its lower edge, caused by droughts and changes in the acidity of the water.

food or dissolved salts, such as lime, and is often quite unpredictable in amount and duration. The rivers may be flooded one year and dry the next; a quiet stream may become a raging torrent overnight, or may remain dry for many years. Dissolved salts can only come from the rocks and soil over which rainwater and rivers flow, and plants and animals which serve as food can only grow when conditions are right for them.

Thus, in the smaller creeks around Sydney, molluscs are quite rare for several reasons. The streams flow mostly over Hawkesbury Sandstone rocks, which contain little or no lime. They drop quickly down steep valleys over rapids and waterfalls to the larger rivers, and being only small streams, there is little in the way of microscopic plant life, as it is quickly washed away. The larger plants, such as water-lilies, water-grasses, reeds and the like, are unable to grow, for they need a muddy bottom, and most of the mud is also washed away.



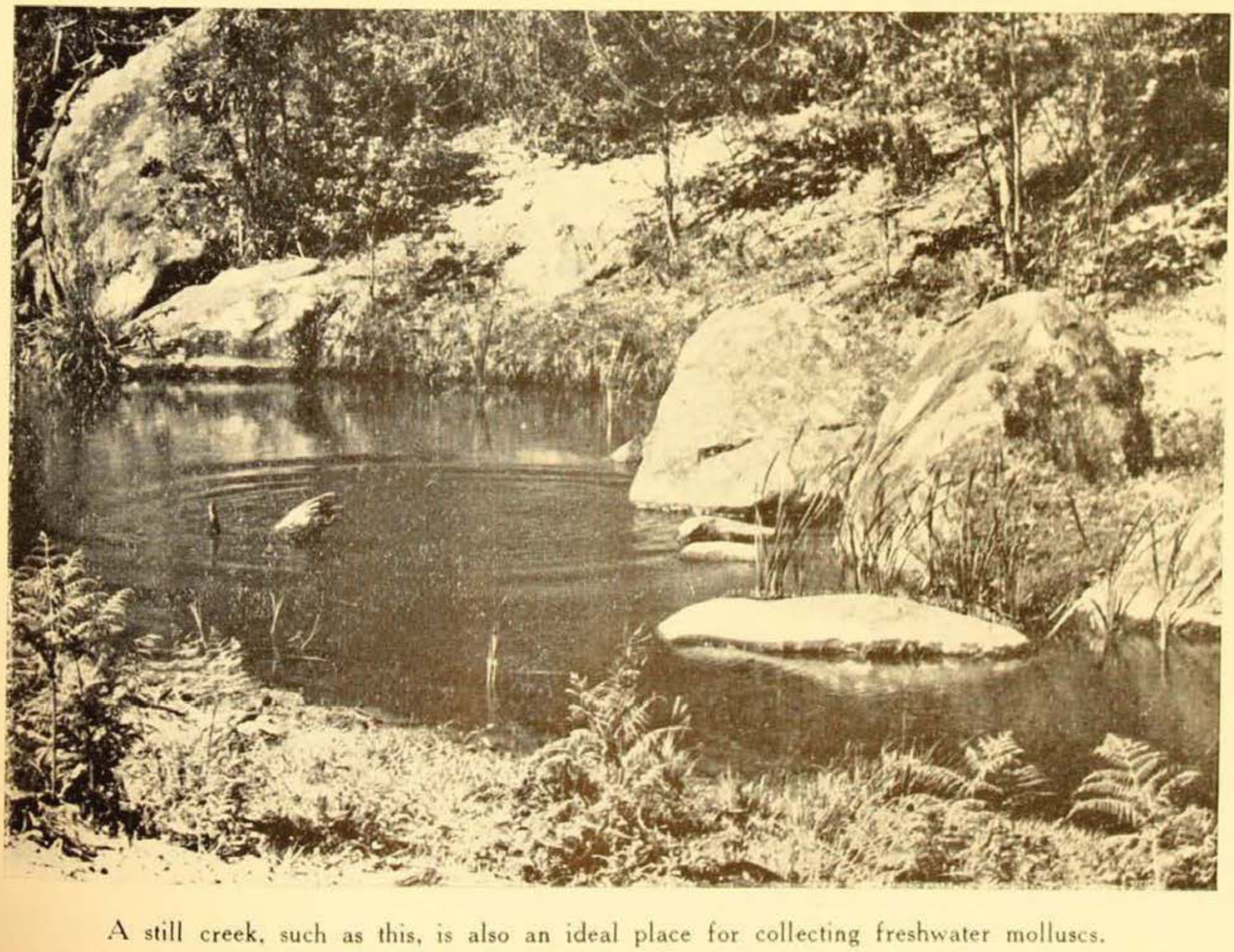
Photomicrograph of filamentous algae and a single celled alga, one of the Desmids, common in river water, near Sydney. Desmids and Diatoms provide food for freshwater bivalves, while freshwater snails feed on the filamentous algae and diatoms coating rock surfaces, as well as the larger plants. (x 300).

Photo.—Prof. P. D. F. Murray.

A few freshwater molluscs are adapted to live in very fast-flowing water, and have a clinging foot, enabling them to resist the current, and to creep along, feeding on the slimy algae which coat the rocks. But no mollusc can live in water in which there is insufficient lime to form a shell. The absence of lime, together with the presence of large amounts of the gas carbon dioxide, causes the water to become acid, and this tends to dissolve away the shell, as can easily be seen in most large fresh water mussel shells. The shell around the beaks, which is the oldest part of the shell, is usually heavily eroded, due to variation in the acidity of the water.

These various factors also account for the fact that molluscs are frequently found in abundance in one stream or pond, and yet may be absent only a few miles away. This patchy distribution can be attributed to one of the necessary conditions for molluscan life being present in one stream, and absent in the other. For instance, molluscs are abundant in the larger rivers near Sydney, such as the Woronora, or George's River, because these flow for many miles and can dissolve sufficient lime over their courses. Also, they have cut down through the rocks so that they do not flow very fast, and mud and sand can accumulate on the relatively flat bottom. However, shells are seldom found in the tributary creeks which flow into them.

Variations in these conditions can have marked effects on the shells. Fresh water mussels from rivers whose waters are poor in lime are often quite thin and weak, while the same species from a river rich in lime will have a strong thick shell. During severe droughts, the rivers and creeks dry up, and the shells may become dormant. Fresh water mussels will then bury deeply into the mud and their shells will cease growing, becoming thickened at the edge. When rain comes again, the shells may emerge and grow quickly, leaving a thick growth line on the shell which marks the dormant period. Mussels in particular can withstand long periods without water and,



A still creek, such as this, is also an ideal place for collecting freshwater molluscs.

in fact, one mussel was sent from Australia to England by sailing boat and revived on arrival 498 days later when placed in an aquarium.

If you are interested in collecting fresh water shells, therefore, you must select your place carefully, or your search may be in vain. Find a pond or stream which is not flowing too fast, and where there is plenty of plant life, either as streaming filamentous algae coating the rocks, or where the higher plants line the banks and grow in the shallower parts of the stream. Look also for a sandy or muddy bottom in which the shells can bury themselves, and finally, a stream which flows over soil or rocks which contain a fair amount of lime, that is, where the water is "hard" or alkaline. You should be able to find many different types of freshwater snails, mostly living on the water plants, or crawling over the rocks coated with algae and mosses; perhaps the tiny freshwater limpets, *Ancylus*, clinging to plants; or freshwater mussels, and their smaller relatives, the Corbiculinas and the Pea Shells (*Sphaerium*) partly or completely buried in sand or mud.

Most of them will live quite well in an aquarium, if the water is changed fairly regularly, and a sandy bottom and a few water plants are provided.

In the next article, I will describe the different kinds of fresh water shells which are found in Australia and tell you something of their habits.

Review

UNDERSTANDING HEREDITY—AN INTRODUCTION TO GENETICS. By Richard B. Goldschmidt, University of California. Pp. x and 228 with 49 figures. John Wiley and Sons, Inc., New York, 1952. Price $3.75.

On each occasion when Richard Goldschmidt has set out to tell non-specialists about his chosen field of research the result has been a delightful and stimulating book. "Understanding Heredity" is no exception in this regard and the author, a noted geneticist, describes, step by step, the experiments done in the last century, to discover and test the various laws and principles which are now known to govern inheritance. The reader is, as it were, taken into all the great genetics laboratories to see the experiments which have been and are being done so that he can see for himself the results and judge the true way in which heredity works.

The work is splendidly illustrated by clear line drawings which show in a graphic and memorable way how traits are passed from generation to generation. Those demonstrating statistical principles, as applied to analyses of behaviour of hereditary traits, are particularly clear. In fact, many teachers of mathematics might envy the author's facility at explaining and giving examples to illustrate the laws of chance and of probability.

As the author points out, a little concentration may be needed to follow all the arguments but, because of the intensely practical approach adopted, any reasonably interested person should be able to acquire from this one book a good basic knowledge of the science of genetics. The book has been produced with two main objects. To provide firstly a readable account of the basic facts of genetics for non-biologists and secondly to enable people to judge between the claims of the orthodox geneticists and those of believers in the Communist creed of Lysenkoism.

"Understanding Heredity" will supply the answers to most queries on heredity and gives the answers to such fascinating questions as "How accurate can blood tests for paternity be?", "What is the Rh blood group and how is it inherited?", or "How can two parents of only medium height have very tall offspring?" and a host of other questions of practical interest to the man in the street.

The work can be thoroughly recommended as an accurate, readable and fascinating account of that most interesting of subjects, heredity.

E. C. POPE, M.Sc.

Model of a Gilbert Islander of old wearing a porcupine fish skin helmet and sennet armour and carrying a shark-tooth sword.

After Auckland Museum. Ann. Rept. 1919-20.

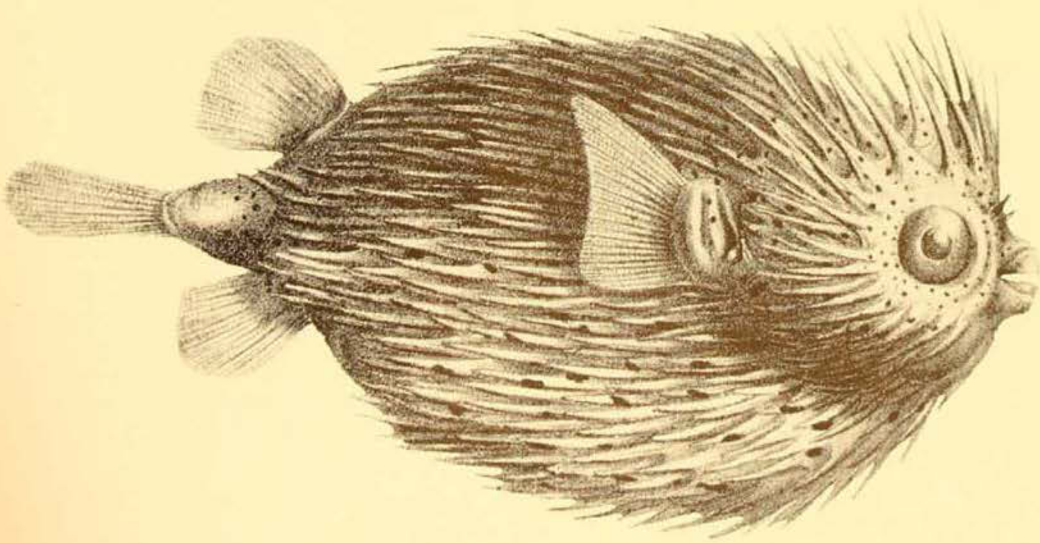
Porcupine Fishes

By GILBERT P. WHITLEY

A modern Gilbert Islander with an inflated *Diodon hystrix* at Tarawa.

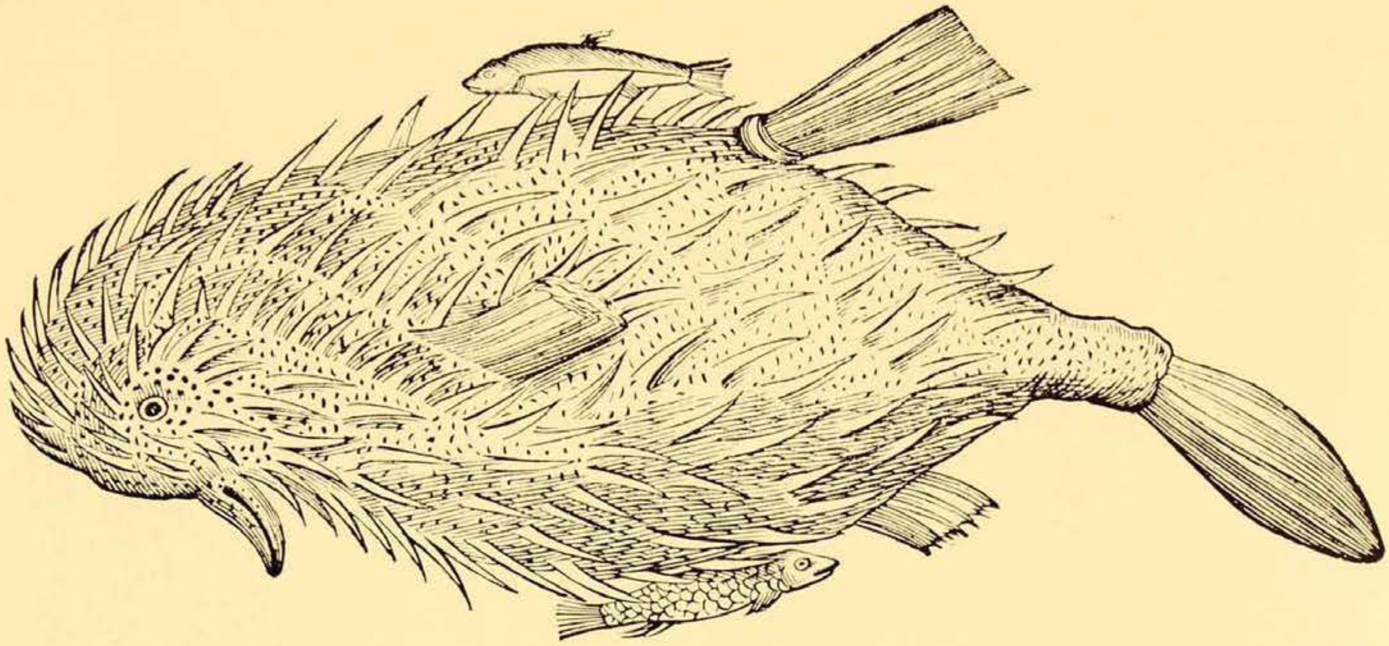
Photo.—R. Catala.

ONE could write an article on porcupine fishes in the form of an anthology, plucking other authors' blooms from many an obscure by-way of bibliography, for porcupine fishes have excited interest from the earliest times to the present and there is a great deal of quaint lore and sober science concerning them scattered amongst learned libraries. But the living fishes claim our interest even more than what has been set down about them, so, in this account, part has been taken from literature and part from life. Let us begin the quotations with a not very favourable one, from Cooke's *Voyage to the South Sea*, i. 1712, p. 16:



A porcupine fish (*Diodon holocanthus*) from Port Jackson.

After Steindachner.



One of the earliest published pictures of a porcupine fish shows other fishes impaled on its spines. The antique artist endeavoured to illustrate the then newly reported sucking fish used by West Indians to catch manatee and turtle by attaching itself to them by its sucking disc, but he drew a good deal on his imagination.

After Aldrovandi, 1638.

"The Sea Porcupine . . . being a thick cloddy Fish, with a large Head, like a Frog . . . He swells his Body at Pleasure, . . . his Skin full of black Spots and sharp Prickles, a very ugly Fish to look at."

But this quaint comment scarcely does our subject justice and for a more charming account we might turn to the pages of Charles Darwin's *Journal of Researches* wherein he relates his observations on a Brazilian porcupine fish (*Diodon antennatus*) which he saw in 1832.

"One day I was amused by watching the habits of the Diodon antennatus, which was caught swimming near the shore. This fish, with its flabby skin, is well known to possess the singular power of distending itself into a nearly spherical form. After having been taken out of water for a short time, and then again immersed in it, a considerable quantity both of water and air is absorbed by the mouth, and perhaps likewise by the branchial orifices. This process is effected by two methods; the air is swallowed, and is then forced into the cavity of the body, its return being prevented by a muscular contraction which is externally visible; but the water enters in a gentle stream through the mouth, which is kept wide open and motionless; this latter action must, therefore, depend on suction. The skin about the abdomen is much looser than that on the back; hence, during the inflation, the lower surface becomes far more distended than the upper; and the fish, in consequence, floats with its back downwards. Cuvier doubts whether the Diodon in this position is able to swim; but not only can it thus move forward in a straight line, but it can turn round to either side. This latter movement is effected solely by the aid of the pectoral fins; the tail being collapsed, and not used. From the body being buoyed up with so much air, the branchial openings are out of water, but a stream drawn in by the mouth constantly flows through them.

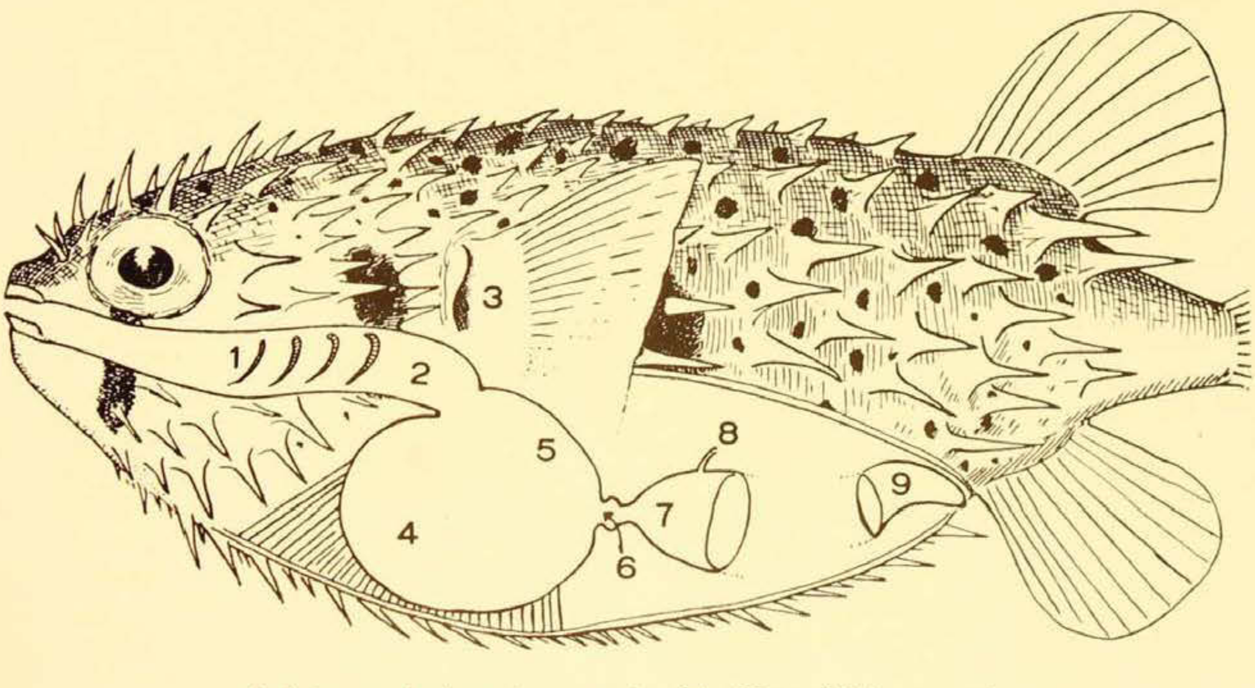
"The fish, having remained in this distended state for a short time, generally expelled the air and water with considerable force from the branchial apertures and mouth. It could emit, at will, a certain portion of the water; and it appears, therefore, probable that this fluid is taken in partly for the sake of regulating its specific gravity. This Diodon possessed several means of defence. It could give a severe bite, and could eject water from its mouth to some distance, at the same time making a curious noise by the movement of its jaws. By the inflation of its body, the papillae, with which the skin is covered, become erect and pointed. But the most curious circumstance is, that it secretes from the skin of its belly, when handled, a most beautiful carmine-red fibrous matter, which stains ivory and paper in so permanent a manner, that the tint is retained with all its brightness to the present day: I am quite ignorant of the nature and use of this secretion. I have heard from Dr. Allan of Forres, that he has frequently found a Diodon, floating alive and distended, in the stomach of the shark; and that on several occasions he has known it eat its way, not only through the coats of the stomach, but through the sides of the monster, which has thus been killed. Who would ever have imagined that a little soft fish could have destroyed the great and savage shark?"

I have not seen the red dye from porcupine fishes—possibly it is a feature of the American genus, not of ours—but Gordon[1] says it is caused by a dinoflagellate, *Oodinium*, a tiny one-celled animal. Buchanan[2] has illustrated in colour the blood-smear of an Australian porcupine fish, without discovering anything unusual about its corpuscles. Darwin did not mention any poisonous properties of his fish, but the flesh is reputed to be very poisonous to eat and the fish should not be left lying about where pets might feed on them. Yet it has been reported that the livers were eagerly eaten by the natives of Fatuna.

The spines are really very modified scales. In some species they are long and dagger-like with short roots, but in others the roots are longer than the very short thorn-like spines so that in the latter types, the burr fishes, the roots just below the skin protect the fish more than the spines do. Old museum specimens were usually blown up to an abnormal extent so that the spines jutted out like the quills of the fretful porcupine and their roots (normally decently covered) were revealed as a corsetry-like basket-work. Normally a swimming porcupine fish is roughly pear-shaped but when inflated the body is practically a sphere. Inflated porcupine fishes seem to have been regarded as indispensable adornments to alchemists' dens, as old prints show, or as "prickly customers" in curio shops. One very old picture of a porcupine fish, in a book in my possession (U. Aldrovandi, *De Piscibus*, 1638, p. 300) is entitled "Reversus Indicus squamosus" and shows small fishes impaled on the spines of a porcupine fish like the legendary apples on the hedgehog or like the prey of a butcher-bird upon a hedgerow. Curious as to why the porcupine fish should have been shown thus, I translated the old Latin context and found that Aldrovandi or his artist had evidently confused the porcupine fish with the sucking fish of the West Indies, for the text describes how the Indians use the fish to catch manatee and turtle by letting it swim towards them attached by a string, and when the "Reversus" fish has attached itself to its host, the Indians dragged it to their skiff or ashore. However, the artist, who probably had never seen a live "Reversus" fish, turtle or manatee, illustrated Aldrovandi's true story with imaginary fishes spiked upon a porcupine fish! The same ancient authorities seemed to think that the

[1] *Animal Kingdom*, xlix, 1946, p. 65.

[2] *Proc. Roy. Soc. Victoria*, xxviii, 1916, p. 188, pl. xviii.



Inflating mechanism of a porcupine fish (*Dicotylichthys myersi*).

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1. Gill-slits in pharynx; 2. Oesophagus or gullet; 3. External gill-opening; 4. Inflatable sac; 5. Stomach; 6. Pylorus; 7. Duodenum; 8. Duct from liver; 9. End of intestine.

"Reversus" fish was endowed with considerable intelligence, just like the elephant, being easily tamed and docile, especially when young!

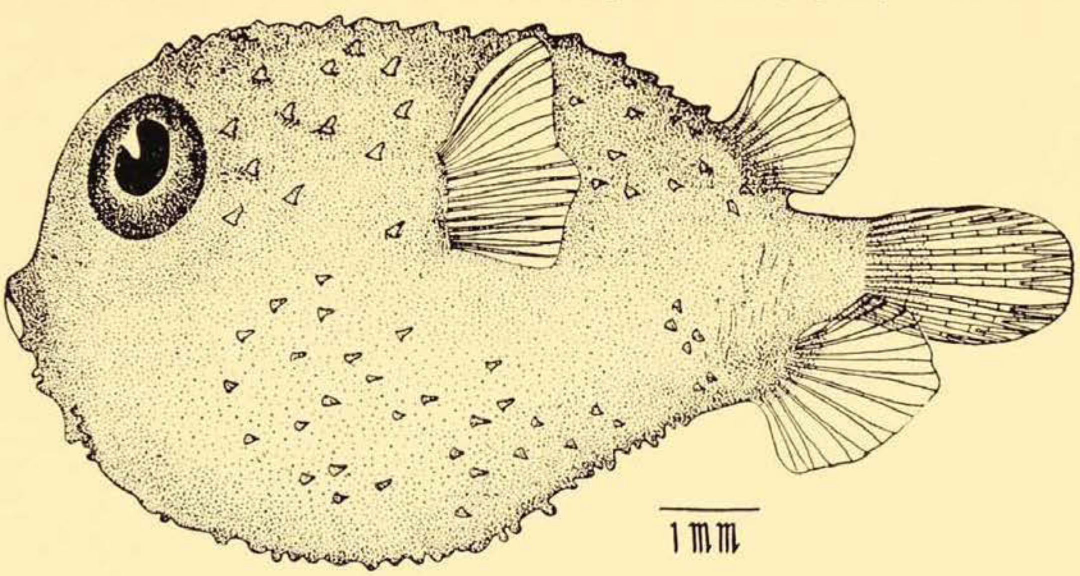
The jaws of porcupine fishes are somewhat like a parrot's beak but formed of closely united teeth forming a cutting edge. In the related toadoes the beak is divided into right and left halves but in porcupine fishes there is no median gash. Behind this trenchant beak, above and below, is a round, bony part, furrowed crosswise, which forms powerful millstones for mastication. These characteristic dentures are found in aboriginal kitchen-middens and the curiously shaped swim-bladder[3] is found cast ashore on beaches. As Waite has indicated, when the flesh of a dead porcupine fish has rotted out, the tough skin holds the spines firmly and the light object is trundled about by the wind and buried in the sandhills. So the presence of jawbones in middens does not prove that the aborigines ate this poisonous creature.

The Maori names for the porcupine fish were Koputotara, Kopuawai, or simply Totara, the latter being spread over Polynesia and resembling the Hawaiian Kokala, meaning spiny, though the fish was also called Hoana, a grindstone. Australian aborigines called ours Ralti, Culma, or Purrelli. In English they are termed Sea Hog or Hedgehog, Burr Fish, Globe or Porcupine Fishes, and a colleague has suggested Cherub Fish because of the beatific expression when seen head on. The Japanese call them Thousand Needles. The first man to use Porcupine Fish in English was Grew in 1681; it had been the Sagittarius of Ælian who flourished more than 450 years before Grew. Mr. K. C. McKeown (the colleague aforesaid) has kindly allowed me to quote from his book, *The Land of Byamee*, his version of the aboriginal legend of how Culma, the porcupine fish, acquired its spines from Kulai, the Echidna or Spiny Anteater:

"Kulai was a young and innocent little Echidna who lived with his parents deep in the heart of the bush. Life was pleasant, and there were always plenty of fat white termites for him to eat, but, like Kipling's Elephant Child, he was filled with insatiable curiosity . . .

"One day . . . he decided to see for himself what lay on the edge of the bush . . . Presently he found that he was completely lost . . . After a while the bush thinned, and finally lay altogether behind him. In front lay sand dunes, rising one behind the other, rank after rank. He climbed very slowly to the top of one, only to find another before him. At last he topped just that "one more", and saw below him a little beach of damp sand washed by the waves of the Gulf of Carpentaria. Descending the hill to the edge of the water, he paused and stared. He had never seen so much water before . . .

"Suddenly he saw quite the strangest creature swim past in the water, a curious, soft, silvery-white thing—a fish called Culma. Kulai had never seen a fish; neither had Culma ever seen an Echidna. The fish stopped to talk; he asked Kulai where he came from and all about his way of life. Kulai, being naturally inquisitive, also asked all the questions he could think of.



A 10 mm. juvenile porcupine fish (*Diodon bleekeri*) from Luzon, Philippine Islands.

After Blanco & Villadolid, Philip. Journ. Fisher. i, 1951, p. 90, fig. 35.

[3] The jaws were illustrated in THE AUSTRALIAN MUSEUM MAGAZINE, vol. iv, no. 3, 1930, p. 97, fig. 2, and the swim-bladder was figured and discussed by Miss E. Pope in the last issue, vol. x, no. 10, p. 335.

"At last Culma said, 'Come into the water and play with me . . .' Kulai entered the water . . . the waves began to roll him over and over so that he became afraid and cried out to Culma to save him. The fish only laughed and said: 'Oh, foolish one, I have you at my mercy! Now I will eat you up.' Kulai tried to roll himself up into a prickly ball, as he would have done on land—but this was quite impossible to accomplish in the water. He tried to swim to the shore, but it was no use. Culma soon caught poor little Kulai, and swallowed him in one mouthful. Culma had been soft and smooth, but now Kulai's spines pierced his flesh, and their sharp points projected through his skin.

"That is how the fish came to get their spiny tails and fins."

George Turner[4] tells a story from Nui or Netherlands Island, of legendary battles between the large ocean fishes and the small reef ones under their king Tapakea. The shark was selected to fight the porcupine fish, ". . . and gaped and looked about for his small enemy. The porcupine fish leaped into his mouth, cleared the serrated jaws, expanded its prickles, and stuck fast in the shark's throat. The shark tumbled about distressed and defeated; and again Tapakea called out to mark and declare the porcupine fish as the hero." It was the rule that if the larger fishes were beaten, they were to bring their teeth as an offering to the small ones, and hence the reason for the porcupine fish's being so well endowed with jaws. The same author[5] also relates of Funafuti how "Tradition says that the place was first inhabited by the porcupine fish, whose progeny became men and women."

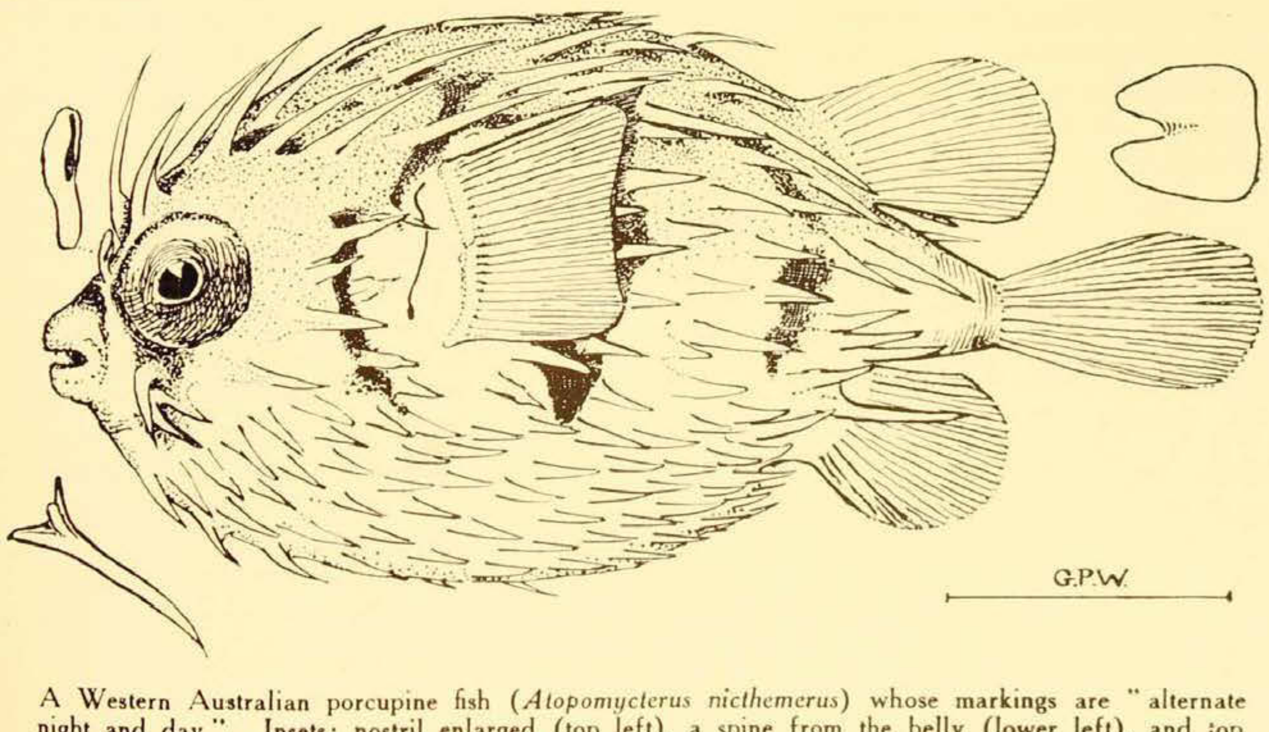
[4] *Samoa a Hundred Years Ago*, 1884, p. 302.

[5] *Op. cit.*, p. 281.

Perhaps the earliest observations by a white man on an Australian porcupine fish were those of Labillardière, in February, 1793, when in Tasmania, who wrote:

"I happened to be present several times during the day, when they were hauling the seine; and I always observed some new species of sea hedgehog. I admired the promptitude with which these little fishes, by swelling themselves, as soon as they were handled, erected the prickles with which they are covered; but they let them fall, and kept them, throughout their whole length, drawn in close to their skin, as soon as they thought themselves out of danger. From this observation it is evident, that the attitude which is given to fishes of this genus, by swelling them as much as possible, and in which they are exhibited in cabinets of natural history, is not that which is most common to them."

Defence by puffing up the body is characteristic of certain lizards and amphibia, the swell shark (*Cephaloscyllium*), toadoes and porcupine fishes and the pigmy



A Western Australian porcupine fish (*Atopomycterus nicthemerus*) whose markings are "alternate night and day". Insets: nostril enlarged (top left), a spine from the belly (lower left), and top of swim-bladder from another specimen (upper right). Nostrils in larger fish may be cleft into two flaps.

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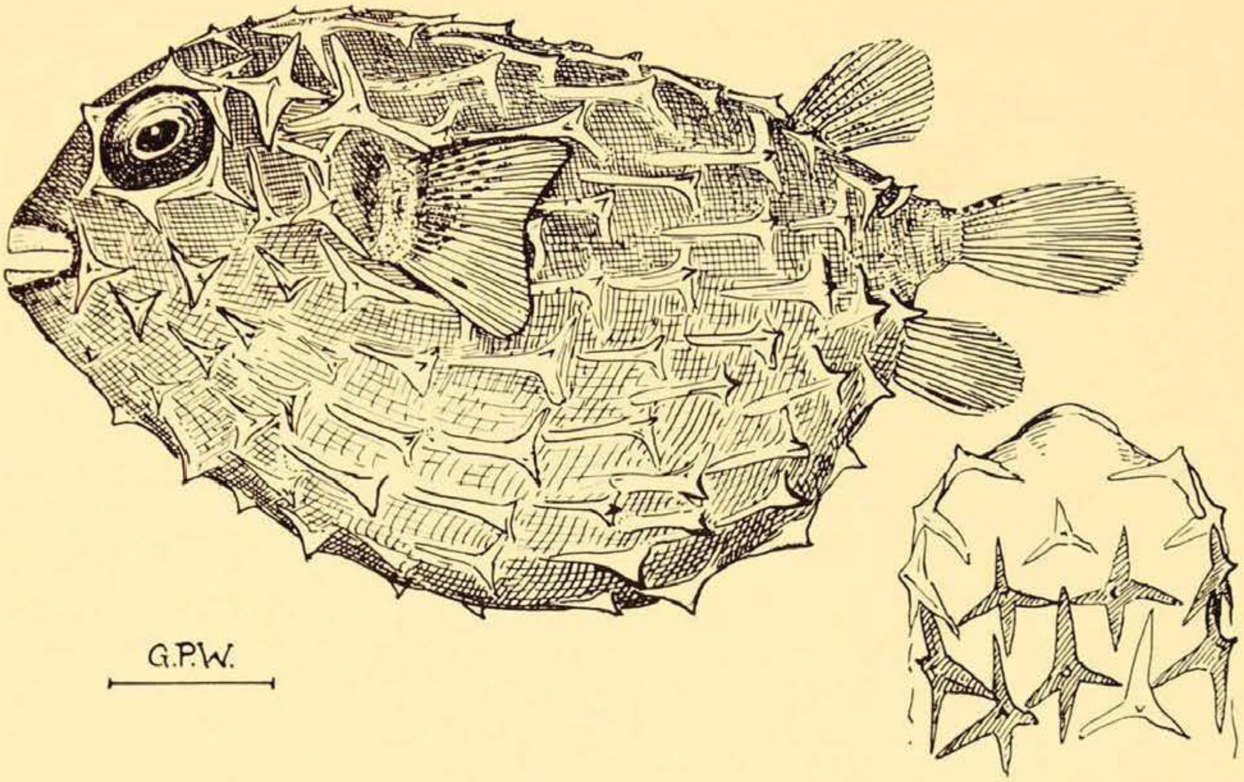
leatherjacket (*Brachaluteres*). To understand the mechanism for the inflation of porcupine fishes we must consider the gut or food-passage. This tube goes from the mouth back between the gill-openings (which pierce the pharynx) to the gullet or oesophagus; the latter leads to the stomach behind which is the pylorus or "gateway", just posterior to which a duct leads from the liver to the duodenum or front portion of the intestine; the hinder intestine extends to the vent. Whereas this gut is relatively undifferentiated in sunfishes, boxfishes, filefishes, and leatherjackets, their close relatives, the toadoes and porcupine fishes have an inflatable, thin-walled sac depending from the stomach. This sac is not separated from the stomach by any constriction, but there is a controlling sphincter where the sac opens into the gullet at its front end; posteriorly the sac enters the duodenum by the "gateway" regulated by the pyloric sphincter. The outside of the inflatable sac is attached to the inside body-wall by strands of anchoring tissue. Powerful muscles just below and behind the fish's head expand the mouth-cavity and draw in water or air, the inflatable sac is filled and its contents retained by its sphincter muscles fore and aft. The flap-like breathing-valve in the mouth, behind the teeth, does little or nothing in this connexion and the opercular valves merely prevent leakage during the compression stroke. The contents of the inflatable sac are released by relaxation of the "gateway" to the gullet, allowing the air or water to be expelled from the mouth. How the fish manages to retain and even digest food in the stomach[6] during this process is little understood. One investigator tried celluloid windows in the fish's side to gain the "inside information."

Porcupine fishes can probably "talk" to one another, especially at mealtimes, as the jaws make grinding noises. During these "conversation pieces", perhaps the ridged palates of porcupine fishes may be stridulatory organs and the airbladder may act as a hydrophone. Porcupine fishes are usually school fishes rather than solitary and may "keep in touch" by noise-production. Their method of defence by inflation is not their only trick, for William Beebe "watched a number of little porcupine fishes and saw that when they were threatened by a large gar-fish, four feet in length, they bunched together for protection, giving the appearance of one large, round, and prickly fish; occasionally, however, a single individual would become detached from the mass, when it was promptly seized and devoured." Little seems to be known of the life history of any porcupine fish. The eggs are unknown to me. Very young ones are like golf-balls—some even white-coloured with a few round black spots like the dots on a golf-ball—and are said to enjoy turning somersaults. A young *Diodon*, only 5 mm. long, was obtained at the surface off Three Kings Islands, New Zealand, in July, 1911, by the "Terra Nova" Expedition. A 10 mm.-long juvenile *Diodon bleekeri* illustrated by Blanco and Villadolid from the Philippines is shown here as the smallest specimen of which I have found a figure. Australian porcupine fishes are usually less than 1 foot long but overseas examples between 2 and 3 feet long have been measured.

Porcupine fishes occur in most seas, preferring tropical or temperate waters, and can drift long distances when inflated. Seven species are known from Australia classified according to the form of their nostrils, the nature of the spines and the roots thereof, and their numbers of fin-rays. A new illustration is given here of of a common type from south-western Australia to Tasmania which is known by the appalling scientific name of *Atopomycterus nicthemerus*, derived from Greek and meaning, for the genus, a misplaced nose or nostrils and, for the species, night and day, evidently from the alternate light and dark areas on its globular body.

There is one rare Lord Howe Island porcupine fish, *Euchilomycterus*, which is unique in having some of its thorn-like

[6] It is evident that a good deal of food passes quickly to the duodenum and is digested in the intestine, wherein I have found, for example, the beads of *Hormosira* weed. Their usual food consists of crustacea, echinoderms and other marine animal life.



A unique Burr Fish (*Euchilomycterus quadriradicatus*) from Lord Howe Island, with some of its spines four-rooted, as shown (shaded) on the top of its head at lower right.

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spines four-rooted. I have found no teratological porcupine fishes but Darwin collected one abnormal one with accidentally forked spine. Fossil porcupine fish remains—mostly teeth—have been found in the Miocene of Carolina, Italy and Sardinia and as far back as the Eocene of Burma, Italy, Belgium, Egypt, and elsewhere, some 55 million years old. The giant ocean sunfishes (*Mola*) are thought to have branched off from the porcupine fish family in Tertiary times.

E. W. Gudger[7] poses the question, "If this [porcupine] fish makes use of its spine-covered skin for its own protection, why should not man likewise and for the same reason use it?" And he traces, with customary thoroughness and scholarship, many cases of *Diodon* skins fashioned into helmets by South Sea Islanders. Commander Charles Wilkes, in the 1840s depicted a Drummond Islander (in the Kingsmills) wearing such a helmet, a fish-skin cap with two or three feathers of various colours stuck in the top for a panache. Lappets of skin covered the ears and an internal padding enabled the warrior to ward off blows or to use his helmet in butting. Similar helmets were used by the Gilbert and Marshall Island warriors who were further protected by armour of sennet and fought with shark-toothed prongs or swords, this curious assortment of weapons and dress being peculiar to Micronesia. I have given an illustration, supplementary to Gudger's ones, in my "Fishes of Australia."[8]

A curious use of a porcupine fish reliquary is referred to by W. G. Ivens in his *Melanesians of the South-east Solomon Islands*,[9] in his account of the burial methods. Skulls of the deceased were

[7] *Bull. N. York Zool. Soc.*, xxii, 1919, p. 129 and figs.

[8] i, 1940, p. 32 and fig. 24.

[9] 1927, p. 210.

enclosed in the "wooden figures of a porcupine fish, *poe*, and a crocodile, as well as a swordfish. The two former were in a relic house on the west side of Little Mala, and in each case the relics were in a cavity on the back." Apart from the above, porcupine fishes have few uses and are usually thrown away by fishermen. Swollen specimens, as we have seen, are kept as curios and in the West Indies the pumped-up skins have lanterns placed inside them and are hung as unusual light-shades. Living ones are kept as occasional exhibits or pets in aquaria.

The Australian species of porcupine fishes may be identified from the following key:

A. Nostrils each with two separate openings in a tubular papilla.

B. Most of the spines three-rooted and immovable (two-rooted and movable only behind pectoral fin). Eleven or twelve dorsal and anal rays. Length to 10½ inches. W. Australia, Arafura Sea and Queensland . . . *Tragulichthys jaculiferus.*

BB. All spines two-rooted and erectile. Twelve or more dorsal and anal rays.

C. Spines on top of head long. Small spots on body. Generally less than 12 ins. W.A., Q., N.S.W., Vic. and S. Australia, wandering from tropics . . . *Diodon holocanthus.*

CC. Spines on top of head short. Spots on body larger.

D. No dark chin-band. About 20 rows of spines between snout and dorsal fin. 30 ins. Widely distributed outside Australia, coming to N.S. Wales . . . *Diodon hystrix.*

DD. Dark collar-like band on chin. About 17 spines between snout and dorsal fin. Nearly 15 ins. Queensland . . . *Diodon armillatus.*

AA. Nostril-openings not separate but confluent, each nasal organ appearing as a pair of flaps.[10] Some or all of the spines two-rooted, erectile.

E. Most spines three-rooted, immovable. Rather large dark spots on back.

F. Only behind pectoral fin are the spines two-rooted and movable. 15 or 16 dorsal and anal rays. 12 ins. N.S. Wales to Bass Strait,[11] deep water . . . *Allomycterus pilatus.*

FF. Only on head are spines two-rooted and erectile. About 12 dorsal and anal rays. 17 ins. Southern Q. and N.S. Wales, in harbours . . . *Dicotylichthys myersi.*

EE. All spines two-rooted, erectile, nearly round in section. 12 dorsal and anal rays. Small dark spots on back. 13½ ins. W.A., S.A. and Tasmania . . . *Atopomycterus nicthemerus.*

[10] In small, fresh *Atopomycterus* each nostril is a slit in a columnar papilla sealed at the top, as figured here; in old or dried specimens the top appears to split forming the bifid tentacle noted by authors.

[11] A new record based on one trawled over 70 to 100 fathoms by the *Endeavour*, N.E. of Babel Island, Tasmania, in 1914.

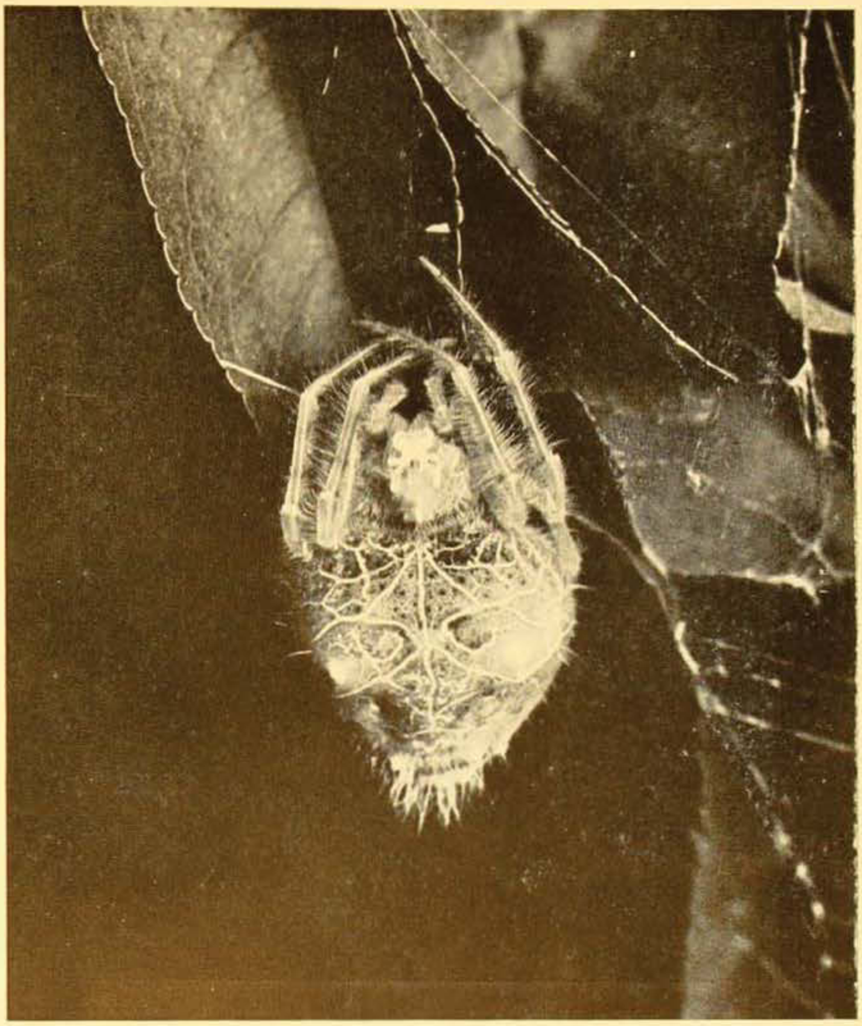
Long Journey Made by an Oar Blade

Since Beachcomber's Harvest was written[1], a most interesting piece of flotsam has turned up on the west coast of the north island of New Zealand. The *Sunday Sun*, Sydney, of 11th May, 1952, tells of the finding of an oar blade, branded "Mona Vale", on the 90-Mile Beach, about 50 miles south of Cape Maria Van Diemen. The oar had floated in the Tasman Current, taking a circular course down the east coast of New South Wales, thence westward to New Zealand and so up the west coasts of the two islands to 90-Mile Beach. It was lost off Sydney on 26th December, 1950, and has thus been over a year on its journey and travelled thousands of miles.

To an oceanographer this is a most romantic find—almost as good as finding a sealed bottle with a message in it!

Elizabeth C. Pope, M.Sc.

[1] Australian Museum Magazine, x, 10, p. 332.



The Hairy Imperial Spider (*Dicrostichus furcatus.*)
Photo.—A. Musgrave.

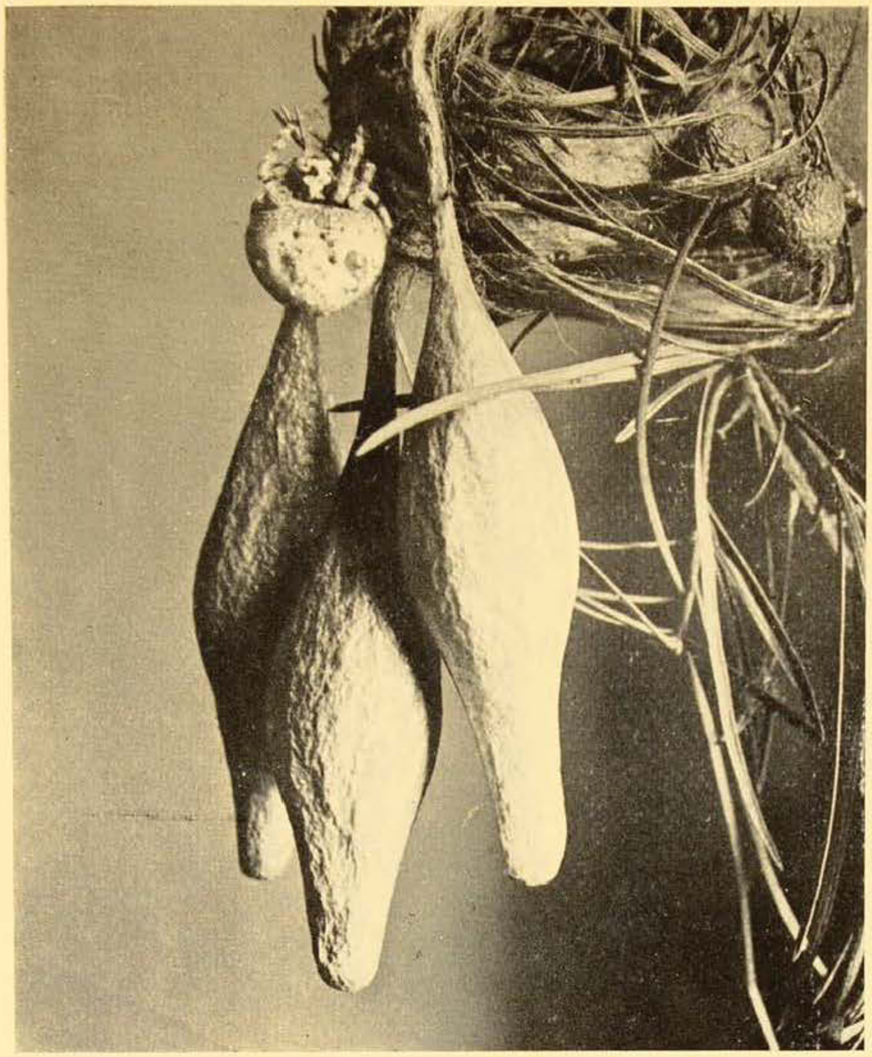
Line Fishing for Moths

By VERA LEVITT.

THERE are at least two species of spider in Australia which capture their prey by using a line and bait. Of these the habits of the Magnificent Spider (*Dicrostichus magnificus*) have been recorded very clearly by Mr. H. A. Longman, of the Queensland Museum, but the habits of the Hairy Imperial Spider (*Dicrostichus furcatus*)* do not seem to be quite so well known. For this reason, and because her method of "fishing" seems to differ slightly from that employed by the other species, I recorded some observations, made over a period of several months, on the habits of the Hairy Imperial Spider.

My observations started on the 24th September, 1948, when I found a female Imperial Spider on a Melaleuca bush in a paddock opposite my home at Punchbowl, near Bankstown, Sydney. It was dusk, and the spider was just coming out from her retreat, so I cut off the twig she was on, took her home, and tied the twig to a Teatree in the garden. I knew I was taking a risk in doing this, as previous attempts

* I take this opportunity of thanking Mr. A. Musgrave, Curator of Insects of the Australian Museum, Sydney, for identifying the spider for me.



The Magnificent Spider (*Dicrostichus magnificus*) and her egg-sacs.
Photo.—A. Musgrave.

to do the same thing with this species of spider had resulted in losing the specimen, but, as this spider does not take kindly to captivity, I had to take a chance that she would find the Tea-tree to her liking and settle down.

Fortunately the spider had not been disturbed too much, so that she merely moved to another twig, in a convenient position for easy observation, and made herself a retreat by weaving several leaves together to form a fairly thick silken covering, roughly umbrella-shaped, about 1 inch in diameter. The spider clung to the underside of this during the day, and was extremely difficult to see, as she merely looked like a piece of fluff caught in the bush.

At night she came out and could be seen swinging from a single footline she had spun between two twigs about 6 inches from her retreat, but it was not until the 8th October that I actually saw the spider "fishing".

The footline was so loosely spun that it sagged under the spider's weight. When I saw her, she was hanging from this line by the last three legs on the left side, whilst the fourth leg on the right side was brought across the body to grip the line as well. The third leg on the right side was held tightly against the cephalothorax, where it fitted so closely between the other legs that it was only seen after careful examination. I concluded that this leg was used to brace the others, but this is only a theory and may be wrong. The second leg on this side held the "fishing line", one end of which was made fast to the footline, and the other ended in a small sticky globule, about the size of a large pin's head. The first leg on each side was held out at right angles to the cephalothorax.

At irregular intervals the spider beat the air with her front legs, moving them rapidly up and down together. This was usually followed by rapid jerking movements with the legs holding the footline, which set the spider swinging backwards and forwards, and at the same time the leg holding the fishing line was swung round, causing the bait to be whirled around in a large circle. This method of "fishing" was checked on a number of subsequent occasions.

The size of the arc described by the bait was brought home to me rather forcibly when I tried to measure the "fishing line". The spider was resting at the time, but although I held the ruler at what seemed to me to be a safe distance, when the spider unexpectedly swung the line she "caught" me on the finger, the bait being so extremely sticky that although I tried to free myself without breaking the line I found it quite impossible. The "fishing line" measured 1¾ inch in length from the spider's foot to the end of the bait.

I found it impossible to judge whether the spider would "fish" in the early part of the night or not. She was out on most warm nights, but would sometimes leave her "fishing" till the early morning. On the other hand, I would sometimes find her "fishing" when the nights were cold and so windy that she swung to and fro on her footline like the pendulum of a clock. On other windy nights she would not attempt to "fish".

On the 2nd October, some nine days after capture, I found the spider's first egg-sac, which was attached to a twig near her retreat. It differed from those of the Magnificent Spider (*Dicrostichus magnificus*) by being smaller, of much stouter construction, and the peduncle by which the sac was attached to the twig was rayed out at the top, each ray having a separate line attaching it to the twig; the Magnificent Spider carries the peduncle of the egg-sac straight up and over the twig.

The spider made her second egg-sac on the night of the 17th October, and followed it with seven further sacs which were found at intervals up till 7th January, 1949. The period between egg-sacs varied from 9 to 16 days, and, as far as I could determine, depended on the state of the hunting. As a rule the egg-sacs hung loose, merely supported by their tops, but in very windy weather the spider would attach them to adjoining twigs and to each other with extra lines fastened at strategic points down the sides of the sacs.

On the evening of the 16th December, 1948, some ten and a half weeks from the time the eggs were laid, the spiderlings emerged from the first egg-sac. Most of them dispersed, but a few remained in the Tea-tree. Spiderlings emerged from the other egg-sacs at roughly weekly intervals up to the 16th January, 1949.

On the 17th January further observation was temporarily interrupted as the four remaining egg-sacs and the Spider were sent to a worker in England with a consignment of Australian spiders. I had, however, managed to keep two of the spiderlings which remained on the bush under observation. I believe these two came from the first egg-sac, but, owing to the subsequent emergence of fresh batches of spiderlings, I could not be certain that their place was not taken by spiderlings from one of the other egg-sacs.

At first these spiderlings seemed to spend the nights hanging from tiny footlines with their legs outspread in much the same attitude as that adopted by the adult when "fishing", but I could see no sign of any "fishing line". However, the spiderlings grew, so I concluded that they must be catching something.

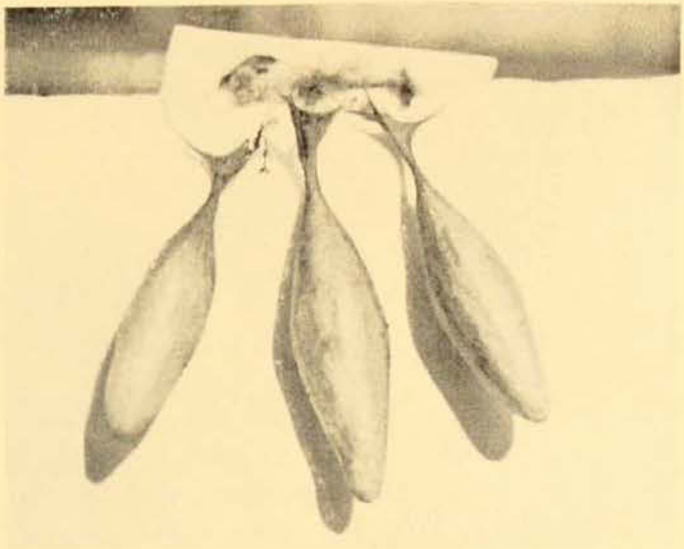
By the 10th February, 1949, the babies were about ⅛ inch in diameter, and that night I found that one of the spiderlings had slung the usual single footline across a gap in the twigs and was "fishing", the line being ¾ inch in length with a tiny sticky globule on the end. She used the same rapid, jerking movements as the mother as she swung the bait in a circle. Apparently the fishing was good, because from that night she grew rapidly.

On the 27th March, 1949, a third spiderling was found on some weeds in the garden and was also placed on the Tea-tree. It settled down, and on most warm nights the three spiderlings were to be seen with their "fishing lines", but either the first

Left—The egg-sacs of the Hairy Imperial Spider fixed in position with "storm-lines". On the lower side of the centre sac can be seen the small hole through which the spiderlings emerged.

Below—The egg-sacs detached to show the rayed-out tops by which they are normally suspended.

Photo.—V. Levitt.



spiderling was in a better position (she was on the outside of the shrub while the other two were in the centre of it), or else she was a more expert "fisherman" than the other two, for by the 2nd May she was fully grown. The second spider was only half her size, whilst the third was three-quarters grown.

The strength of the "fishing line" can be judged by the fact that by the time the first spiderling was half grown she was catching moths about ¾ inch long, which is the size normally caught by the adult spider.

On the morning of 22nd May I found the first spider of the second generation had made an egg-sac. The second spider was missing from its usual place in the bush, and I could not locate it.

About 8 p.m. on the 29th June, 1949, I found the third spider changing its skin. The night was clear, with a cool breeze blowing. The next morning I found it still struggling to free itself from the old skin, which seemed to be stuck to the tip of its abdomen. I put some lukewarm water on the affected part, and, upon my return from work about 6 p.m. that evening, I found the spider in its retreat. There was no sign of the cast skin.

This spider had been coming out regularly on frost-free nights, but the first spider had not been seen to leave her retreat since the beginning of June. On the 12th July the second spider reappeared near the third spider, which came out of its retreat for a short time, but retired without attempting to "fish". During the next two days the small spider remained near the third one, spending the day not more than 1 inch from it.

The first spider was seen on the night of the 14th July making a second egg-sac. The night was cold, with a light drizzle falling and, when first seen, she had a round piece of fluffy white silk about the size of a shilling which she was holding away from herself with her legs while she added extra silk to it. The spider seemed to be combing the silk from her spinnerets with her hind legs, and, while doing so, occasionally pausing to touch the round piece of silk with her spinnerets. Unfortunately I could not stop to watch her, and when I returned at 9.45 p.m. I found a small egg-sac almost completed. It looked perfect, but the spider was just adding a few finishing touches.

Two days later, on the 16th July, the first spider left her position near the egg-sacs, moving into a denser part of the bush, and, on the same day, the third spider was found dead, but I could observe no sign of injury on her. The weather over the last two days had been remarkably warm for the time of the year, so that exposure to the elements seemed ruled out too.

During the second week of August I was watching the first spider "fishing" when she stopped and hauled in the line. Both front legs were used, the line being drawn in "hand over hand" like any human line fisherman, and the "bait" was eaten by the spider. On the 20th August she was seen "fishing" for the last time. The following night she was missing from her usual place, and I could not ascertain what had happened to her. The second spider also disappeared.

My chronicle of the Hairy Imperial Spiders closed on the 25th October, 1949, for although on that date spiderlings were seen near the egg-sacs, none remained in the Tea-tree. A search of the garden also failed to reveal any. However, I could not complain, as the spiders had remained on the one bush for more than twelve months, and, although there are still gaps to be filled in, for two generations I had had the pleasure of observing much of the life history of one of our most interesting spiders.

Sea foam, an Unsolved Problem of the Seashore

By ELIZABETH C. POPE, M.Sc.

SOMETIMES, after very heavy and prolonged onshore storms, great masses of foam are drifted in from the sea on to the local rocks and beaches. On one such occasion the foam was blown right across the sand and up on to the grass-covered dunes behind one of our surf beaches, till it formed a mass waist deep and covering from one-third to half an acre. The accompanying photograph of a small sports car travelling through this foam gives some idea of the extent to which it can be banked up.

A curious feature of these lather-like masses is the way in which they persist for relatively long periods, even when blown about by the wind. Ordinary lathers which we sometimes make with soap and water (when no detergent is added) soon revert to their former unlathered state but these sea foams may persist for a day or more when the weather continues moist and stormy and no sun shines. At such times public interest is keenly aroused and, at the Museum, we are asked for explanations as to how the foam is produced, why it lasts so long, and so on . . . To such questions our answer must at present be "We don't know" but that doesn't prevent us from making guesses. However, until these theories are tested by physicists and chemists we have no notion as to whether they are correct or not and since the matter is of no known practical importance at the moment, little is being done about it.

In order that a foam may be whipped up in sea water, it is first of all necessary to have present some substance which will lower the surface tension. Ordinary soap, for instance, will not lather in sea water. Then the liquid and the air must be whipped up violently together till the frothy, barmy condition is produced and

Yellowy-green sea foam banked up waist-deep behind Newport Beach. Such fields of foam persist for days during moist, stormy weather.
Photo.—*Sydney Morning Herald.*

there must be some additional substance present which will "hold" the foamy state and last for some considerable time. One thinks immediately of some substance such as protein, as being the type of chemical suitable for doing this.

First of all when seeking for an explanation of the formation of these foams we had a theory that there might be some industrial waste substances being carried out to sea through local sewage outfalls and that, during storms, these were being whipped into a barmy froth by storms and then carried onshore by winds. That this idea was totally incorrect was soon realised after two visits to Nambucca Heads in northern New South Wales. Here the same, large, billowing masses of sea foam were observed during storms and they were being banked up on the rock platforms and in small baylets along the ocean coast in places far removed from the influence of industrial wastes in the sea.

It has also been learned since, from an authority on such subjects, that great yeasty conglomerations of foam are often encountered out in the middle of the great oceans, after storms, so that it is very evident that the ingredients in the sea water that go to make up the foams are not found only in the proximity of the coastline. These potential foam-makers must be substances that are found everywhere in the sea. We are left wondering what they can possibly be and why, if these substances are present universally in the oceans, are the foams only seen during and just after very rough seas?

My own personal interest in this unsolved problem was re-awakened recently, when a business man came to the Museum seeking information on a seaweed product which is used by the makers of fire-extinguishers for "holding" in suspension the foams which are used to put out chemical fires, by excluding oxygen from the flames. Credit restrictions, at present in operation, were preventing the importation of this algal product from Great Britain and our inquirer was looking for a local substitute. After referring him to the correct authority, the matter was temporarily dismissed from my mind until the thoughts "seaweed product" and "persistent foam" clicked together and made me wonder if here was an explanation of those mysterious, lasting sea foams which have always been so intriguing.

After searching through a modern book on seaweeds and their uses, it was found that there were certain substances in some of our algae which could possibly serve to "hold" the foams once they had been produced. In fact some of the alginate products could conceivably act in this way.

Tourists examining a mass of sea foam at Nambucca Heads, curious to know why it remains in the whipped up state. Onshore wind was blowing puffs of foam over the rocks.

Photo.—E. C. Pope.

This fact did not, however, explain how the surface tension of the sea water could be so lowered that the whipping action of storm waves could create the frothy mass.

A possible explanation of this phenomenon has been supplied to me by another worker. He explained that, during storms, large numbers of small planktonic organisms are destroyed and broken up due to the battering they receive in the choppy seas. He referred particularly to the tiny algae, the diatoms, and the minute animal organisms among the plankton, pointing out that they contained the necessary lipoid and protein chemicals which would respectively lower the surface tension and "hold" the froth in suspension once it was formed. These organisms are also present everywhere in the surface of the seas.

Let us suppose then that the seas in a particular area are so stormy and rough that they kill and break up large numbers of these minute organisms. The surface-tension-lowering chemicals which have thus been released into the sea water will allow the waves to whip up a froth and if there is also present enough protein matter (released from the algae) a foam with lasting qualities might result—just in the way in which an egg-beater can whip up a firm foam in white of egg. One often sees small tufts of foam coming ashore and blowing about on beaches like roley-poley weeds out West or like Fairy Floss at carnival time. Once it is formed, it is quite easy to see how a prevailing onshore wind can drift the foam ashore and mass it up on the beaches and dunes.

Is this the true explanation of how sea foam is made and blown ashore? At the moment we just do not know and it must remain still one of those fascinating unsolved mysteries of the sea.

Australian Insects, XLVII

Coleoptera, 24.—The Cleridae.

By KEITH C. McKEOWN

THE family Cleridae is an important one, not only in numbers but for the economic part it plays in maintaining to some degree the balance in wood-boring insects. No detailed estimate of the importance of these insects in the control of forest insects has been made but, under natural conditions, there can be little doubt that both the larvae and adults of many such pests fall victims to their voracious appetite. More than three hundred species of Clerids have been described from Australia, ranging in size from *Eunatalis titana*, up to 2 inches in length, and *Trogodendron fasciculatum*, about an inch, to *Lemidia hilaris*, no more than 5 mm. long.

Most of the perfect insects, together with their larvae, are predaceous, but the beetles may often be found frequenting flowers, apparently attracted by the nectar.

The tarsal formula of the perfect insect is 5-5-5 or 4-4-4, with the segments 2-4 prolonged into flaps below, and one or more bilobed. The antennae are very diverse, and may be serrate (saw-like), flabellate (flail-like), or clubbed. The elytra, in some cases abbreviated, usually cover the abdomen but, beneath, 5-6 abdominal segments are exposed. Many species are of slender and graceful form and are brightly coloured. The active, cylindrical larvae have well developed legs and powerful jaws, enabling them to enter the burrows of wood-destroying insects and to kill the occupants, for they are both fierce and voracious.

The life-histories of the majority of the Australian Clerids are unknown but W. W. Froggatt has recorded that of *Trogodendron fasciculatum*, which may be taken as an example. This fine beetle has a very wide range over Australia, and may often be seen flying about in the bright sunshine or running over the trunks of fallen trees infested with the larvae of wood-boring moths and beetles which will form suitable prey for its own grubs. The beetle is glossy black, with the elytra bearing an erect tuft of hairs upon each shoulder and a velvety area of intense black, bordered with white, on the apical third. With its constantly vibrating yellow antennae, the insect presents a remarkably wasp-like appearance. It is very fearless and, if carelessly handled, may sink its powerful jaws into one's finger, hanging on with a bulldog grip, and sometimes even allowing its head to be pulled from its body rather than release its hold. This Clerid is remarkably variable in size, and may measure up to and over an inch in length.

The actual egg-laying has not been observed but the eggs are probably deposited in cracks in the bark, the newly-emerged larvae then seeking out their hosts in their burrows beneath. Numbers of the Clerid larvae, in all stages of development, may be found in the tunnels of longicorn larvae, the species suffering most from their attacks being the common black and yellow *Phoracantha recurva*. The cylindrical Clerid larva is of a general pinkish colour, measures up to an inch in length and is clothed in dull yellow hairs. A horny plate covering the thorax is black, and a reddish-brown plate covering the last abdominal segment is armed with a pair of stout, curved spines at the tip. Froggatt describes the larvae as "active creatures, contracting and extending their segments as they crawl about in the burrows, and if two or three are left in a box, the largest one soon eats up the smaller ones." When fully grown they form rounded cocoons of wood fragments cemented into a hard shell in which to pupate. The beetles emerge in October and November but may be taken throughout the summer months.

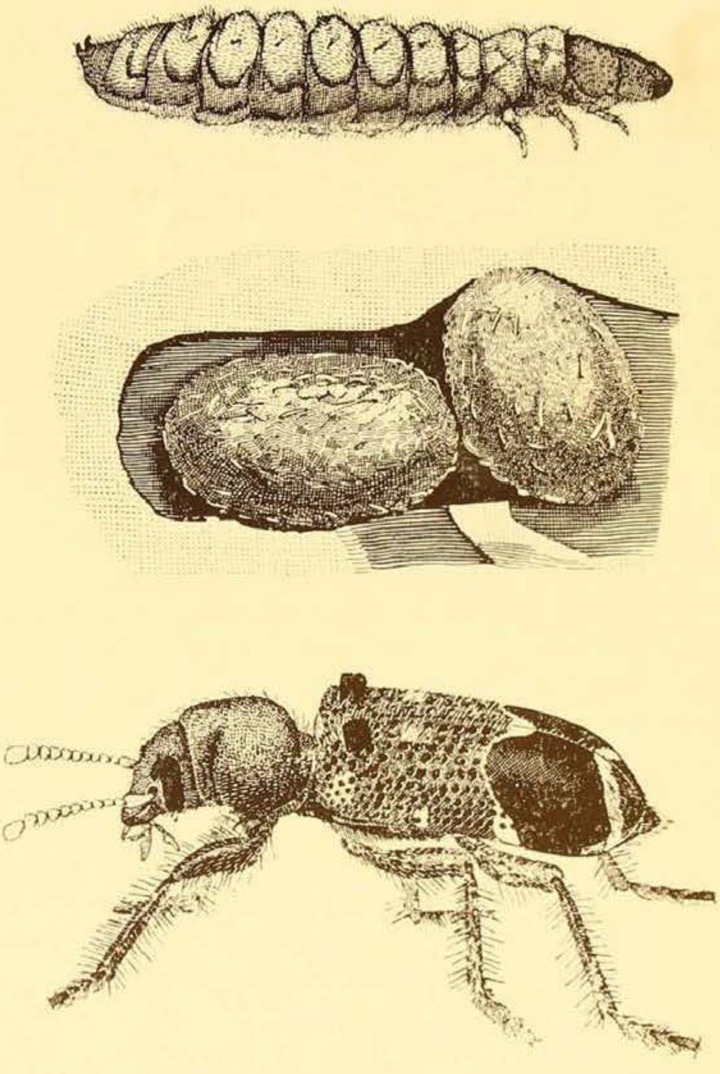
It is unfortunate that more is not known concerning the life-histories of our Clerids, or, at least, the host species preyed upon. Of *Cylidrus basalis* Macl., Froggatt records that he "obtained several specimens when cutting out the little thickset shot-hole borer (*Xyleborus solidus*) . . .

"They enter the open burrow made by the borer through the bark and attack him in the rear, feasting upon the helpless *Xyleborus*, which, fitting close into his cylindrical tunnel, can neither move forward nor backward.

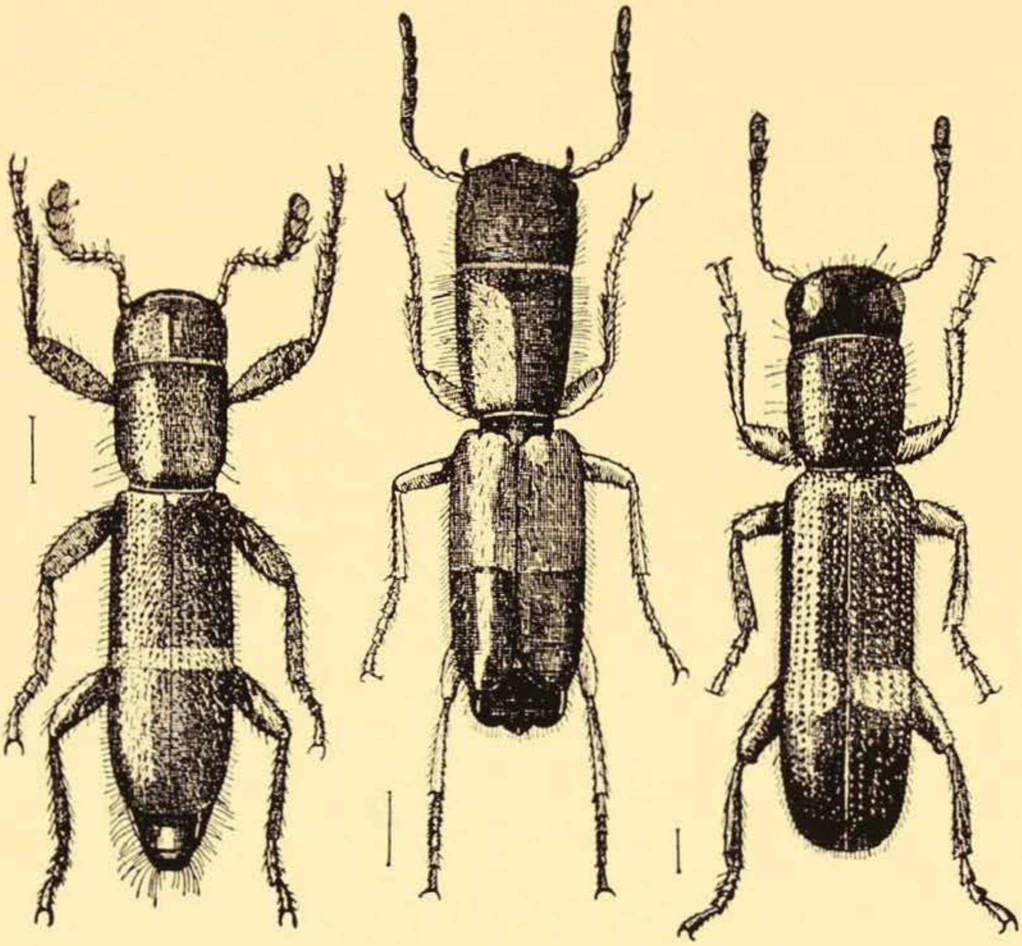
"This ferret-like beetle with his powerful jaws soon finishes his feast, and I found one resting in a burrow with only the remains of the wing covers of the victim. This slender, active beetle is well adapted in form for the life it leads . . ."

The larger *Cylidrus nigrinus* White has been found, also, in the burrows of *Xyleborus solidus* and, although its larva has not been identified with certainty, it is definitely an enemy of wood-boring grubs.

The beautiful little Clerid, *Paratillus carus* Newm., is a good friend of the householder, for it attacks and destroys Powder-post Beetles (*Lyctus brunneus*). I have



Life history of *Trogodendron fasciculatum*; the larva, pupal cocoons in cavity of bark and the perfect beetle. After E. H. Zeck.



From left to right, *Paratellus carus*, *Cylidrus basalis* and *Tarsostenus univittatus*. All three are predatory enemies of timber-boring beetles.
After W. W. Froggatt.

often had them brought to me from borer-infested buildings under the impression that they were the insects responsible for the damage. Froggatt describes how, "When the adult stage is reached the beetle cuts its way out through the surface of the timber, often dislodging more dust round the exit hole than the powder-post borers. As they are often found running about on felled gum trees, they probably attack and devour other small bostrychid beetles when they are depositing their own eggs in the bark or cracks in the surface of the wood, and the resultant larvae worm their way through into the wood-borers' galleries and feed upon any larvae they find. Their larvae can be easily identified from those of the wood borer by their elongate form, well-developed legs, armour-plated prothorax, and horny head furnished with a pair of projecting jaws."

Our largest Clerid is *Eunatalis titana* Thom., a huge brown insect about 2 inches in length, with the elytra over the first two-thirds deeply pitted in regular rows. Occasional examples may be found in which the wing-covers are blotched with dull yellow. The much smaller *E. porcata* Fabr., variable in size and measuring up to an inch in length, is similar in appearance but the rows of almost square pits extend to the apex of the elytra. The habitat of *E. titana* is Queensland; that of *porcata* covers the whole of the continent. *E. floccosus* Schkl., from Queensland and New South Wales, is remarkable in having the coarsely pitted elytra clothed with tufts of erect hairs.

Members of the genus *Cylidrus*, so aptly described by Froggatt as "ferret-like", are elongate and slender, with the head and thorax occupying a disproportionately large portion of the total length. They are black, often marked with patches of yellow. *C. basalis* Macl., *centralis* Pasc., and *nigrinus* White are all widely distributed in Australia.

The genus *Opilo* contains a number of coarsely punctate, elongate insects, banded with brownish-black and yellow. *O. congruus* Newm., and its varieties, are to be found practically throughout Australia. *Thanasimus eximius* White is a very beautiful, thick-set beetle coloured with varied iridescent tints, ranging from gold-copper to deep blue. The genera *Stigmatium* and *Ommadius* contain elongate insects with the head and thorax forming a rounded mass, coloured in obscure shades of green and brown with an evanescent pattern similar to that seen in figured velvet. Members of *Cleromorpha* are small, stout, and hairy; *C. novemguttata* Westw. is a rich blue adorned with small, snowflake-like white spots.

Insects in the large genus *Phlogistus* form a group resplendent in the metallic tints of green, blue, and copper; many of the species, especially *P. eremita* Blkb., *P. delicatulus* Boh., and *P. smaragdinus* Gor. are common and widely distributed. The large and striking *Trogodendron fasciculatum* Schr. has been referred to previously in giving details of its life-history. *Zenithicola* is a genus of stout and comparatively broad insects, coloured mostly black with touches of white; in the common *Z. crassus* Newm. the smooth and glossy prothorax is brightly yellow. Slender in build, the members of the large genus *Eleale* are mostly of dull and obscure tints: *E. reichei* Spin., and *simplex* Newm. are brownish; *E. lepida* Pasc., and *pulchra* Newm. are barred with yellow, while *E. smaragdina* Chev., from Queensland, is a beautiful, matte, metallic green. Another very large genus is *Lemidia*, with the insects comprising it small but very beautiful, presenting a bewildering array of colour and pattern. *Paratillus* contains the species *carus* Newm. to which reference has already been made as an enemy of the Powder-post Beetle; it measures under a quarter of an inch in length, black, with the head and thorax reddish, and a narrow transverse yellow band on the elytra.

In conclusion, it may be mentioned that two introduced Clerids, *Necrobia rufipes* de Geer and *N. ruficollis* Fabr. are sometimes plentiful; the former is deep blue with red legs, the latter blue-black with the thorax and the base of the elytra orange-red. *N. rufipes* is a pest in copra cargoes, in which they sometimes cause considerable damage; *N. ruficollis* feeds on carrion. The name "Ham Beetle" has been given to the firstnamed species but, in Australia, it is more frequently known as the "Copra Bug".

Obituary

Keith Collingwood McKeown

Keith Collingwood McKeown, whose contributions to these pages have been a regular feature over many years, passed away suddenly on 21 August during the A.N.Z.A.A.S. conference at Sydney. He had been assistant entomologist at this Museum since 1929. As a youngster his steps led him here regularly when visits from the country brought him to the city, visits which held an increasing attraction for him as he grew older and his interests focussed upon the cabinet collections. A keen naturalist, he retained his affection for the bush and all that dwelt therein. A wide circle of readers is familiar with his many popular books and articles in the Press; his last book, "Australian Spiders: their lives and habits" appeared a few weeks ago. There is another circle, however, which knew him as a scientific specialist, an authority upon Coleoptera. The economic aspect of entomology also interested him—he had conducted investigations into the food of birds, trout and Macquarie perch. Apart from his natural history knowledge he possessed a fine store of general information and there were few subjects, indeed, upon which he could not help one.

He is survived by a widow and a young son, a boy who participated in many of his interests and in whom he had great hopes.

—W.A.R.

Broken Hill—I

By R. O. CHALMERS

AS an individual producer of lead, silver and zinc Broken Hill is perhaps the most important mining centre known. The total yield of minerals from the district exceeds £250,000,000 in value. The field has been producing continuously for sixty-six years and the output for the period is 65,000,000 tons. Present reserves in sight are in excess of 75,000,000 tons. There seems little doubt that steady production is assured for another century at least, perhaps longer.

Broken Hill lies in the Western Division of the State, 700 miles west of Sydney and only 30 miles from the South Australian border. It lies at an elevation of about 1,000 feet above sea-level in a dissected rocky plateau known as the Barrier Ranges. This plateau gradually falls away and merges with the low-lying grey and brown soil plains of the West Darling district. The highest point in the Barrier Ranges is Mount Robe, 1,550 feet above sea-level. It is an area of low rainfall, the average in Broken Hill being only 9 or 10 inches a year. It is hot in summer and cold in winter. Creeks, some of considerable size, but completely dry except when rain is falling heavily, have well-defined courses in the ranges. In the plains the channels can scarcely be discerned, both to the east where they approach but seldom reach the Darling, and to the west where they just disappear. The only large trees are the stately river gums (*Eucalyptus camaldulensis*) which grow profusely along the banks of the larger streams. As is to be expected in an area of such low rainfall the trees elsewhere are not large and often somewhat stunted. Various species of *Acacia* are most characteristic, notably the mulga (*A. aneura*). This somewhat dried up small tree, with its needly, sparse leaves, greenish grey and dusty looking, and its near relatives of generally similar appearance, seem to impress themselves most in the memory of a general observer with no botanical experience. They seem to accentuate the somewhat primeval appearance of this region which is geologically most ancient. They form a spare mantle on the reddish-brown hills of compressed and contorted schists with their thin slaty edges projecting vertically through the thin cover of soil. The opposite picture is that of astonishing fertility brought forth in good seasons. The plains are covered with rippling long grass and are thick with wildflowers, the prince of which is the magnificent scarlet Sturt's Desert Pea. The rockiest hills have a cover of green with which is contrasted the bloom of wattles and cassias. Good seasons though are the exception rather than the rule.

It was in one of the worst of the droughts in the spring of 1844 that Captain Charles Sturt set out from Adelaide, along the Murray, up the Darling to the present site of Menindee and then pushed on into the unknown west. There is not time to tell the oft-repeated story of the subsequent privations of his party in its slow, painful journey through the parched land and pitiless heat until halted on the eastern edge of the Simpson Desert, and of the even more difficult return. Some 70 miles west of Menindee, Sturt collected specimens from a narrow ironstone ridge about 2 miles long with an irregular broken outline rising sharply 100 feet or so above the plain, but later he had to discard them. Thus was the "broken hill" discovered but at that stage it was not recognised as the surface outcrop of a phenomenally rich ore body.

Sturt's expedition led to the almost immediate spread of pastoral development in the West Darling District. Conservation of water in these regions is obviously a difficult matter because of low rainfall and high evaporation. Although no artesian water is found as far south as Broken Hill, sufficient ground water is obtained by sinking wells which, though mostly too saline for human consumption or irrigation, suffices well for stock, especially sheep. By 1871 the present site of Broken Hill was part of a large holding of 14,000 square miles known as Mount Gipps. The stone walls of the head station and wool shed still stand on the Tibooburra road 13 miles north of the city.

On the mining side, from 1861 on, prospectors came to the Barrier Ranges but few cast more than a passing glance at the hill on the Mount Gipps out-paddock. Some shadowy rumour led to a disastrous gold rush in 1867 in which many died of thirst. The ill-fated Burke and Wills had passed through Menindee a few years before on their last journey. Definite finds of silver and lead ore at Thackaringa and Silverton not many miles from Broken Hill, established the first permanent mining in the district. By 1883 Silverton had a population of 3,000 and still the ridge a few miles to the west on Mount Gipps Station was contemptuously referred to as the "Hill of Mullock" as if to indicate its complete barrenness of mineral wealth in comparison with the Daydream, Silver King, Apollyon, Nil Desperandum and dozens of other small but rich shows.

McCulloch, the manager of Mount Gipps, his interest centred on the pastoral industry, viewed with little enthusiasm the mining activity in the district with its attendant evils of drink and gambling, all a possible source of unrest amongst the station workers. He sternly discouraged any interest in prospecting amongst his men. However, in 1883, Charles Rasp, one of the boundary riders who had been assiduously studying a prospectors' guide in lieu of a more academic training in mineralogy, could resist no longer an exploration of the saw-toothed hill 13 miles to the south. Convinced as a result of his examination that it was a cassiterite (tinstone) lode he decided to brave the certain wrath of his chief and pegged out one claim. McCulloch, after a preliminary choleric outburst, now that the die was cast and in order to prevent outsiders swarming on the station property, decided to peg the whole hill forming a syndicate of seven with Rasp and five other station hands. The ore turned out to be silver-lead, not tin, and the syndicate began mining. Success did not come immediately. Some of the original seven wavered and disposed of their share, but in 1885 the discovery of rich masses of silver chloride heralded the almost unbelievable richness of the ore body and in this year the Broken Hill Proprietary Company was formed from the original syndicate. Mining began on a large scale and the rich ores were smelted on the spot to produce metallic lead and silver. A fourteenth share originally disposed of for four bullocks, and a few months before having cost £150, was bought for £2,000. Within six years it was to be worth £1,250,000. The rapid exhaustion of the small mines of the Silverton district was almost as spectacular as the rise of the new colossus. Silverton became a ghost town within two years.

Unfortunately a sober article with a geological bias is no place to attempt the portrayal of the boom times that hit Broken Hill like an avalanche. Thousands of people anxious to make their fortunes crowded to the young city which soon came to resemble a wild west American town in all respects. It rapidly reached the status of third city in New South Wales and has remained so ever since.

Beneath the flamboyancy, the ostentation and the garish front presented by the lusty young Broken Hill, serious problems had to be faced. The city was not linked by rail with the outside world. The South Australian Railways ran to Cockburn, 30 miles away on the border, but it was not the province of the South Australian Government to build railways in New South Wales. The nearest New South Wales railhead was about 350 miles distant. So the private Silverton Tramway Company was formed to link Broken Hill by rail with Cockburn, thus firmly establishing Broken Hill as a geographical and economic unit of South Australia.

The next thirty or forty years must be passed over briefly although in every respect they make an eventful chapter in Australian history. The prosperity of the field due to the phenomenal wealth of the ore-body continued undiminished but difficulties continued to arise. The independent action of the miners' organisations in protecting their own interests during the onset of the 1893 depression years inevitably led to industrial unrest. Health conditions were far from desirable. The searing summer heat was poorly checked by the inadequate timber and iron dwellings. The ceaseless belching of sulphurous fumes from the smelters polluted the atmosphere. The mulga scrub, once so thick that surveyors in the early days had difficulty in running traverses, had disappeared entirely around the city having been cut for mine timbers and firewood. Stripped of cover the soil was blown into the city in the form of violent dust storms which at their worst turned day into night. Bad and insufficient water caused typhoid epidemics. Infant mortality from gastro-enteritis was high. Typhoid at its worst was killing ten people a day in the early 90's.

Death was also taking a large toll in the mines. Lead poisoning was rife. Insufficient ventilation underground and lack of any attempt to lay the dust at the working faces marked many a miner as a victim of pneumoconiosis (dusted lung).

At this stage, due to lack of water for fire-fighting, Broken Hill had two Great Fires as well as its Great Plague. Feeling ran high because of the indifference of the government, 700 miles away in Sydney, to the problem of water supply. This general feeling that Broken Hill is part of New South Wales in name only, is exemplified even to-day in the titles of the posting boxes at the Broken Hill G.P.O. They read "South Australia", "Victoria", "Local" and "Other Places". Reverting to the water difficulty, in the big drought of 1891 water had to be railed from Adelaide and cost 15s. per 100 gallons. As a protest at the continued neglect by the New South Wales Government, Francis Abigail, M.L.A., Minister for Mines, was burned in effigy.

Stephen's Creek Reservoir, the first of Broken Hill's two dams, was built in 1892 and the second at Umberumberka in 1917, but, until a few months ago when the long-awaited pipeline from the Darling was completed, the water supply was never adequate. Water trains from Menindee were still running regularly right up to the time the pipeline was completed.

(*To be continued.*)