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The Frogmouth.

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THE AUSTRALIAN MUSEUM

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THE AUSTRALIAN MUSEUM MAGAZINE

● OUR FRONT COVER. The Frogmouth (*Podargus strigoides* Latham) is by Lilian Medland. It is one of a series of post cards issued by the Australian Museum.

This curious-looking bird is commonly known as the Morepork, because it was supposed to utter the cry that really belonged to the Boobook Owl. Of late years it has been claimed that the Frogmouth really does make a sound resembling "Morepork", but if this be true, it is not characteristic. The usual note is a soft "*oom-oom-oom*", not unlike the droning of a telephone wire, many times repeated. This is uttered only at night, the bird being nocturnal in its habits; by day it rests in the open on the branch of a tree.

The Frogmouth feeds upon the larger night-flying insects, and is helped in the capture of these by its keen vision and its wide capacious mouth. It is generally distributed over southern Australia and Tasmania, its place in the north being taken by allied species. Its coloration is protective, and the protective resemblance is increased by the attitude which the bird adopts, so that it looks like a piece of broken branch, or a flap of fibrous bark hanging down. The bristle-like feathers round the base of the beak aid this resemblance. The nest is built of twigs, and two or three white eggs are laid. The young are covered with white down.

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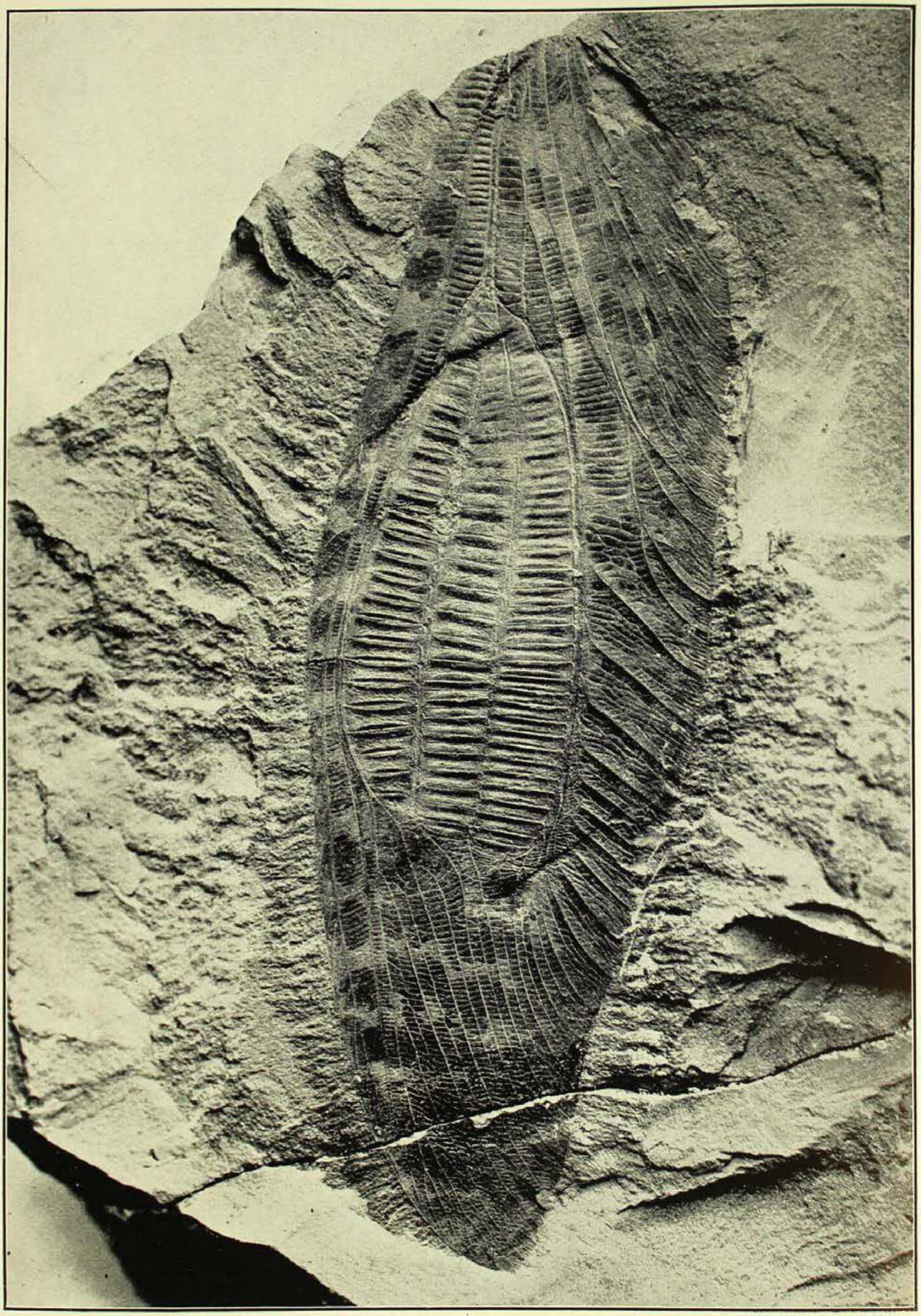

Wing of fossil insect from Brookvale, in a fine state of preservation. The wing exceeds five inches in length, and the venation is beautifully shown. In the middle is a grid-like structure, which is supposed to have been a sound-producing organ. Australian Museum specimen.

[Photo.—*G. C. Clutton.*

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The Sydney District a Hundred Million Years Ago

By C. ANDERSON, M.A., D.Sc.

There rolls the deep where grew the tree,
Oh, Earth, what changes hast thou seen;
There where the long street roars hath been
The stillness of the central sea.

TENNYSON.

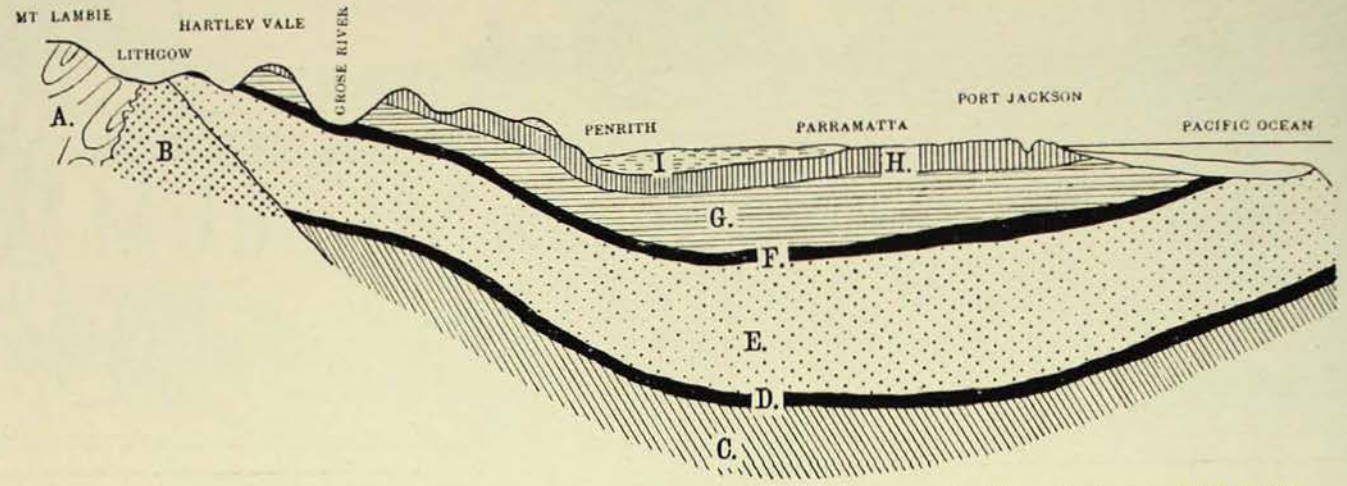
THIS earth of ours, since it was first born from a gaseous nebula, or took form from the coming together of a swarm of meteorites, or originated in some other manner which does not greatly concern us at the moment, has had an eventful history. The earliest chapters of this history cannot be read, for the oldest rocks, which might have furnished the records on which the historian relies, have been so folded and altered that the evidence has been destroyed.

THE SEDIMENTARY ROCKS.

Wherever the land projects above the surface of sea or lake it is incessantly attacked by various destructive agents, rain, wind, frost, and particularly running water in the form of rivers and their tributaries. Even the hardest rocks are by these means reduced to gravel, sand and clay, and these incoherent products are borne along and ultimately come to rest in the ocean or in lakes, or are spread out to form flood plains at lower levels. But these flood plains must be regarded as merely temporary accumulations of detritus, for only when the sediments come to rest on the sea floor is their journey at an end.

It would seem, then, that the outcome of continuous denudation would be to reduce the land to below sea level, beyond the influence of tidal and breaker action. But another and a counteracting force is also to be reckoned with, namely, a process of upheaval, mostly very slow in action, by which these sediments, now consolidated by pressure into sandstone, shale, and mudstone, may become once more elevated to form dry land and perhaps high mountain ranges, once more the prey of the agents of destruction.

If we examined the sedimentary rocks, as these now consolidated materials are called, we shall find that they are layered or stratified, the layers being sometimes as thin as paper, sometimes of consider-



Section west to east showing the geological structure of the Sydney District (after Pittman). A, Devonian; B, Granite; C, D, E, F, Permo-Carboniferous (F = Upper Coal Measures); G, Narrabeen beds; H, Hawkesbury Sandstone; I, Wianamatta shales.

able thickness. This stratification is the result of the mode of formation of the rocks as sediments in water, the layering being due for the most part to intermittent deposition.

In undisturbed sedimentary rocks the planes of stratification are practically horizontal, and the lowest beds will be the oldest. This is an obvious yet very important truth, for it forms the basis of geological chronology. It is true that in extreme cases, for example in the alps of Europe, the natural order of the rocks has in places been inverted as a result of immense earth forces by which they have been folded and crumpled. Yet even in such cases it is usually possible to establish a time sequence in sedimentary rocks. This is done by means of the contained fossils.

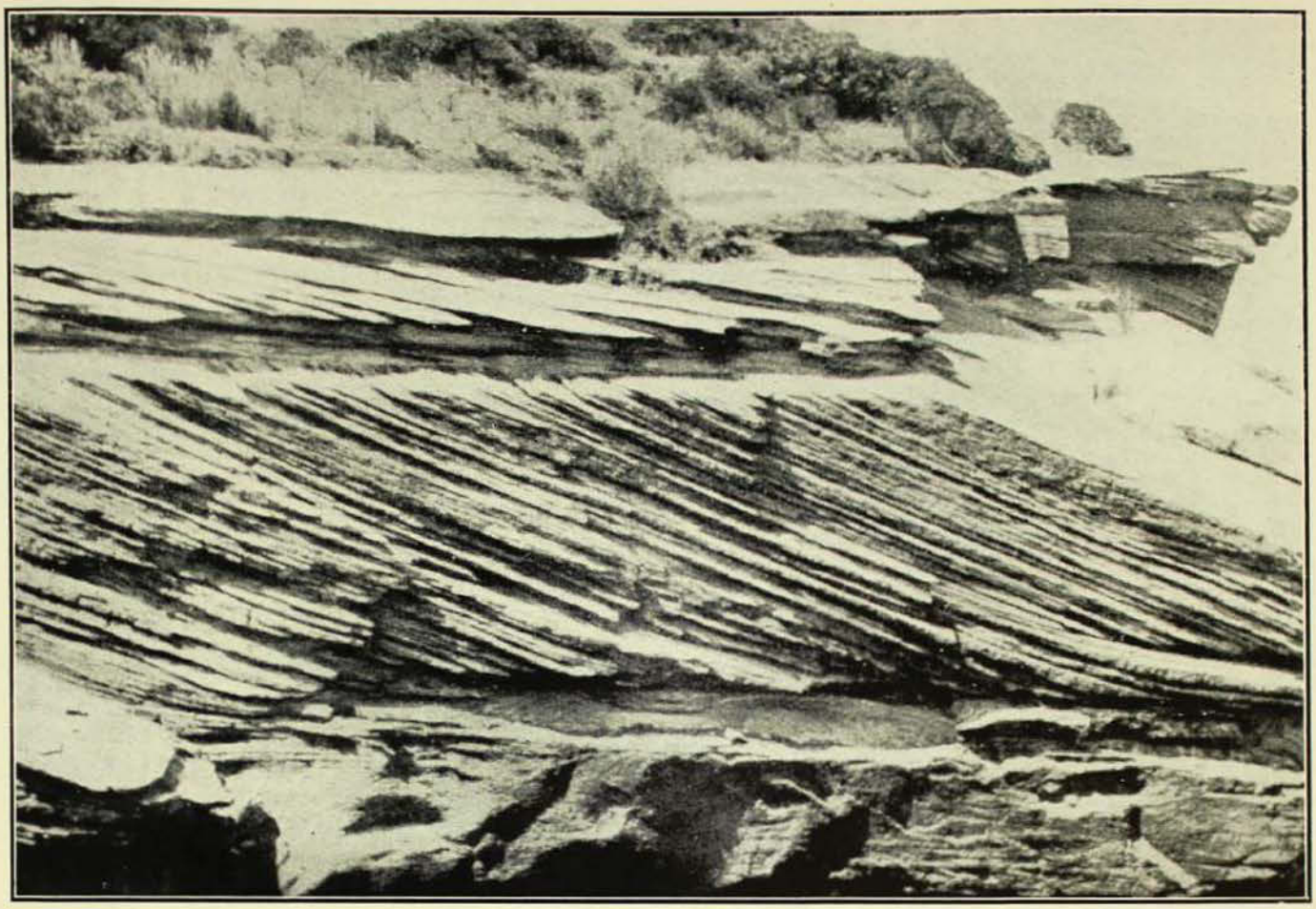
NATURE AND USE OF FOSSILS.

A fossil is literally something dug up, but in geological usage the term is restricted to denote any trace of life, plant or animal, preserved by a natural process in any deposit, whether hard rock or loose sediment.

At the present day the bodies of animals and the stems and leaves of plants sometimes become embedded in soil or washed into lakes or the sea. If these become quickly covered by silt and thus protected from the destructive action of the atmosphere, organisms, or other destroying agents, they may leave recognizable traces of their existence as impressions and moulds, or if they have hard parts, their actual substance may be preserved.

It is obvious that animals which pass their existence in water, such as fishes, molluscs, and corals, are more likely to be entombed in accumulations of mud and ooze than are land animals and plants, but even these may find a final resting place on the sandy or muddy bottom of a lagoon or in an estuary of some river.

In process of time, perhaps hundreds of millions of years, loose sediments become hardened into rock, and the remains of any embedded animal or plant become converted into stone, or, as it is called, petrified, in which condition they are as lasting as the rock itself. Thus when a quarry is opened in a rock formation which was laid down in the form of mud or clay on a lake bottom millions of years ago, we may, and generally do, find the remains of animals and plants which were living in that remote period. And what a marvellous story may be revealed by these mute relics of a primeval world! From them we can extract information regarding the former distribution of land and water, we learn what sort of climate prevailed in the distant past, and, most important of all, we gain information regarding the gradual unfolding of life on the earth.



Current bedding in the Hawkesbury sandstone, Bondi, Sydney. This indicates shallow-water conditions and rapid currents.
[From Süssmilch's *Geology of New South Wales.*

SUCCESSION OF LIFE.

Evolution teaches us that the animals and plants now living are the modified descendants of previously existing forms, hence we find that the oldest rocks, those at the bottom of the sedimentary pile, contain a different assemblage of organic beings from those found in higher and therefore younger rocks. The oldest rocks, as determined by order of succession, contain the most primitive forms of life, and as we proceed upwards in the geological scale we also advance in the scale of life. At the bottom we find only backboneless (invertebrate) animals and the simplest plants, then we encounter fishes, the lowest class of vertebrates, and later reptiles, birds, mammals, and finally man himself.

Thus it will be found that the stratified rocks of a given period are characterized by the presence of certain distinctive fossils and the absence of others, and that rocks of this age can always be recognized by the contained fossils. If we find Trilobites in a certain formation we can be certain that it was laid down on the sea floor in what is known as the Palæozoic Era.

GEOLOGICAL CHRONOLOGY.

By observing the order of superposition of the sedimentary rocks, or, as geologists say, their stratigraphical relationships, and also their characteristic or type fossils, a time sequence in the history of the earth can be established. This sequence is found to be the same in all parts of the world, for the general order of succession of plants and animals has been everywhere the same. Thus, by the evidence contained in the rocks themselves, they can be divided into *Groups*, such as Palæozoic, Mesozoic and Cainozoic (meaning, respectively, deposits containing ancient, middle, and recent forms of life), these into *Systems*, which again can be divided into still smaller

The quarry at Brookvale, near Sydney, which has yielded a rich harvest of fossils of various kinds. These are found in the fine-grained shale, which forms a mass about 25 feet thick in the Hawkesbury sandstone.

[Photo.—*G. C. Clutton.*

Series. To these *rock*-divisions correspond *time*-divisions, *Eras, Periods* and *Stages.* Thus the rocks of the Triassic System were deposited during the Triassic Period, which, with the succeeding Jurassic and Cretaceous Systems, forms the Mesozoic Group, and this was formed during the Mesozoic Era, frequently referred to as the Age of Reptiles.

It will be readily understood that at no one locality do we find an orderly succession of stratified rocks forming a pile extending from the base to the top of what is called the geological column, for a given area may have been dry land throughout a certain period of time, so that no deposits were formed; or if such were formed and the area was subsequently elevated, denudation may have swept away a whole rock formation or even an entire system. Thus the rocks which now form the surface may be of Palæozoic age in one locality, and Mesozoic or even younger in another. Of course the superficial layers, the soil and subsoil, which rest upon the solid rocks, are everywhere of quite recent age.

THE ROCKS OF THE SYDNEY DISTRICT.

When the resident of Sydney regards the cliffs and rocks of his city, or admires the bold ramparts and magnificent gorges of the Blue Mountains to the west, he is looking at rocks of Triassic age, which were deposited as incoherent sediments more than fifty, and perhaps as long as one hundred or more million years ago.

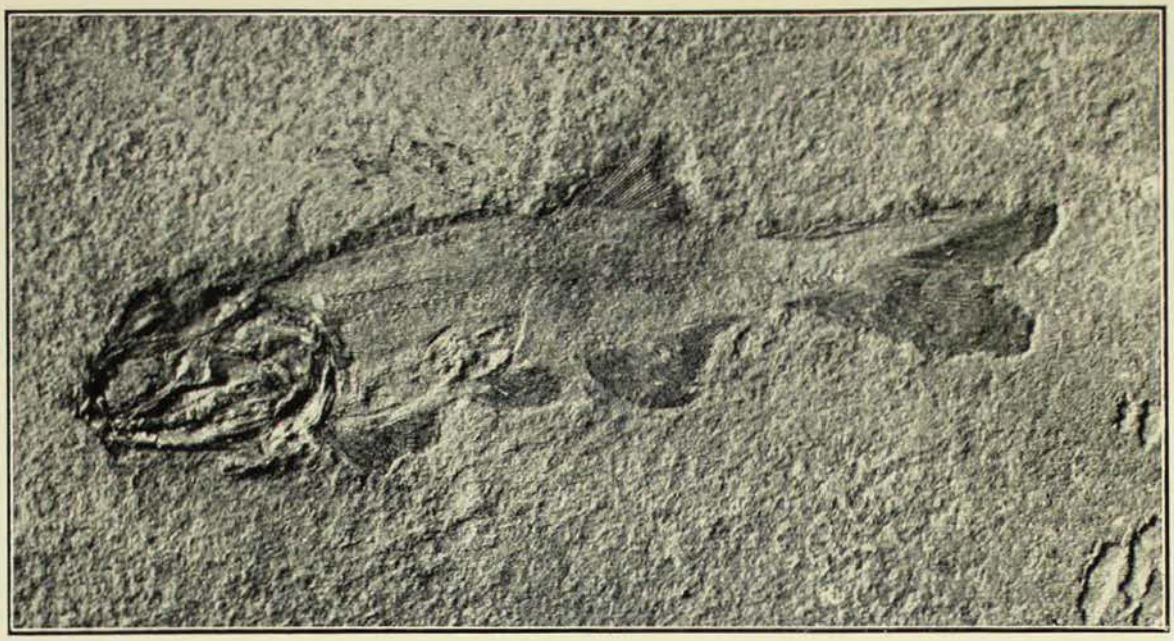
The Triassic System is so called because in Germany and adjacent parts of Europe the system admits of a threefold division. In the Sydney district, too, the system is divided into three stages, the Narrabeen Shales, succeeded by the Hawkesbury Sandstone, which is capped here and there by the Wianamatta Shales. The whole may be called the Hawkesbury Series, and underneath it lies the preceding Permian or Permo-Carboniferous System, which contains the coal seams of the Hunter River, Illawarra, and Lithgow districts. The Permo-Carboniferous rocks occupy a

This is the original specimen of the fossil fish, Cleithrolepis granulata, found on Cockatoo Island, Port Jackson, and described by Sir Phillip Egerton in 1863; it is about five inches in length. Australian Museum specimen.
[Photo.—*G. C. Clutton.*

great basin extending from eastward of the present coastline to the western margin of the Blue Mountains (see section), and from the Illawarra district northwards to the southern boundary of the New England tableland. The deposits which accumulated in this basin were partly of marine, partly of fresh-water origin, according as the land rose or fell in relation to the sea, but towards the close of the period a fresh-water lake of no great depth existed in eastern New South Wales, and in this the Upper Coal Measures were laid down. There was a general downward movement of the land during the closing stages of the Permo-Carboniferous, and each coal seam indicates a period of comparative rest, when the water shallowed sufficiently to allow of a dense growth of swamp vegetation, which now forms the coal seams.

THE TRIASSIC.

At the beginning of the Triassic Period the whole of New South Wales, which then extended further eastwards than it does at present, was above sea-level, but large areas were covered with fresh-water lakes. What we may call the Hawkesbury Lake, in which the Narrabeen Shales, the Hawkesbury Sandstone, and the Wianamatta Shales were laid down, was essentially the same sheet of water as that in which the Upper Coal Measures were deposited. Throughout this extensive series of fresh-water beds, which have a maximum thickness of 3,000 feet, we encounter evidence of shallow water conditions, such as is afforded by ripple marks, current bedding, and beds of gravel, so that we may conclude that throughout the Triassic Period a slow subsidence of the lake bottom was proceeding.



A young and almost scaleless specimen, about two inches in length, of Brookvalia gracilis. Australian Museum specimen.

[Photo.—*G. C. Clutton.*

The Narrabeen Stage consists of sandstones and shales, with occasional beds of conglomerate (cemented gravel and pebbles), and attains its maximum thickness near Sydney, where, in the Cremorne bore, it has been proved to have a thickness of over 1,800 feet.

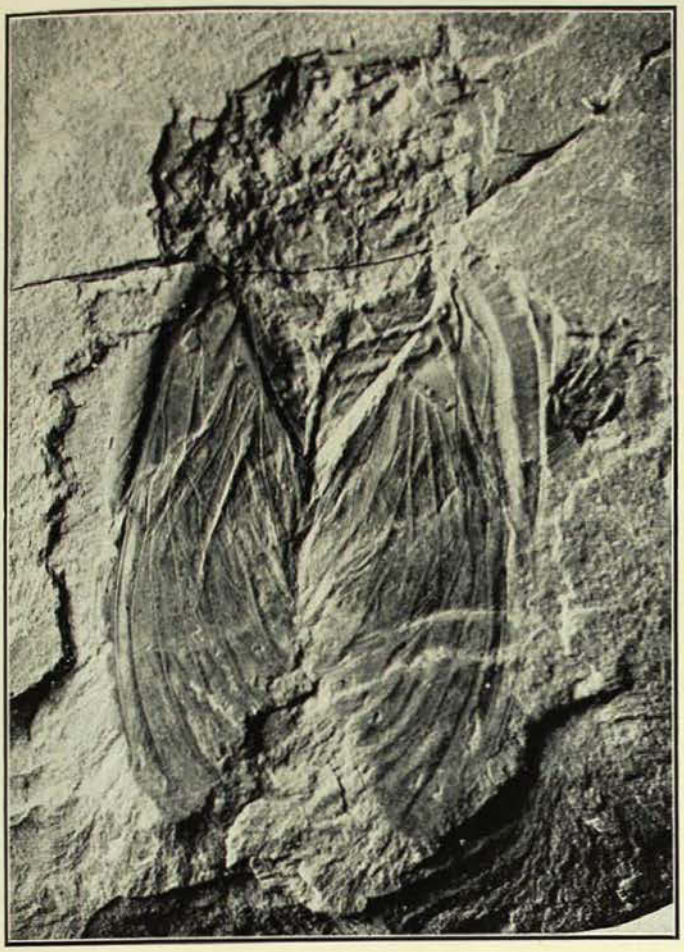
The presence of beds of tuff in the Narrabeen Stage indicates that somewhere in the neighbourhood an active volcano was throwing out ashes. The succeeding Hawkesbury Sandstone, about 1,000 feet in thickness, is mainly composed of coarse massive sandstones and grits, with occasional beds of shale, and forms the most striking feature in the scenery of Sydney and the Blue Mountains.

Much has been written regarding the origin of the sediments which compose the Hawkesbury Sandstone, and the question cannot yet be regarded as settled. It has been suggested that it is a wind-blown formation, that it is a vast delta deposit, and that it was accumulated in a huge flood plain. The prevalence of current bedding indicates that the sandstones were deposited in shallow water which was occasionally turbulent. It is certain, however, that dry land conditions prevailed at times, at any rate in certain localities, and it is probable that wind-blown material and sand dunes accumulated here and there throughout the area. Unfortunately the sandstones themselves are too coarse to form a good medium for the preservation of fossils, but the occasional beds of shale which occur in the sandstones contain abundant remains both of plants and animals, and these clearly indicate fresh-water conditions.

The youngest Stage of the Hawkesbury Series is the Wianamatta Shales, so well known to Sydney residents as the source of the raw material for the manufacture of bricks and pottery, and of the rich soil of the country between Sydney and Penrith, where vineyards and orchards flourish. In many places the Wianamatta Shales have been denuded until they form but a thin capping on top of the Hawkesbury Sandstone, but at Picton and Campbelltown they have a maximum thickness of about 700 feet.

TRIASSIC LIFE.

The Triassic is interesting to the historical geologist, for it ushers in the Mesozoic Era, and the fossils found in Triassic rocks indicate a distinct advance in the scale of life. With the passing of the Palæozoic many primitive groups of plants and animals became extinct, and



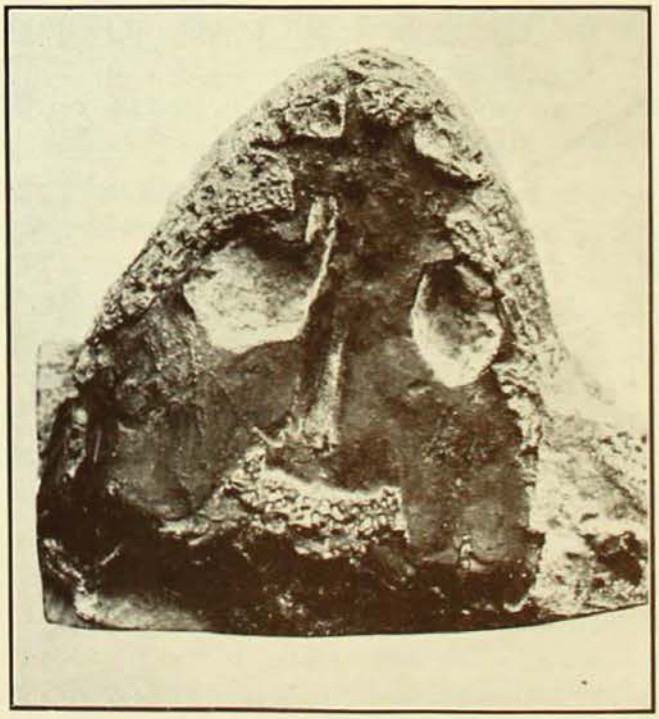
A primitive Cicada, 3½ inches long, from the Brookvale quarries. Australian Museum specimen.

[Photo.—*G. C. Clutton.*

land plants and land animals took on a new importance. Thus in the Trias appeared the first recognizable mammals, and this period, too, witnessed the beginning of that marvellous deployment of reptilian life which has caused the Mesozoic to be known as the Age of Reptiles. It is true no mammal remains have been discovered in our Trias, nor apparently did reptiles play any important part in Australia in Triassic times, yet the animals and plants of the Australian Trias present some interesting features.

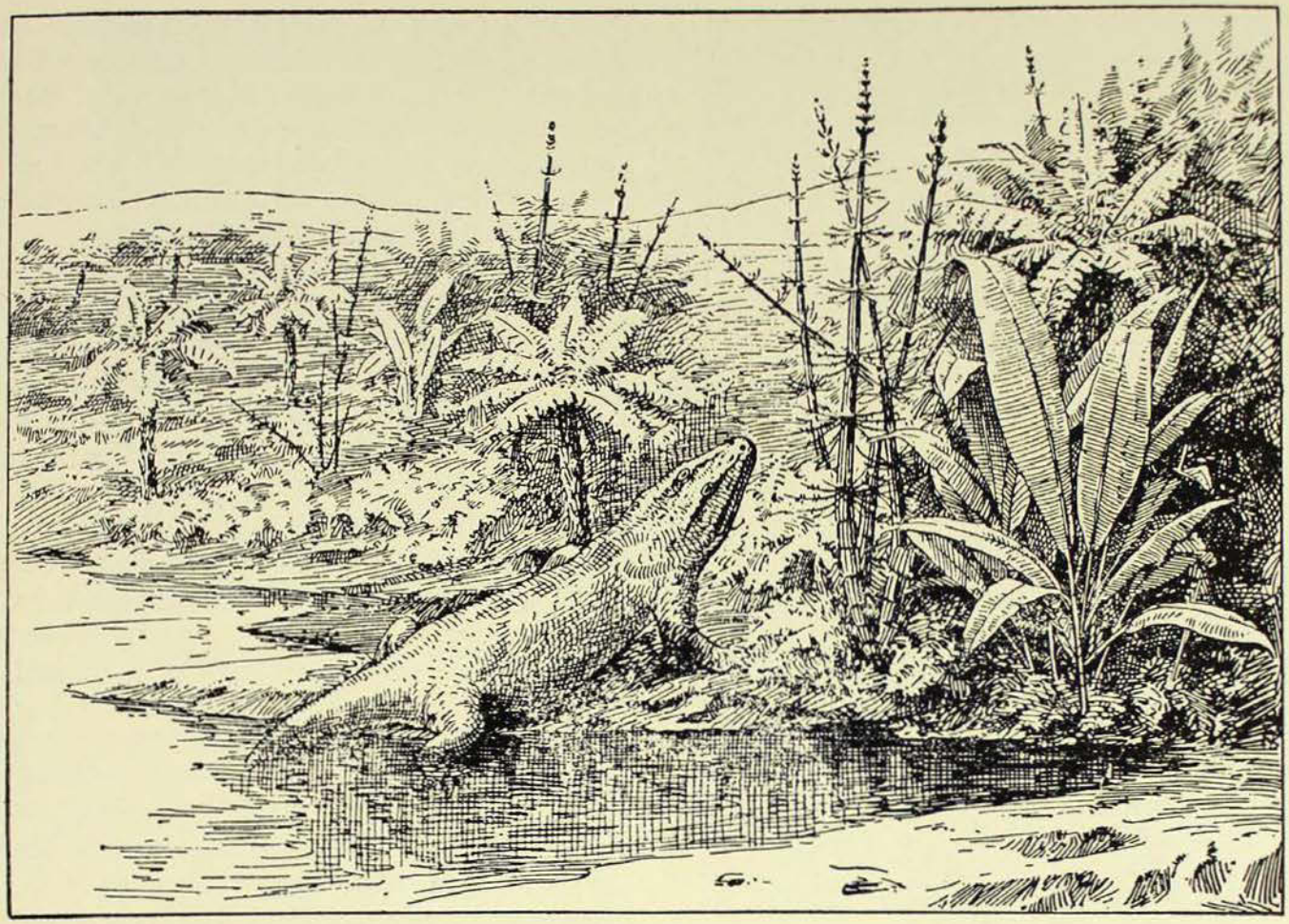
During the preceding Permo-Carboniferous the most abundant and characteristic plant in the southern continents was *Glossopteris*, a fern or a close relative of the ferns, with a large tongue-shaped frond. This and the related *Gangamopteris* were accompanied by several kinds of ferns, horsetails, and other swamp-loving plants, which flourished luxuriantly in and around the lagoons and lakes, and their carbonized remains form the coal seams of eastern Australia. Trees of large dimensions were not lacking, for *Dadoxylon*, which was possibly related to living Araucarias, attained a height of 120 and a girth of over three feet.

Fishes were already old inhabitants in Permo-Carboniferous times, though the record of fossil fishes found in Australian rocks older than the Triassic is not large. Land-living vertebrates made their first appearance on the Australian stage in the highest beds of the Permian, though very few have been found as fossils. As we should expect they were amphibians, though quite unlike the toads and frogs which are now the best known representatives of this class. Insects of a primitive type were fairly abundant in the Upper Permian, and Dr. R. J. Tillyard, F.R.S., to whom we owe most of our knowledge of the fossil insects of Australia, has described many interesting forms found at Warner's Bay and Belmont in the Newcastle district. According to Dr. Tillyard, these ancestral bugs, scorpion flies, beetles and other insects found in the Permian of Australia were generally



Skull of a small Stegocephalian, Bothriceps australis, described by Huxley in 1859; the skull is about three inches in length. From cast in the Australian Museum.

[Photo.—*G. C. Clutton.*



Scene in the Sydney District in Triassic times. In the foreground is a lagoon, from which a labyrinthodont is emerging. On the right can be seen the large fronds of Macrotæniopteris, and another fern, Thinnfeldia, is shown behind the labyrinthodont. The tall reed-like plants are horse-tails.
[From Curran's *Geology of Sydney and the Blue Mountains.*

dwarfed, owing no doubt to the inclement climate, for in Permian times Australia and other southern lands were visited by a severe glaciation.

In the Triassic conditions became more genial, and a general advance took place both in plant and animal life. The characteristic plants of the Glossopteris flora disappeared, although a few persisted into the Triassic, and ferns, horsetails and primitive conifers were still the chief representatives of the vegetable kingdom.

One of the most characteristic plants of the Hawkesbury Series is the fern *Thinnfeldia,* which can be recognized by its broad fronds and strong stems. Another common fern was *Tæniopteris,* with its relative *Macrotæniopteris,* which had simple fronds consisting of one large leaf not unlike the leaf of a banana. There were also various cycad-like forms and a number of conifers such as *Araucarites,* which probably grew on the higher ground. A prominent group of plants in Hawkesbury time was the horsetails, of which the living *Equisetum* is a representative. These were tall, slender, bamboo-like plants, with jointed stems and a sort of frill of leaves at each node. There were also many climbing and creeping plants, and no doubt the ground was covered with mosses and liver-worts and other lowly forms of plant life. But there were no true flowering plants or shrubs, so that the Triassic forest or swamp thicket would have presented a gloomy appearance to modern eyes. Perhaps the New Zealand fern forests afford the best comparison with these early Mesozoic woodlands.

ANIMAL LIFE.

The fishes of the Hawkesbury Sandstone and the Wianamatta Shales are

numerous and varied in size and appearance, some reaching a length of three feet or more, while others were no more than three or four inches in length when full grown. Among them are found ancestors of the living Queensland lung-fish (*Neoceratodus*), but the majority belonged to a group commonly referred to as ganoids, because their scales were covered with an enamel-like substance known as ganoine. These scales did not overlap one another as is usually the case in modern fishes, but were bound together by a peg and socket arrangement.

In these fishes, as a general rule, the backbone was cartilaginous, not bony as in all but a few modern fishes, and the tail was unsymmetrical, the tapering end of the body being tilted upwards into the upper lobe.

Fishes have been found at three main localities in the Triassic of the Sydney district, namely, at Gosford, in a bed of shale which may be near the top of the Narrabeen Stage or low down in the Hawkesbury Sandstone; at Beacon Hill, near Brookvale, in a lenticular mass of shale about twenty-five feet in thickness and about 500 feet above the base of the Hawkesbury Sandstone; and in the Wianamatta Shale at St. Peters, a suburb of Sydney. The fossils, therefore, are found at three different levels, and were not quite contemporaneous. As we should expect, the fishes from the three localities present difference in detail, though in general character there is much similarity in the fish fauna. All are of fresh-water type, though it is not impossible that some of them may have been able to live in brackish water.

One of the commonest and most easily recognizable of the fossil fishes found in the Sydney district is the form known as *Cleithrolepis granulata*, a deep-bodied fish of no great size, with large eye orbits and a blunt snout. This fish was first discovered while excavations were being made for the construction of the dry dock on Cockatoo Island, Port Jackson; it was found in a shale bed enclosed in the Hawkesbury Sandstone. Photographs of two specimens, one an almost complete fish, the other a fragment, were forwarded by the Rev. W. B. Clarke, the "Father of Australian Geology", to Sir Phillip Egerton in London, and it was on these photographs that Egerton, in 1863, established the new genus. The larger specimen, forming the type, is in the collection of the Australian Museum, and a photograph of this historic relic of the past is here reproduced.

BROOKVALE FOSSILS.

The shale at Beacon Hill no doubt occupies the site of a lakelet or lagoon which was surrounded by sandhills, and into which fine silt and mud were carried and gently deposited. The shale, which is now being worked for the manufacture of bricks and tiles, is horizontally bedded and very fine grained, forming an admirable medium for the preservation of plants, fishes, insects, and other animals. Not infrequently the quarrymen, when splitting a block of shale, see on the smooth rock the impression of a fern, an insect wing, or a fish, the finest details of the structure being sometimes preserved.

Dr. R. T. Wade, formerly of Sydney, who has made an intensive study of Australian Mesozoic fishes, in a publication recently issued by the British Museum, enumerates no fewer than twenty-eight species of fossil fishes from Brookvale, nearly all of them new. Two of the commonest forms are *Cleithrolepis granulata* and an elegant little fish, *Brookvalia gracilis*, which varies in length from about one inch to three and a half inches, according to age. Another interesting species found at Brookvale is *Ceratodus formosus*, a relative of the existing *Neoceratodus* of Queensland, the type and only specimen being a young individual about three inches in length. Ceratodus is of fairly common occurrence in Triassic rocks in various parts of the world, but this is the first find in which the body is satisfactorily preserved.

Insects are not so abundant as fishes in the Brookvale quarries, though doubtless many escape discovery owing to their small size. Yet not all the insects are

small, and Dr. Tillyard has described as *Mesotitan scullyi* a large member of the extinct order Protohemiptera, which he estimates to have had a wing spread of ten or twelve inches, and an even larger species, *Mesotitan giganteus*, was previously discovered at St. Peters and described by Dr. Tillyard. But the most sensational discovery is of quite recent date, Mr. W. Bass, foreman at Brookvale, obtaining the magnificent wing, over five inches in length, a photograph of which forms the frontispiece of this number. The wing is perfectly preserved, all the veins being clearly shown, and even the colour markings are indicated. But the most striking feature is the curious grid-like structure in the middle of the wing; this consists of three sets of slightly raised ridges forming a corrugated area. This structure was no doubt a sound-producing mechanism, and we can well imagine that the sound given forth was both loud and shrill. Thus, though there were no singing birds in the Triassic woodlands, nor any bellowing or howling mammals, there was nevertheless the hum of insect wings and the air was split by the screeching of this lusty creature which has not yet been described and named.

Another interesting Brookvale insect belongs to the Cicada family, and in this case not only the wings, but practically the whole body and the head, which together are about three and a half inches in length, are preserved. It is thought that this ancestral cicada is closely related to a form still existing in the high lands of south-east Australia.

Another intriguing inhabitant of the Brookvale lagoon was a small shrimp, closely related to the celebrated *Anaspides* of Mount Wellington, Tasmania. This belongs to a peculiar Order of crustaceans, which is now confined to Australia, but which in ages past was more widely spread, for a representative has been described from the Permian of Germany. Another peculiar family of crustaceans, the Phreatoicidæ, which belong to the same Order as the familiar garden "slater", is today represented in New Zealand, Australia, and South Africa, and an extinct relative, *Eophreatoicus*, has been described from the Triassic shales of St. Peters. It is wonderful to think that these primitive crustaceans still survive in Australia and that they have changed but little in the course of many millions of years.

AIR-BREATHING VERTEBRATES.

There is no doubt that the pioneer air-breathing vertebrates were the lung-fishes such as Ceratodus, in which the swim-bladder can function as a lung, enabling the animal to spend some time out of water, resting on a log or mud bank. But the exact steps whereby water-dwelling fishes evolved into land-living creatures is still a subject for conjecture, though more or less plausible explanations have been offered of the manner in which the swim-bladder became a true lung and the fin became a limb fitted for progression on land. It does not seem, however, that the lung-fishes were the direct ancestors of land vertebrates.

At any rate, in Permo-Carboniferous or earlier times amphibia made their appearance and they culminated in the Triassic. These earliest land vertebrates are called Stegocephalia, a word which indicates that they had roofed-in heads, their flat skulls having a roof of bones with no opening save for their nostrils and the orbits for their eyes. Although they belonged to the same class as modern toads, frogs, and newts, they presented more bodily recemblance to large-headed lizards, with long tails and sometimes armour plate on their heads and backs. Clumsy and ugly no doubt they were, yet we hail them as the first true land vertebrates and so entitled to our respect and admiration. They were not, however, completely emancipated, for, like modern amphibians, they were hatched in the water and in their early stages they led an aquatic life, breathing by gills.

Stegocephalians varied considerably in size, for some had a length of only a few inches, while others were as large as small

crocodiles and possibly as formidable, though no doubt they were more sluggish in action.

The earliest known Australian stegocephalian was described by Huxley in 1859 as *Bothriceps australis*. Only the skull, about three inches in length, is known, and unfortunately the exact locality where this interesting specimen was found is uncertain; but there is no doubt that it is of Triassic age and that it came from the Hawkesbury Series. It was a comparatively small animal, which belongs to a family with one representative in Africa and another in India.

Skulls of stegocephalians have been discovered both at Gosford and at Brookvale, but the most important find was made at St. Peters about forty years ago. This celebrated specimen, now in the British Museum, was discovered by the late Benjamin Dunstan, afterwards Government Geologist of Queensland, who spent much time in developing it. It is about eleven feet in length, and is considered to be one of the finest specimens of its kind known, for the skeleton and skull are practically complete; it is possible to make a cast of its brain cavity and even the roots of the principal nerves can be distinguished. It belonged to a family of Stegocephalia known as Labyrinthodonts on account of the complicated structure of their teeth.

A TRIASSIC LANDSCAPE.

If we try to picture the scenery of the Sydney district at the time when the Hawkesbury sandstone was forming, we get the impression of a low-lying sandy waste covered with sparse vegetation consisting of primitive conifers and cycads. To the north-west and south-west the land stood higher, and from these directions came the sediments of which the Hawkesbury sandstone is formed. The coast was then some miles to the east of its present position, and on the extensive coastal plain were a number of lakes and lagoons fed by rivers and small creeks. Around the shores of these lakes and water-holes there was a luxuriant growth of ferns, horse tails, and other moisture-loving plants, and in their waters swam various kinds of fishes. In the thickets and glades were the hum of insect wings, the high note of the recently discovered giant signalling to his mate, and the beetle's "small but sullen horn". Stegocephalians, large and small, splashed in the lagoons and crawled among the undergrowth, living on one another and on the fishes, crustaceans, and other creatures of the day. The fishes no doubt fed largely on the scorpion flies, cicadas, grasshoppers and other small creatures that came their way, and such insects as escaped the snapping jaws became water-logged and sank to the bottom to be enclosed in the mud. We can imagine that at times the land was held in the grip of a drought as sometimes happens today. Then the ponds would dry up and the fishes would burrow into the muddy bottom to await the return of the rains. Should the rains not come in time the mud became their sepulchre, and thus we find them today, encased, young and old, large and small, in the layers of shale.

Prominent amongst recent visitors to the Australian Museum may be mentioned Mr. Justice Wm. Harman Black, of New York, author of travel books and many writings. Mr. Justice Black, who, in his journeys, has visited many museums of world importance, was eulogistic of the high standards attained by our Museum, despite limited resources.

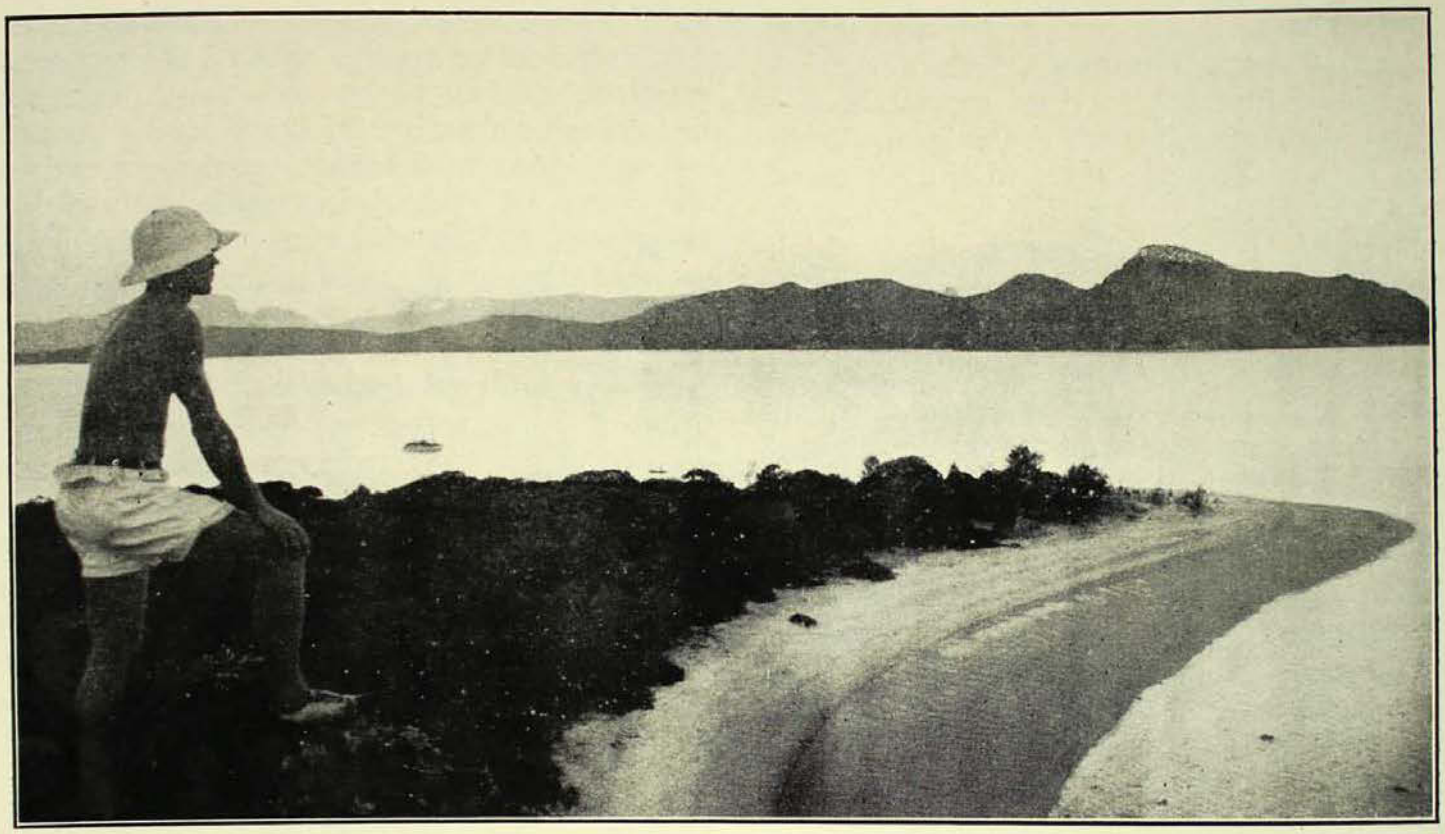
Miss Linda M. Nilsson, also of the United States of America, who has travelled extensively through Australasia, spent much time here studying our shell collections. The various habitat groups she considered particularly fine.

* * * *

The Australian Museum is more definitely associated with mundane matters than many realize. Mr. G. L. Windred, B.Sc.(Agr.), F.R.E.S., of the Colonial Sugar Refining Company, Ltd., has spent much time here studying the sugar cane beetle borer and its allies, his ultimate object being to find a means of controlling this pest.

The Whitsunday Isles

By A. J. Marshall.



Dent Island, looking westward. Once the summits of mainland mountains, these glorious untouched isles, with their placid waterways, are now havens of beauty and tranquillity.
[Photo.—*A. J. Marshall.*

DURING the Christmas and New Year holiday seasons of the last two years I had the good fortune to be one of a party which visited the Whitsunday group of islands situated off the North Queensland coast, and the present article contains some geographical and zoological observations made on these two trips.

Some half million years ago great changes took place along the eastern coast of Australia, as a result of which the sea gained on the land. Port Jackson became a "drowned" river valley, Broken Bay and the Five Islands, off Wollongong, came into being, and in North Queensland this subsidence of the land or rise in the sea level resulted in the picturesque Whitsunday Passage and the delectable isles with which it is studded.

For these jungle- and pine-clad islands were once tall mainland mountains, and the placid blue waterways between them were deep coastal valleys. The coral organism made its appearance, fringing reefs and lagoons were gradually formed, and so on Monday, June 4, 1770, the intrepid navigator James Cook was able to report[1] ". . . a Gentle breeze and Clear weather. In the P.M. Steered thro' the passage, which we found from 3 to 6 or 7 Miles broad, and 8 or 9 Leagues in length . . . Our Depth of Water in running thro' was between 25 and 20 fathoms; everywhere good Anchorage; indeed the whole passage is one Continued safe Harbour, besides a Number of small Bays and Coves on each side, where Ships might lay as it where in a Bason; at least so it appear'd to me, for I did not wait to Examine it, as having been in Port so lately and being unwilling to lose the benefit of a light Moon. The land, both

[1] *Captain Cook's Journal*, by Capt. Wharton, p. 269, 1893.

As the tide ebbs the blue waters of the lagoons recede and the uncovered mud flats become a moving scene of life. All manner of crabs, molluscs, bêche-de-mer, and other curious organisms are revealed to the wanderer among the tidal pools.
[Photo.—*A. J. Marshall.*

on the Main and Islands, especially on the former, is Tolerably high, and distinguished by Hills and Vallies, which are diversified with Woods and Lawns that looked green and pleasant. On a Sandy beach upon one of the Islands we saw 2 people and a Canoe . . . At 6 we were nearly the length of the N. end of the Passage . . . This passage I have named Whitsundays Passage, as it was discover'd on the day the Church commemorates that Festival . . ."

Today, happily, many of the islands are still in much the same state as when the gallant little bark *Endeavour* threaded her way among them. And even though their former primitive inhabitants have gone forever, the orchid-festooned pine forests, creeper-hung jungles, and shady coral strands on the majority of the isles are still unspoiled by the hand of man.

THE TIMBER-GETTING DAYS.

On some of the larger islands mute indications of former industry may be seen in sheltered situations where hoop-pine (*Araucaria Cunninghami*) was abundant and fresh water permanent. Usually a few coconut palms, scraps of pig-iron, and other oddments are all that may now be seen, but occasionally the remnants of a primitive "railway", a battered and silted-up cement dam, or a tumble-down shack may be found in the gloom of the encroaching jungle. In the old days the patriarchal forest monarchs, which seem to invest the ridge-bound waterways with an almost fjord-like atmosphere, were cut down and floated in rafts to the mainland. Many Bowen and Townsville homes are built almost exclusively of hoop-pine from the Whitsundays.

Apart from the relics left by the old timber-getters, the only indications of former industry in these islands are a few twisted and storm-swept wrecks which may on clear days be seen fathoms down in the submerged reefs. A steamer or two and several luggers are said to have

left their bones amid the Whitsunday reefs, and old fishermen tell wondrous tales of wrecks of Spanish galleons, of native children seen playing with spoons and other articles of European manufacture and of native legends concerning " yellow men " who visited the islands and their tribes in days long gone by. So far the only " galleon " was found to be a cargo-steamer which was wrecked about forty years ago ; and it seems very doubtful if, in the Whitsundays at least, proof will be found that Cook was not the first European to sail up our eastern coastline.

THE MOUND BUILDER.

Although bird life is not abundant on most of the islands, there is a considerable diversity of types ; probably because of a like diversity of habitat. Water, and presumably its attendant animal life, is scarce, and this seems to control the distribution of the island avifauna. Sea-birds and shore-birds are fairly numerous. Sea-eagles and ospreys build on rocky eminences throughout the group, and the shady coral strands skirting the lagoons are the haunt of brilliant little sun-birds, chattering drongos and sombre long-legged Stone Curlews.

Spiders and land shells are everywhere in the jungle, which has few birds save occasional Rufous Thrushes (*Colluricincla megarhyncha*), Lilac-crowned Pigeons (*Ptilinopus regina*) and wary Jungle-fowl (*Megapodius*). Despite the depredations of shooting parties from the mainland, the Jungle-fowl is still fairly plentiful in favoured situations.

Here is a bird which is a survivor of an ancient race ; a bird which still retains the reptilian characteristic of not sitting upon its eggs. The Australian member of the genus, *M. reinwardt*, though only as large as a domestic hen, often accumulates a vast pile of sand and decaying debris some twenty feet high and weighing many tons. At the apex of these jungle pyramids a hole is scooped and the eggs are laid, after which the parent bird is thought to leave incubation to the action of heat generated by the decaying debris. When the eggs hatch, the young Jungle-fowl either fight their way up through the loosely heaped debris at the apex of the mound, or escape through " run-holes " which have apparently been previously constructed by the mound builder.

One such natural incubator which I examined in a lonely Hook Island scrub was probably the accumulation of years of labour and the work of generations of birds. This mound was about thirty feet in height, forty feet across the base, and weighed perhaps 200 tons ! In striking contrast to the nuptial labours of the Australian form is the nesting economy of the New Hebridean Jungle-fowl (*M. layardi*), which simply scoops a hole in the earth under a sheltering log and there deposits her eggs. According to the natives—expert naturalists all—" Nemal " never returns to tend the eggs or assist the youngsters.

HAUNT OF THE GREAT-BILLED HERON.

Gulnare Inlet ! A place of towering granite bluffs and of lofty jagged pine forests, through which flocks of snowy White Cockatoos winged their leisurely and noisy way. Beneath the lichen-clad granite shelters the jungle, and below, in a depression that was once a mainland gully, is the picturesque mangrove-lined waterway. This is the haunt of the dreaded estuarine crocodile (*Crocodilus porosus*), the nesting place of the gregarious Nutmeg Pigeon, and the feeding and probable breeding place of the rare Great-billed Heron (*Ardea sumatrana*).

Originally described from Sumatra, this handsome wader is found from Malaysia, through the Celebes to Central-Eastern Queensland, but seems nowhere very plentiful. It was with considerable pleasure, then, that I found them in this lonely inlet in Whitsunday Island. Apparently the heron, which stands nearly three feet high, lives primarily on large fish and crustaceans, which offer little resistance to the large and powerful bill which has given the bird its vernacular name.

Nesting in the mangroves we found dozens of snowy Nutmeg Pigeons, and only a few inches above high water the fragile nest of *Ptilinopus*, the Fruit-Pigeon, was

discovered. This nest consisted of perhaps thirty frail twigs, upon which precariously balanced the single white egg which the species produces. It is difficult to imagine how the egg manages to remain on the flimsy platform until the chick arrives; apparently, too, the pigeon appreciates the instability of her dwelling, for she always leaves and enters without any semblance of haste.

Nara Inlet, on Hook Island, is also a place of many attractions. A well-known watering place, it has more than its fair quota of visitors, yet has remained unspoilt through the passing years. *Stenocarpus*, the " Wheel-tree ", relieves the persistent green with an umbrella-shaped scarlet mass of blossoms, which attract many honey-loving birds to the vicinity. One particular " umbrella " I saw was occupied by a Rainbow Lorikeet, a Helmeted Leatherhead, and a chattering, fluttering group of Dusky Honeyeaters. Each of the larger birds kept to its own " rib " of the bloom, systematically working each separate scarlet bud. Not so the temperamental little honey-birds, which fought and frolicked among themselves all over the whole " umbrella ", but taking great care not to approach too closely to either parrot or leatherhead. Nearby a bevy of gold, blue, and olive-green Sunbirds (*Cyrtostomus*) occupied another flaming blossom.

NUTMEG PIGEON COLONY.

Picturesque Double Cones, some eight miles across the passage from the mainland, is the home of the Nutmeg Pigeon, (*Myristicivora*). Each year thousands of pigeons arrive in various parts of north Australia and breed in remote islands off the coast; they are thought to come from the Aru Islands in order to breed in our cooler climate. Each dawn parties of pigeons leave the breeding island and fly low over the sea to the mainland feeding grounds, returning shortly before nightfall to their island sanctuary. Formerly shooting parties from mainland towns took great toll of the nesting pigeons, but most of the islands have now been declared sanctuaries, and it is hoped that the pigeons will soon regain their former numbers. In the height of the breeding season, even nowadays, the air is filled with the cooing of brooding pigeons, and the constant greenness of the scrub disrupted by the flashing white wings of the swift-wheeling " nutmegs ".

THE SMITH GROUP.

As none of the islands which we had visited are of coralline origin, and we were anxious to see a true coral island, we set sail for Bushy Island, a coral cay some hundred miles to the south-east. We passed the Smith Group by night and did not see more than the dim bulk of these curiously-named islands. The group were named after Sir James Smith, and includes Blacksmith, Goldsmith, Silversmith, Coppersmith and Tinsmith Islands, and, as though he did not want his famous " smiths " to remain in idleness, the donor of the extraordinary titles has given them adequate tools. Hence we have Anvil, Hammer, Pincer, etc., scattered through the Group as well!

A CORAL CAY.

After frequent trips to the masthead, Bushy Island was at length sighted, and all hands waited impatiently as we approached it. Soon we could distinguish waves foaming on the surrounding reef, gaunt niggerheads, the snowy strip of clean sand, and the extraordinary greenness of the Pisonia forest growing densely in the centre of the isle. Sharks and turtles could be seen in the pellucid depths below, the former questing curiously around, the latter sweeping rapidly out of sight with powerful strokes of their flippers.

A typical coral cay, the island is composed almost entirely of sand, and is only a few hundred acres in extent. We crowded into the dinghy, landed on the reef crest, splashed through the lagoon, and were soon busy pitching our lightweight bush-walker tents in a Pisonia clearing. That evening the dusk was split by half a dozen campfires over which turtle steaks were roasted, dampers baked, and the inevitable billy boiled. Turtle steak was fine, but turtle eggs were voted a failure by all save the boat's crew. First it was necessary to boil the eggs, after which the yolks were fried, it being impossible to coagulate the albumen.

It was a gloriously clear night, and a sense of peace and security seemed to pervade the very atmosphere. We were walking along the moonlit beach on the lookout for laying turtles, when a gale travelling at the rate of an express train struck us. It blew one of the girls over, whipped our faces with coarse sand, and sent us staggering back to camp. Here I had the melancholy satisfaction of noting that my tent was the only one standing. Gear was strewn all over the clearing.

The wind howled, the sky quickly became filled with black storm clouds, and in five minutes we were experiencing a blinding tropic squall. The thunder roared, the foliage seethed, and the pounding of seas on the reef made us fear for the safety of the sturdy little *Defiance* and her crew at anchor off the lagoon. Jagged streaks of lightning revealed everything with an uncanny clarity as we cut our way into the twisted Pisonia grove and re-erected our dripping tents. Dozens of white-capped Noddies (*Anous*), attracted by the light from our torches, fluttered down from overhead perches, and often impeded operations. In a few hours the storm seemed to blow itself out, but a couple of hours past midnight it returned with renewed vigour, finally dying away in eerie cadences into the north. The new day dawned bright and clear, and we were immeasurably relieved to see the *Defiance* bobbing safely at her anchor chain.

Egyptological Additions to Our Collections

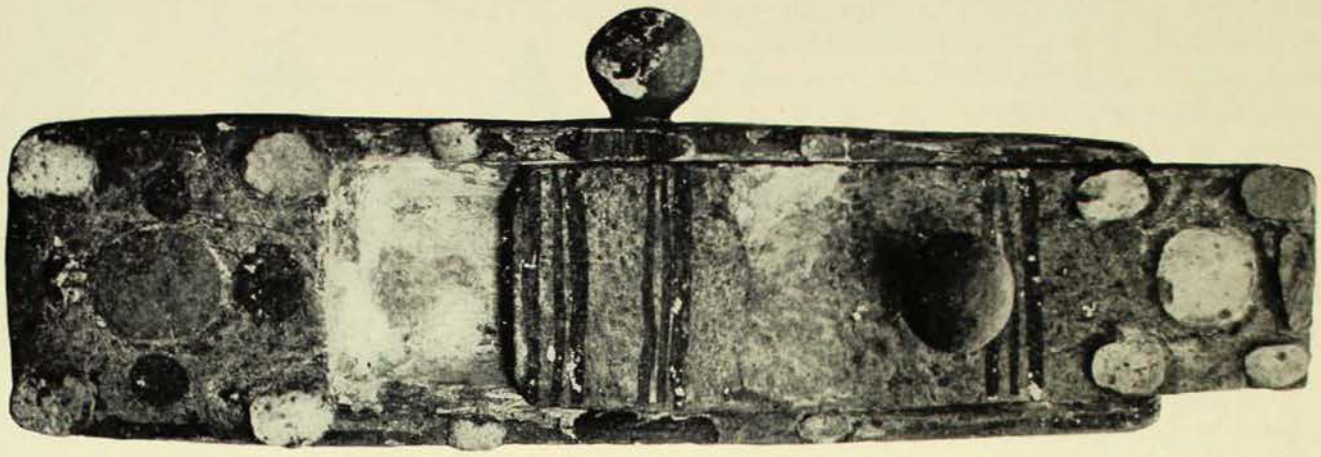
OVER a series of years Mr. Ernest Wunderlich, F.R.A.S., formerly a Trustee and President of the Australian Museum, has actively assisted in the development of this Museum. He was keen in the furtherance of our various educational activities, in which regard we may remark that the foundation of this Magazine was the outcome of his suggestion, our galleries have gained many fine exhibits as the result of his generosity, and he has enriched our library; in other ways he has also rendered assistance equally valuable, if not so direct.

His latest thought has been further to supplement our Egyptological collections by some fine pieces from his private cabinets.

These exhibits, a selection of which we here depict, have been placed on view in the Egyptological Court. Most of them were received by Mr. Wunderlich from Sir Flinders Petrie, their discoverer, with whom he was associated on various occasions in excavation work.

Small Ushebti figure in earthenware, partly covered with blue glaze, bearing the inscription "Mut-en-apt" down the front. Such figures, made of various materials, were placed in the tombs to act as bond-servants for the deceased when he was called upon to labour for the gods in the hereafter — hence their name, "Ushebti", or "answerers".

Bronze figure of the god Osiris holding the flail and crook, the symbols of royalty. He wears the crown of Upper Egypt, upon the front of which is the sacred Uraeus snake, and on the sides the two feathers which are part of the royal costume when in council.



Scribe's pen-box with the lid drawn back to show the interior compartment.

Blue glaze jar top. The liver and gall bladder of the deceased person were placed in a jar surmounted by a representation of the hawk-headed genius, Gebhsennuf.

Bone figure of the god Ptah, patron of the artist, artificer and artisan.

Small figure in wood representing a servant of a noble.

Usbebti figure which bears the name of Tua-reru and has portion of the sixth chapter of the Book of the Dead inscribed upon it

Small breeciated limestone jar, which was filled with oil or unguents and placed in the tomb of the deceased for use in the afterworld.

Cartouche in limestone bearing the name and titles of "User - Maat - Ra - Neb - Taui" or "Rameses II, Lord of the Two Lands".

Gold-mounted scarab of Thotmes III, 18th dynasty. Found by Sir Flinders Petrie at Jhurob, 65 miles south of Cairo, Egypt, in 1920.

Australian Shells

THE WINKS, RISSOIDS, RISSOINIDS AND STUMP SHELLS.

By Joyce Allan.

THE Australwinks belong to a world-wide group of shells forming the family Littorinidæ. The species are littoral, inhabiting the seashores and sometimes brackish water; some can survive long periods of drought, others live high up on rocks and grasses, or on leaves and roots of trees, especially mangroves, where they are washed only by the highest tides. Their food is vegetable, scraped up by means of a long coiled tongue, three times the length of the animal, and containing many hundreds of sharp curved teeth.

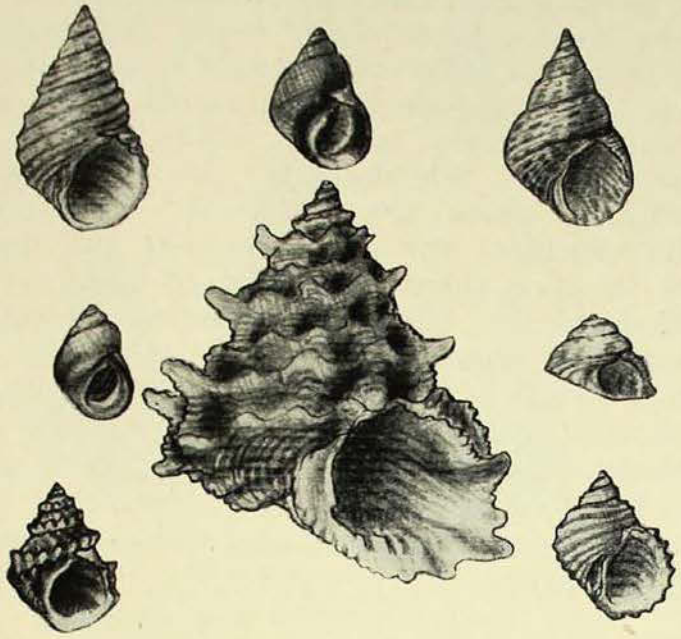
Australwink shells are spiral with half-coiled horny opercula, and the animals have eyes at the base of their long tentacles, and broad feet, square in front and behind. They move in a slow, uneven manner, as the broad foot is divided lengthwise, enabling one side of the foot to move forward at a time.

In Europe and America those belonging to the main genus, *Littorina*, are known as "periwinkles", from "petty winkle" (a small winkle), and are quite different from the shells known as periwinkles in Australia. In the former countries they are used extensively as food amongst the poorer people, and are also an important fish bait; fishermen sometimes distribute them over oyster beds to keep them clear of weed.

In Australia the family of Australwinks contains several well-known genera, members of which are very common along the seashore. The true Australwinks belong to the genus *Melaraphe*, the largest species of which is *Melaraphe scabra*, a yellowish-grey shell about an inch or an inch and a half in size, striped obliquely with chocolate brown, and found in large numbers on mangrove roots in north Australia. This species has a close relative in *Melaraphe luteola*, which is found in eastern Australia but lives high up on mangrove leaves; its colour varies from yellow to rich red, and the revolving striæ on the whorls are more distant and pronounced. A pretty little blue Australwink (*Melaraphe mauritiana*), half an inch high, is extremely common on rocks above low water, ranging to high water, along the coast of southern Australia. It is particularly common round Sydney, where young ones may be seen clustered together in vast numbers in crevices and on open rocks, above low water, making the rocks difficult to walk over. As the shells become adult they scatter more widely over the rocks above high water mark. Two other species similar to this one are *Melaraphe undulata* and *coccinea*, both from Queensland. The latter is whitish or flesh coloured, with an orange columella, while the former is spirally striated, with chestnut lines or marks on a yellow or white body colour; its mouth is tinged with violet. A smaller rounded species, with undulating colour markings and a black tip, is *Melaraphe melanacme*, from Queensland, and the smallest species, *Melaraphe infans*, looks like a tiny speck of dirt when it is found clustered with numbers of others in rock pools, just below high water mark, along the New South Wales coast.

NODDIWINKS AND CONNIWINKS.

Noddiwinks and Conniwinks are closely associated with the Australwinks, as they live under the same conditions and correspond in habits. The common Noddiwink of eastern Australia, ranging from southern Queensland to New South Wales, is *Nodilittorina tuberculata*, with nodular sculpture, and living higher up the rocks than its relatives. In south-west Australia is found a more globose, stronger, white species, with longitudinal sculpture,



Littorinids. The three Australwinks in the upper row are Melaraphe luteola, M. mauritiana and M. scabra. The Giant Noddiwink in the centre is Pagodus pagodus, with Melaraphe infans and Peasiella tantella on each side of it. The two small, lower figures are Nodilittorina tuberculata and Fossarus sydneyensis.

[Joyce Allan, *del.*

Nodilittorina rugosa, and in north Queensland and Western Australia occurs a much smaller species, somewhat similar to *tuberculata* ; this is *Nodilittorina malaccana*. The Giant Noddiwink, *Pagodus pagodus*, from Western Australia reaches a length of two and a half inches, and is easily recognized by the heavy tubercules and ribs. It is yellowish white, often marked with chestnut colour. A smaller species, also from Western Australia, is called *Pagodus bullatus*. Grouped with these two is a somewhat similar shell, *Pagodus cumingi*. This species, however, has a deep umbilicus on the main whorl, and possibly should be in another genus, but is put here with those it most resembles. It is flesh-coloured, with a light orange-brown interior, and is little less than an inch high.

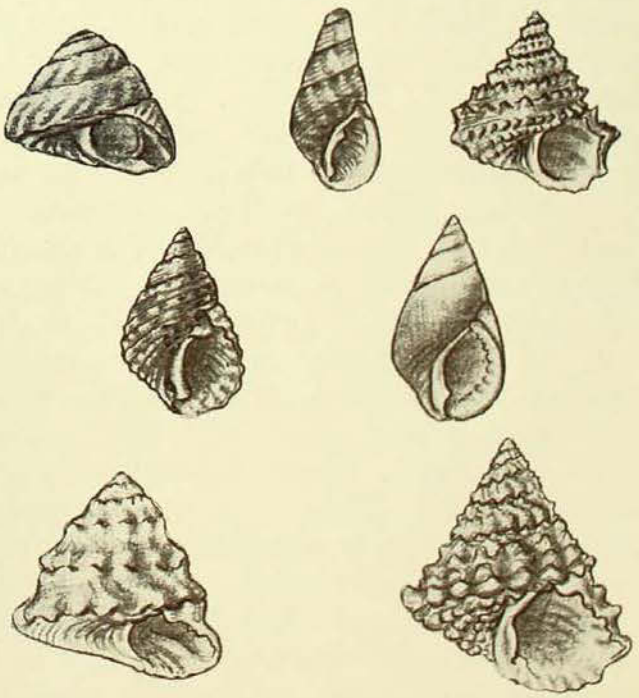
Amongst the Conniwinks the best known species is *Bembicium melanostoma* from southern Australian coast lines. This is particularly common round Sydney, where it is found living generally alongside the Australwink, but is often more numerous than this species. It is a cone-shaped, brownish shell marked with wavy dark brown lines which show distinctly inside the mouth of the shell. This species has a nodulose and more conical relative in *Bembicium kielmanseggi*, which lives in mangroves and muddy places along the coast, extending from southern Australia round to Western Australia, where it now and then meets the former species, which lives on the open sea front. There is a very small Conniwink, *Peasiella tantilla*, only a few millimetres in size, which is occasionally found in Queensland, and resembles a minute *melanostoma*.

Occurring in South Australia, Victoria and Tasmania is a small, flattened, brown species, with a wide mouth and a strong revolving ridge. This is *Risellopsis mutabilis*.

Close to the winks in classification is a small, solid, turban-shaped shell, buff coloured and strongly marked with revolving ridges, with grooves between them. This is the species *Fossarus sydneyensis*, which belongs to the family Fossaridæ and is found under stones along the New South Wales coast.

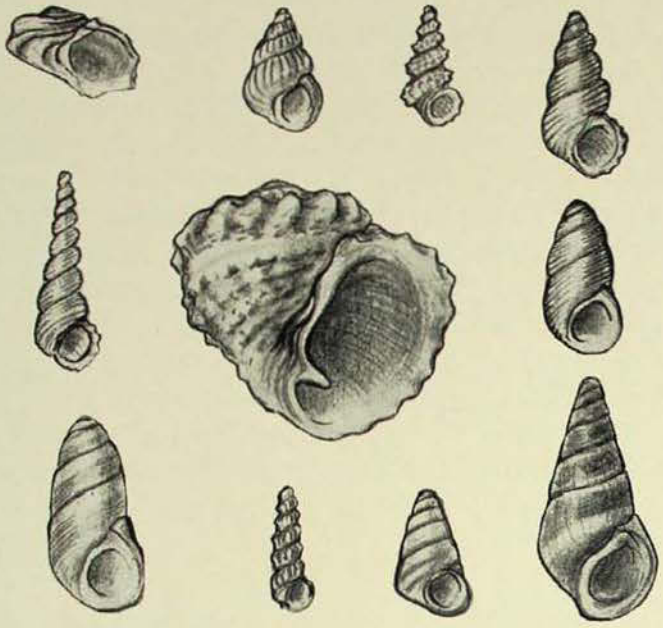
THE CLUSTERWINKS.

Owing to their habit of clustering together in great numbers, the members of the family Planaxidæ are generally



Noddiwinks, Conniwinks and Clusterwinks. From left to right the shells figured in the top row are Bembicium melanostoma, Fissilabia decollata, and Pagodus cumingi. In the centre are Planaxis sulcatus and Hinea brasiliana, and in the lower row are Bembicium kielmanseggi and Pagodus bullatus.

[Joyce Allan, *del.*



The small flattened species on the left in the upper row is Risellopsis mutabilis. The Rissoids next to it are Haurakia incompleta and Merelina cheilostoma, and Lironoba agnewi. The large shell in the middle is Modulus modulus, with a Rissoid, Attenuata integella and Botelloides glomerosa on either side. In the bottom row are Botelloides bassiana, Cœnaculum minutulum, Dardanula erratica, and Estea bicolor.

[Joyce Allan, *del.*

known as Clusterwinks. The common northern Australian species, *Planaxis sulcatus*, a thick shell with spiral ribs, tessellated with chocolate and white, is about an inch high, and lives generally clustered on rocks near the margin of pools left by the tide. Some species adhere to mangrove roots, and dead shells are sometimes found washed up in numbers on beaches. The southern species of Clusterwink is *Hinea brasiliana*, a smooth shell covered with a yellowish epidermis and having a thick outer lip; it is less than an inch high, and lives massed together in crevices and under stones near high water mark on the eastern Australian coast, from Queensland down to New South Wales. A more tropical species is *Fissilabia decollata*, an elongate solid shell with flattened whorls, spirally striated. The mouth has a notch in front and the apex is always broken off; its colour is olivaceous with dull chestnut marking, and its length a little less than an inch. The species occurs in northern Australia.

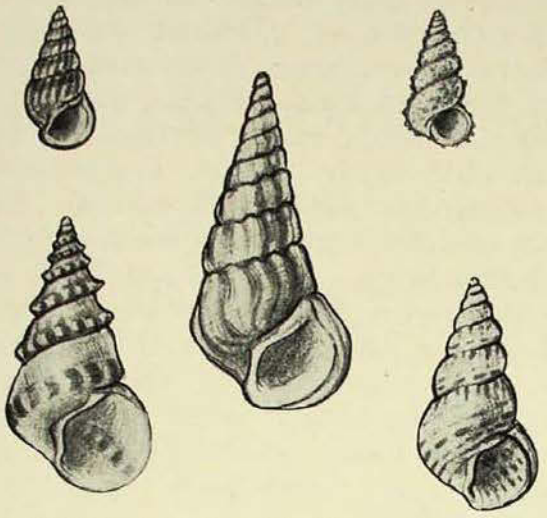
There is a small group of tropical shells which belong to the genus *Modulus*. Though these in no way outwardly resemble the winks, their shells being top-shaped, strong and tuberculate, with a sharp tooth on the columella of the mouth, they are classified close to the winks, owing to anatomical relationship. In fact many authors place the genus in the family Littorinidæ, but the accepted rule now is to give them a family of their own, Modulidæ. Of these shells *Modulus modulus*, from Queensland, is figured in this article. It is about an inch high, whitish, lined with brown, and can be easily recognized by the previously mentioned tooth on the columella. It lives on coral boulders and stones between tide marks.

THE RISSOIDS AND RISSOINIDS.

The Rissoids are a family of small marine shells, mostly of southern occurrence in Australia, and rare in the Tropics. They live chiefly on seaweed, suspended by a mucous thread, and large numbers are found together in shallow water on the weed and under stones. There are between thirty to forty species on record from New South Wales, and many more are likely to be found. The shells are more or less conical or elongated, with

The four shells in the top row are Lævilitorina mariæ, Anabathron contabulatum, Scrobs scrobiculator, and Epigrus ischnus. In the middle row are Rissoina exasperata, Heterorissoa wilfredi, Notosetia atropurpurea and Rissopsis maccoyi. The three in the bottom row are Coxiella striatula, Mœrchiella spirata and Rissolina crassa.

[Joyce Allan, *del.*



In the centre is figured Stiva ferruginea, and above it are Rissoina fasciata and Scaliola arenosa. Below are two close relatives, Diala monile and Alaba phasianella.
[Joyce Allan, *del.*

rounded mouths and, generally, thickened lips. Their colour varies from yellow to brown or purple. A strong microscope is needed to examine the animal, but a good lens will be found sufficient to separate the many different kinds of shells.

The Rissoinids resemble the Rissoids somewhat, but the shells are larger and stouter, with heavier mouths, and the operculum has a blade-like projection on its inner edge. They are, moreover, more common in the tropics, but some species do occur in southern Australian waters. There are no smooth species, all have spiral sculpture, many with additional longitudinal sculpture as well. Though between twenty-five to thirty different species are recorded from Queensland, many more kinds are known to occur there. In colour Rissoinids are commonly white, but sometimes are brown, and a few are banded. Both the Rissoids and the Rissoinids belong to the family Rissoidæ.

The family is divided into many genera and species, and only a few species are figured here, but these are typical representatives of their genera. The size ranges from a millimetre to almost half an inch.

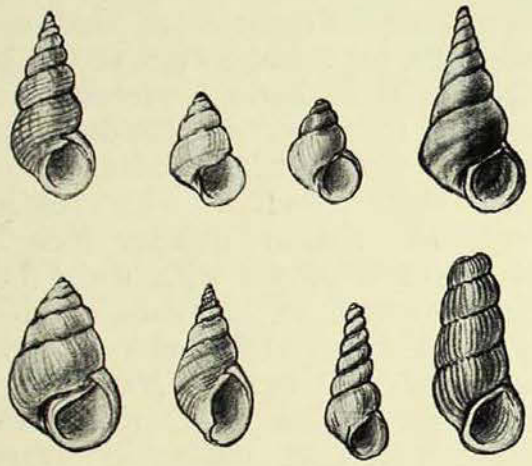
A southern species, common in New South Wales, is *Haurakia incompleta*, a shiny shell with longitudinal ribs, and a thin mouth edge, and *Merelina cheilostoma*, also from southern Australian waters, is an elongate shell, with heavy mouth and longitudinal and transverse ridges forming tubercles. Spiral liræ only mark *Lironoba agnewi*, from all southern States, and similar spiral lines characterize a very elongate deep-water Rissoid, *Attenuata integella*, from the same habitat. A northern Australian shell, *Botelloides glomerosa*, is white with rounded mouth and fine spirals on the whorls, and it has a southern relative, *Botelloides bassiana*, which is slightly larger, and is white, banded with bluish grey. One of the prettiest of the southern Rissoids is a very minute brownish shell, *Cœnaculum minutulum*, thin and elongate, with strong longitudinal ribs, a raised revolving ridge round each whorl, and a peculiar apex, with revolving striæ.

Absence of any sculpture at all is characteristic of a very small white Rissoid which occurs in southern Australia. This species, *Dardanula erratica*, also has an operculum different from that of the true Rissoids, for it has a claw on the back. The small Rissoid *Estea bicolor* is a representative of an important southern group of smooth shells with flattened outer edges to their mouths. This particular species is less than a quarter inch high, and is coloured brown with white bands. *Rissopsis maccoyi* is elongate, thin, and faintly spirally marked, and only a millimetre or so in length; *Notosetia atropurpurea* is smaller still, shiny brown and rounded, and ordinarily smooth; and *Anabathron contabulatum* is a very pretty little Rissoid varying from cream to brown or rose pink in colour, with a prominent ridge round each whorl. On a tiny, smooth, brown Rissoid, *Scrobs scrobiculator*, there is a curious ditch-like structure near the mouth, and another shell, *Epigrus ischnus*, a more elongate, shiny white species, has a similar oval mouth and no ditch. Though placed amongst the Rissoids, *Lævilitorina mariæ*, a small brown shell, looks more like a miniature Australwink than a Rissoid, showing how much animal characters count in classification. The last of the Rissoids figured, *Heterorissoa wilfredi*, is very small, smooth, glassy, thin, and transparent. These all occur in southern Australian waters.

Amongst the Rissoinids, *Rissoina exasperata*, a light-coloured shell, with

strongly marked sculpture, a heavy oval mouth and about three or four millimetres long, is found in Queensland, while a similar banded form, *R. fasciata*, lives in New South Wales. A larger one, *Rissolina crassa*, which occurs in southern Australia, is white, buff, pink, or purple, and is marked with strong longitudinal sculpture, and the largest of the Australian Rissoinids, *Mœrchiella spirata*, from northern Australia, is elongate, white to buff colour, and shiny, and is important because it begins by being heavily sculptured, which shows on the apex of the shell, and then becomes smooth for the greater part of its length. A typical specimen is a little over half an inch in length.

There is a strongly marked Rissoinid, three-quarters of an inch long, which is found in deep water in southern Australia.



Rissoinids, Freshwater Rissoids, and Stump Shells. In the upper row, from left to right, are Obtortio lutosus, Cithna angulata, Potamopyrgus ruppiæ and Tatea rufilabris. In the lower row are Assiminea tasmanica, Litiopa limnophysa, a young specimen of Acmea, and next to it an adult of Acmea valida with the apex broken off.

[Joyce Allan, *del.*

It is more conical, brown, easily recognized, and known as *Stiva ferruginea*. *Scaliola arenosa*, from northern Australia, a delicate, whitish, elongate shell, is covered in a peculiar manner with fine sand grains, and two species from New South Wales, somewhat similar to one another, are *Diala monile* and *Alaba phasianella*, both of which are shiny and elongate, with brown revolving and longitudinal wavy lines. The former, however, has a row of conspicuous chocolate-coloured square marks on the periphery of the body whorl and above the suture on the others.

A northern shell which comes down into New South Wales, *Obtortio lutosus*, has its transverse sculpture more conspicuously marked than its longitudinal, and has also a peculiar swollen apex of variable shape, while in this State is also found in deep water a small glassy Rissoinid, *Cithna angulata*, yellow-brown, especially towards the upper whorls. Its columella is wavy, and on the last or body whorl is a revolving ridge forming an angle on the periphery. *Litiopa limnophysa*, from Queensland, is a small brown shell with an elaborate protoconch or apex, which lives on floating seaweeds, and represents the family Litiopidæ.

A group of little shells resembling Rissoids and living in brackish water form the families Assimineidæ and Hydrobiidæ. Because of their habitat, they are generally called Brackish-water Rissoids. The representatives of these families figured here are *Assiminea tasmanica*, a brownish shell from Tasmania, South Australia, and New South Wales, belonging to the former family, and *Tatea rufilabris*, a smooth brown species from eastern Australia, and *Potamopyrgus ruppiæ*, small and yellowish brown, the last two belonging to the family Hydrobiidæ. A little shell formerly called *Assiminea granum* from Western Australia has an animal entirely different from the eastern Australian *Assiminea*; it is called *Hydrococcus graniformis*.

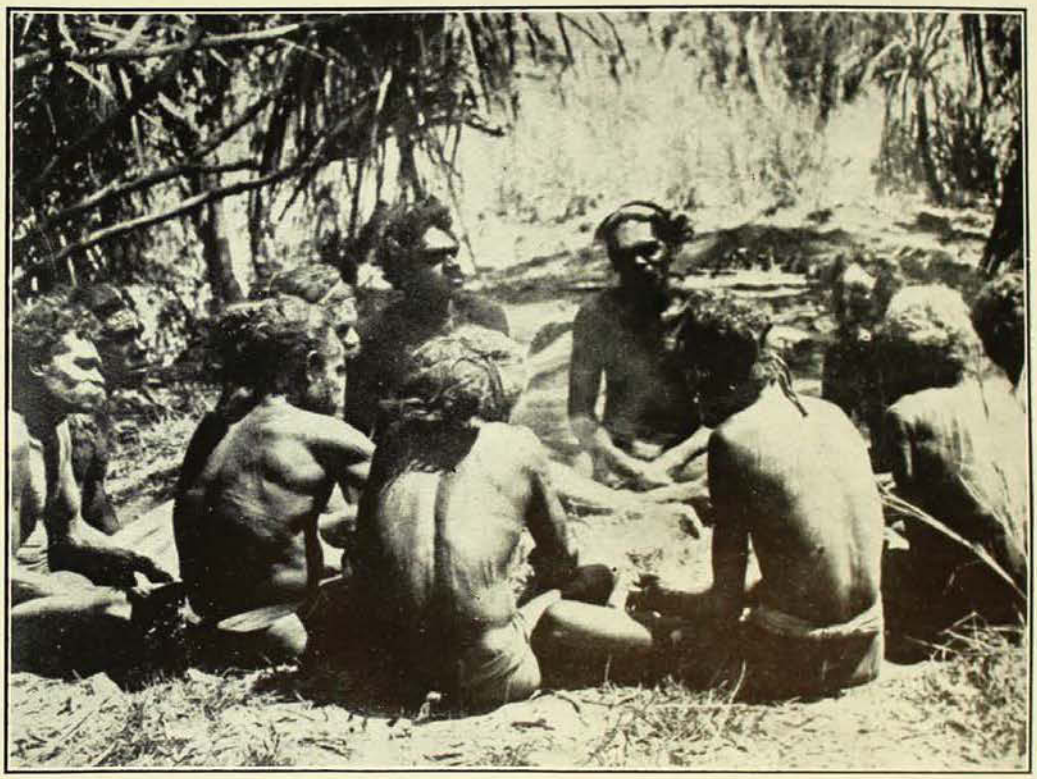
STUMP SHELLS.

Stump shells are a peculiar group of shells forming the family Acmeidæ, which live above high water mark, in amongst sand and grass, throughout Australia and the South Pacific. When young the shells are smooth, elongate, and shiny, but when adult they become longitudinally sculptured, and have their apices broken off, giving the shells a stumped appearance, hence the popular name. Two representatives are figured here, *Acmea valida*, a brownish species from Queensland, with a young specimen near it, and *Coxiella striatula*, a very pretty red, elongate shell from Western Australia. The family Acmeidæ was known formerly as Truncatellidæ, owing to the truncate shape of the adult shells.

Law and Order Among the Australian Aborigines

By Elsie Bramell, M.A., Dip.Ed.

IN the quest for the factors that make for the maintenance of law and order in aboriginal communities, we find ourselves regarding with interest phenomena which on the surface do not appear to have much legal significance, but which, upon analysis, show that they play an important part in the smooth running of public affairs. Kinship ties, for instance, are of immense importance in the conduct of all social, economic and religious matters. A man's mode of behaviour towards his fellows is not left to individual whims, nor guided by personal likes and dislikes, but is based on traditional patterns that have been followed through the ages. The kinship circle is so wide that it includes not only an individual's own family and clan, but all those connected by marriage, including the whole of their families, and, lastly, any others with whom he can establish a link of some kind. Towards each one of these people he is required to adopt a particular attitude that is prescribed by custom. Such obligations are mutual, everyone has his place in the scheme. If a man will not play his part, he becomes an outcast and soon finds that if he is to join in community life at all he must be prepared to give as well as to receive. A breach of social etiquette incurs the severe censure of his fellows, and this is far-reaching enough in its effects to keep him more or less amenable to custom. The simple law of give and take keeps the mechanism in working order. By being law-abiding and acceding to the demands of the social code, an individual may live a life of contentment untroubled by an uneasy conscience—a boon not unconsidered by the prudent.

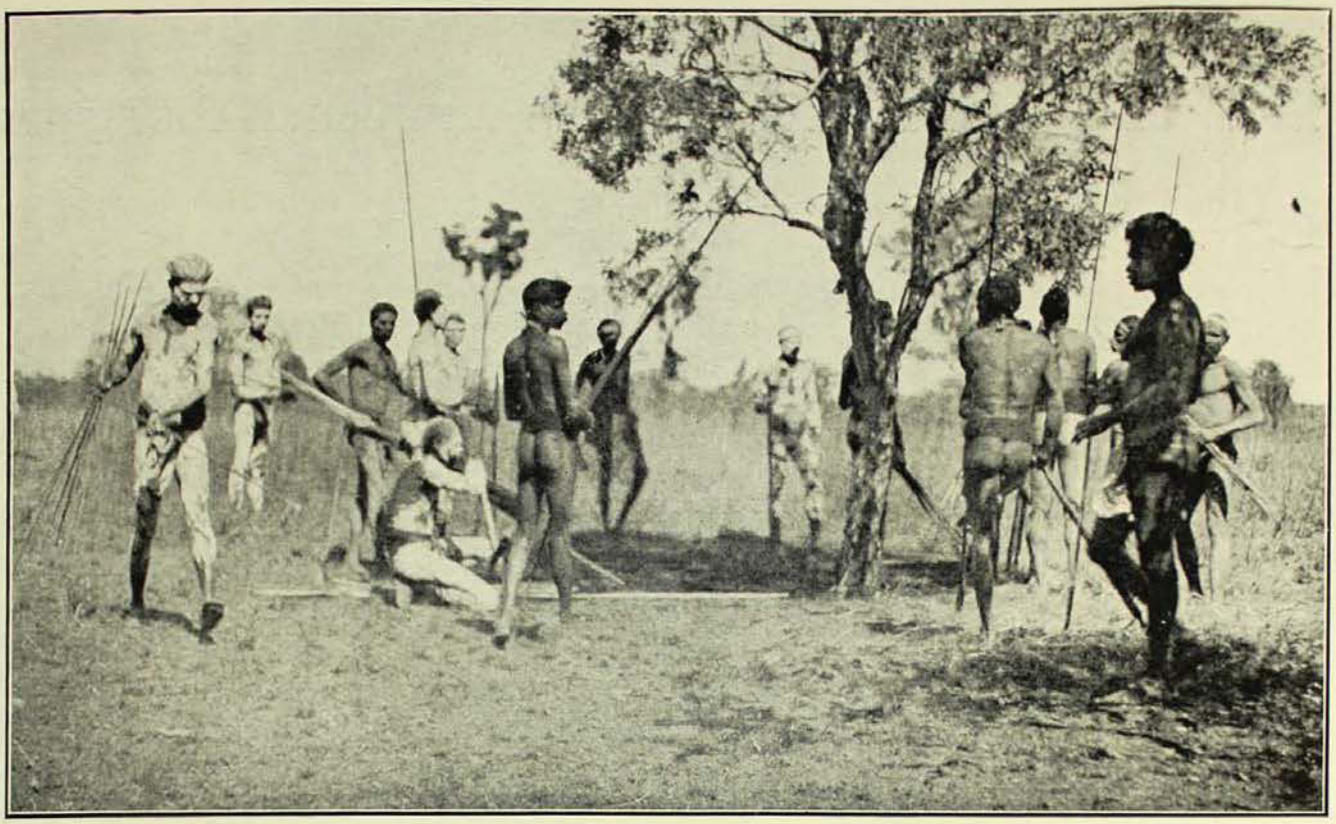


The authority in a local group, and in a tribe, is vested in the old and experienced men, who meet in informal council. They organize tribal gatherings for trade and ceremonial, negotiate for peace and war, and maintain law and order. These men belong to the Ungarinyin tribe, Kimberleys, Western Australia.

[Photo.—*Prof. A. P. Elkin.* By courtesy of *Australian National Research Council.* Copyright reserved.]

THE POWER OF THE ELDERS.

The guardians of the tribal morals are the elders. Indeed, the salient feature of social organization in Australia is the prominence taken by the elder men of the community in all matters of public importance. They meet in informal coun-



Among many aboriginal tribes it is customary for the disputing parties to meet at an appointed spot and in formal fight settle their grievances. Here some Daly River natives await the commencement of a fight in which the aggrieved party hopes to revenge the abduction of some of its women.

[Photo.—*W. E. H. Stanner.* By courtesy of *Australian National Research Council.* Copyright reserved.]

cil away from the women and the uninitiated. Age is not, however, the only qualification for membership. A man must, of course, be of mature years and be fully initiated, but a gift of eloquence, knowledge of tribal lore, skill in magic or fighting qualities, may win him a place amongst the leaders of the community. Great deference is paid to the elders for their superior knowledge and wisdom; certain coveted foods are reserved for their consumption alone.

The assembly of elders concerns itself with all communal matters, both external and internal. External affairs include relations between groups, such as negotiations for peace or war, the settling of quarrels with or without bloodshed, conduct of trade, reception of visitors and the attitude to be adopted towards non-tribesmen. With regard to internal affairs, the council decides when and where the camp is to be shifted, directs all ceremonies, allots wives, and maintains social harmony. It is this latter duty in which we are chiefly interested. Minor disputes are left to be settled by the individuals concerned, but violent quarrels, which result in serious physical injury or homicide, are grave enough to be taken in hand by the elders, and the disputants are obliged to abide by their decision. The case is stated for both sides, and unless the offender can show that his action was justified, he must make expiation in the customary manner.

CRIME IN AN ABORIGINAL COMMUNITY.

The aborigine makes a distinction between criminal and civil law, *i.e.*, between misdeeds which are considered to be offences against society as a whole and those which harm only the individual. Compared with civilized jurisprudence, his code permits of fewer public but a greater number of private offences. To him a crime means black magic, incest or a breach of the marriage laws, and the revealing of sacred secrets. These are the most serious offences that can be com-

mitted, and in the old days a person guilty of one of them suffered the extreme penalty—death.

The practice of magic with evil intent, whether it be to encompass sickness or death, excites general indignation, and is universally condemned. The medicine man may be encouraged to use his skill against a hostile group, but not against a fellow clansman. The discovery of a malicious sorcerer, who directs his powers against his fellows, arouses such fear and horror that the community seldom permits him long to outlive his victim. Not infrequently he is enticed to some lonely spot and is put to death by the agents of the central authority.

A string of natives from north-east Arnhem Land emerges from the bush bent upon an expedition of revenge. Warfare, sham or serious, is to these people the most satisfactory way of settling their quarrels; the offended group does not rest until its thirst for vengeance is quenched.

[Photo.—*W. Lloyd Warner.* By courtesy of *Australian National Research Council.* Copyright reserved.]

With regard to incest or unions between persons forbidden to each other by the social code, there exists a very stringent prohibition against marriage of close kin. An illicit marriage is not an offence that can be easily atoned for and forgotten; it is an act deserving of moral reprobation and calls forth the strongest feelings of repulsion and disgust. So horror-stricken are the members of the community upon discovery of an irregular union that the execution of the guilty couple is considered to be the just and proper penalty.

Homicide, or the taking of human life, does not receive the moral condemnation accorded in our own society. To the aborigine the act of slaying a human being is not an evil thing in itself. Generally it is reprehensible and deserving of punishment only if the victim is a member of the home group, or if it brings trouble from outside upon the murderer's kin in the form of a demand for compensation. Actually it is the identity of the murdered person and his social relationship to the murderer that count. Thus homicide is regarded from two different angles, according as the victim is a member of the community or an alien. In the former case, the murderer may not be slain for the deed because his death would mean further injury to the group; in the latter instance, his act is regarded with indifference, perhaps even with approval by his own friends, though he runs the risk of death at the hands of his victim's sympathizers.

FORMS OF PUNISHMENT.

The blood revenge expedition is a custom of which we have all heard. Nevertheless, its real nature is often misunderstood. Some observers have emphasized the wild savagery of aboriginal justice because they have seen only the act of

In the old days the Kurnai of south-east Australia avenged a death by black magic by compelling the sorcerer to face the spears of the dead man's relatives. The sorcerer might be killed outright, but often, upon seeing him sorely wounded, his kinsmen ran to his assistance and stopped the unequal combat.

[After *A. W. Howitt.*

vengeance and understand nothing of what lies at the back of the deed. They are unaware that the avenger is acting for, and with the consent of, the community as a whole. It is not a wild act of revenge carried out by a half-crazed creature, but is a regulated procedure of organized vengeance. Any man might be called upon to take such a rôle, which depends upon his degree of relationship to the injured person. The nearest male relative bears the major part of the responsibility, and it is shared by other close relatives and friends. The duty cannot be avoided under penalty of severe criticism by the rest of the community. Should the father of a young boy be killed and no one be available to avenge the murder, then, when he attains years of discretion and strength, he is expected to perform this duty. Moreover, he is reminded of his obligation by the elders, who are the instigators of many a revenge expedition. In the light of these facts, one can understand the reason for the apparently wilful killings amongst the natives of North Australia, which are reported in the newspapers from time to time.

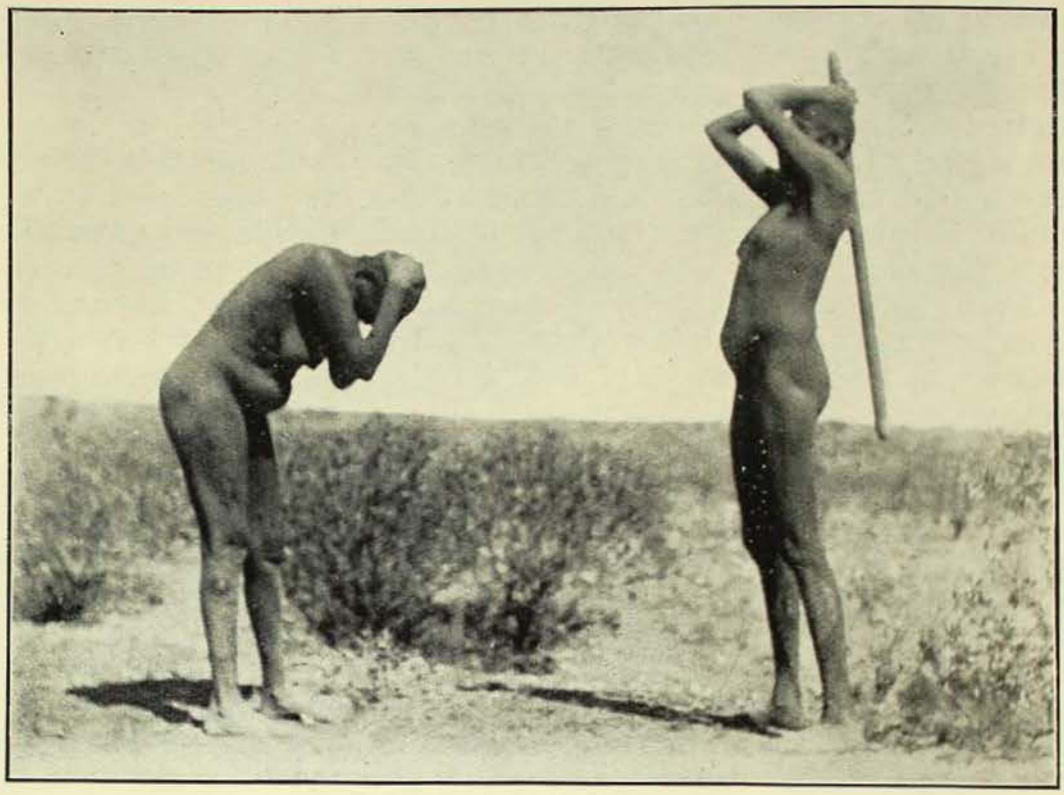
There are, however, less violent forms of retaliation than that of blood revenge. One is the expiatory ordeal. In north Queensland the culprit might offer himself voluntarily for the penalty due. He may have to submit to a blow on the head for philandering with another man's wife, or allow the injured person to strike him on the mouth for slanderous utterances, or again he may have to face a party of armed men and, himself unarmed, have to dodge the weapons hurled at him. This ordeal may last from a few minutes to a couple of hours (in the latter case he may be provided with a shield), and it comes to an end when his attackers decide that his injuries are commensurate with his offence.

Among the Kurnai of south-eastern Victoria the culprit was at times accompanied by his wife, armed with her digging-stick, to ward off some of the missiles directed at her husband, who was subjected to a shower of spears until disabled or transfixed. Sometimes his sympathizers thought he had been too harshly treated and joined in the fray. A general mêlée then took place, and both parties, with much shouting and gesticulating, expended their angry feelings. At length they patched up their grievances and went off to their own camps.

The women, too, with their digging-sticks, settle their differences by duels. In north Queensland the one in the wrong had at times to stand and suffer meekly the first blow, which not infrequently was so severe as to stun her and end the quarrel at once.

RETALIATION AMONGST THE MURNGIN.

The Murngin of north-east Arnhem Land give four reasons for justifiable retaliation by fighting. These are death caused by black magic, wrongful killing, the stealing of women, and the looking upon totemic objects under improper circumstances. The fighting is not a haphazard business, but is conducted in one of the traditional ways here enumerated. (1) The blood revenge expedition, which is a deadly procedure, is carried out by stealth and often at night. (2) As a result of regional antagonisms there may occur at rare intervals the pitched battle, which follows a long series of killings, whereby each side has been worked up to an almost hysterical pitch of enmity. The short and deadly spears are used, and there are many casualties. (3) Within the large camps of the Murngin, quarrels occurring over such matters as adultery or insult are not infrequent. They are settled by means of a general brawl characterized by much noise and sham fighting in which the women join. Little serious harm is done, and when the heat of their emotions cools the combatants withdraw. (4) The stealing of a woman may be followed by a fight of a ceremonial nature, which is conducted according to a recognized procedure; it takes the form of a general preliminary duel, in which all members of the disputing parties may taken part, and then a partial ordeal, in which the culprit—the cause of the trouble—is compelled to face the spears of those whom he has most seriously offended. The latter gradually dance in towards him, and finally stab him in the thigh—a sign that his ordeal is now at an end and the quarrel is finished. The interesting point about these sham ceremonial fights is that they act as a safety valve to the pent-up emotions of the hostile groups. The participants gain much satisfaction therefrom, and for some time afterwards act with tolerance, even friendliness, towards their former foes.



A digging-stick duel between two women of north-east Queensland. [Photo.—*W. E. Roth.*

PUBLIC OPINION AND SUPERNATURAL INTERVENTION.

It has been frequently noted by observers that the native entertains a lively dislike of bringing upon himself the ridicule and scorn of his fellows. The would-be evil-doer, then, has to run this risk as well as that of physical punishment. It is inevitable upon the discovery of the identity of a thief that he is made the butt of adverse social comment; the sneers and insults directed at him place him in an unenviable position. Life in a small community is unbearable if all a man's fellows are against him, and in Australia it is not possible to go off to another part of the country and start life

afresh, for strangers are universally mistrusted and are nowhere given an unreserved welcome. Hence the criminal cannot escape social censure; it may be so bitter as to cause him willingly to make amends. It is evident, then, that public opinion acts as a strong deterrent to wrong-doing.

Even if by some lucky chance the criminal has evaded detection by his fellows and punishment at their hands, he may still have to face the wrath of supernatural powers. It is believed that violation of a strict taboo, such as speech between a man and his mother-in-law, or the eating of a forbidden totemic food, is followed automatically by some particularly unpleasant penalty. It might be premature greyness, skin disease or a crop of painful boils, but it is an unavoidable aftermath of an ill-considered act. Then, again, the injured person may suspect the identity of one who has wronged him and engage a sorcerer to bring upon him a lingering death.

. . . . .

From this brief survey of the law of the aborigine it will be seen that he has ample reasons for being law-abiding. There is no chance to plead ignorance of the law, because every individual from babyhood onwards is trained in correct social behaviour—the young boys by the old men, and the girls by the old women. Contact with his fellows confirms the lessons of the elders, and teaches the youth what society requires of him. Fear of physical punishment, social censure and supernatural might, combine to form a serious warning to the potential wrong-doer. The system may be uncodified and undignified, but it is extremely effective within its own sphere, and answers the needs of the society it serves surprisingly well.

Review

Battle Fronts of Outback. By Francis Birtles. (Angus and Robertson, Ltd., Sydney, 1935.) Crown 8vo., pp. 289. Price 6s.

Few names are better known to Australians than that of Francis Birtles. An intrepid and resourceful traveller and explorer, he has battled successfully with hunger and thirst, wild animals, trackless wastes, and icy mountains, and in this autobiography he shows that, in the words of the psalmist, he also has the pen of a ready writer.

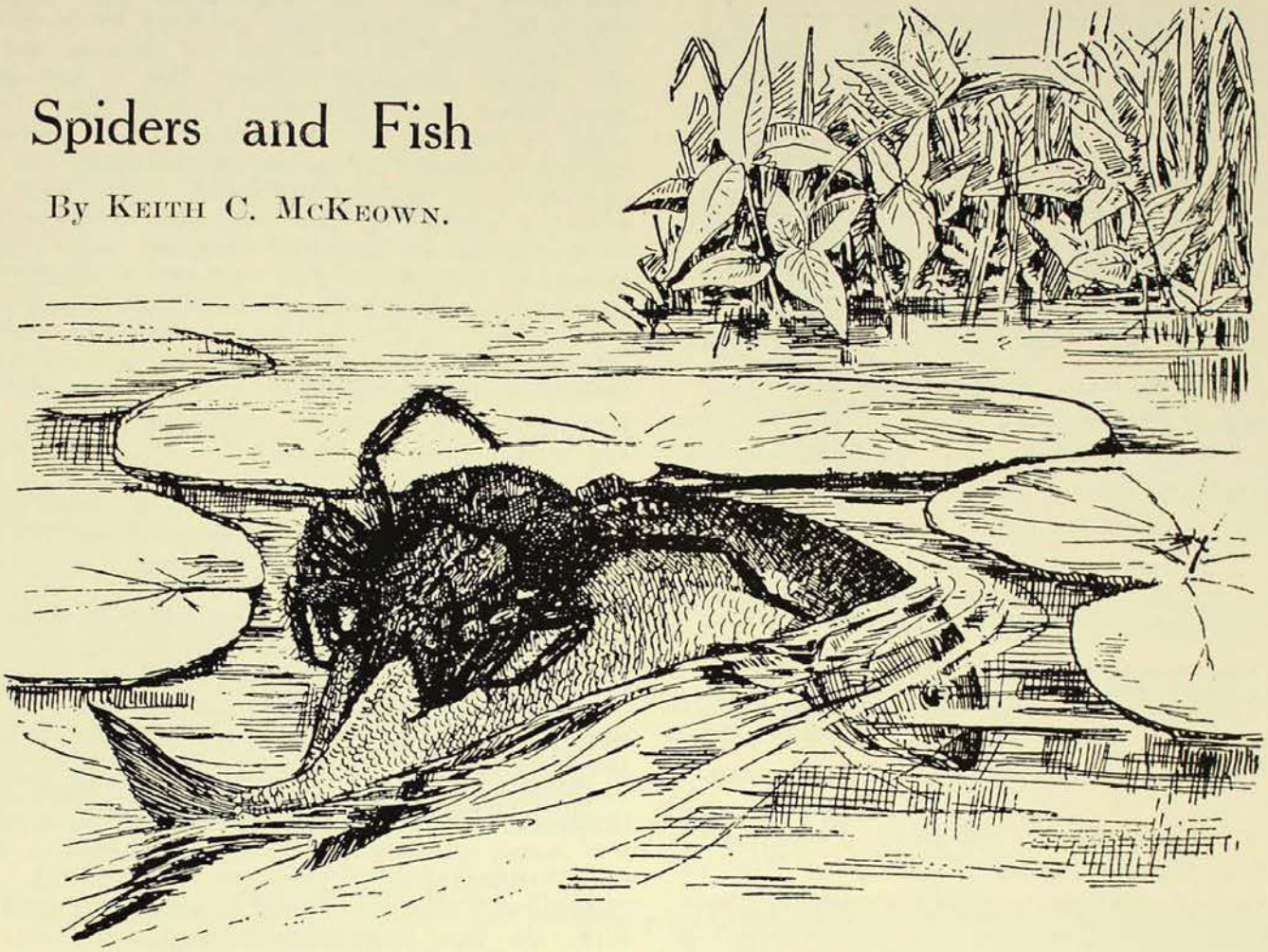
Birtles has had a varied career and many exciting experiences. He has been an apprentice on a windjammer, a private in the Boer War, a police trooper in Zululand, and an overland traveller by bicycle, car and aeroplane. He has traversed the Australian continent from Perth to Sydney, and from Adelaide to Darwin, and has made other toilsome and perilous journeys in the Australian outback. His greatest achievement, however, and that which is perhaps the most interesting in the telling, was his journey by car (the "Sundowner", now in a Canberra museum) from England to Australia, by way of the Balkans, Palestine, India, Penang, thence to Darwin and onwards. Apart from road difficulties, which were many and various, the narrative of this journey includes such incidents as an encounter with a prowling tiger, which padded round close to Birtles' net-shrouded head, a meal of boiled monkey, and a night spent in a mud hut in company with a collection of goats and an unfriendly wolf dog, who seemed to regard the stranger as a new kind of goat.

Readers will rejoice that the author, after many moving accidents by flood and field, has in the end, thanks to a gold discovery in Arnhem Land, won independence and even wealth. But the wanderlust is in his blood, and the saga concludes: "And all the while I am planning to go back".

C.A.

Spiders and Fish

By Keith C. McKeown.

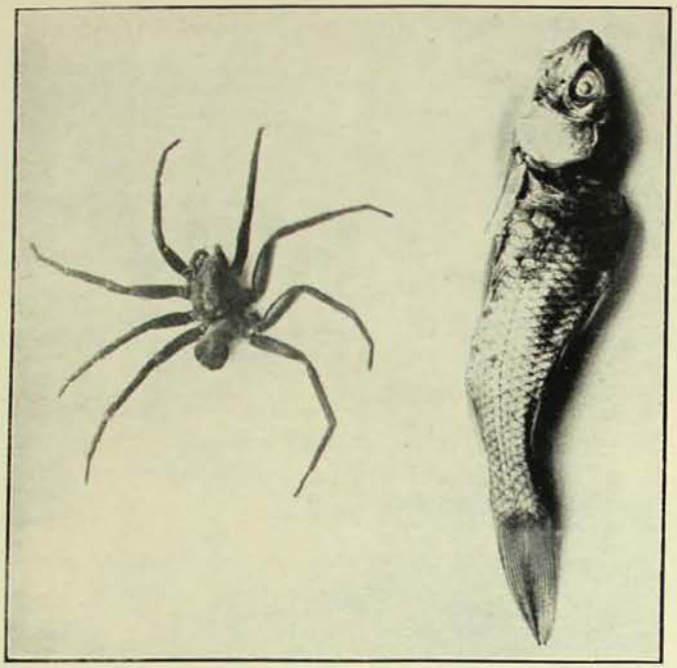


Spider, probably Dolomedes, attacking a minnow. The illustration was prepared from a sketch by Professor E. T. Spring, an eyewitness of the happening.
[After *Dr. McCook.*

ANY connection between spiders and fish may seem to be remote, but the fact that fish do fall a prey to the makers of webs is one of the byways of Nature that is but little known to the majority of those who take even a wide interest in nature study. The subject has come under discussion in various quarters from time to time, but interest has been renewed by the publication in the *South Australian Naturalist* for July, 1935, of a note by Mr. Alfred E. Wadey describing the capture of two red goldfish, in the fish ponds at his home near Adelaide, by spiders identified by the late Dr. R. H. Pulleine as belonging to the genus *Dolomedes*. In an appended note by Mr. H. M. Hale, Director of the South Australian Museum, he gives further information, and states that only two other cases of spiders destroying fish seem to have been recorded, both of which are American.

The destruction of fish by spiders is not, however, such a very rare occurrence. Several specimens of fish, together with their spider destroyers, are preserved in the Australian Museum collection, one of which, a gold carp presented by Messrs. Crawford and Fleming, is shown in the illustration reproduced here. The fish measures 3½ inches in length, and has been partially eaten by the spider, which was forwarded to the Museum with it.

Dolomedes facetus, a large, long-legged spider of a general brown colour, is to be seen fairly frequently resting on the surface of calm pools on the river and creeks at Audley, in National Park. On several occasions I have witnessed the capture not only of small fish, but also of tadpoles, by these spiders. The method by which they capture their prey seems



A gold carp with the spider (Dolomedes sp.) which has killed and partially eaten it. A specimen from the Museum collection. The fish is three and a half inches in length.
[Photo.—*G. C. Clutton.*

to be somewhat as follows: The spider rests motionless upon the surface film of the water with its long legs widely spread to buoy it up, but some anchorage is usually provided by the hind legs, which grip the bank or the edge of some conveniently projecting rock overhanging the pool. The spider may remain motionless for hours, but let some unwary little fish swim close beneath it, and in an instant the spider plunges beneath the surface of the water, and gripping the fish in a close embrace with all its legs, buries its fangs deep in its body. The fish struggles wildly in an unavailing effort to dislodge its attacker, but in a few seconds its struggles become weaker and weaker, and finally cease; then the spider drags its victim on to the bank, and, without delay, proceeds to eat it.

It has been contended that the spiders, living only on the juices of their prey, cannot "eat" the fish, but in all the examples I have examined, considerable mutilation has been apparent. In an account of the feeding process of a spider, the victim being a lizard, Dr. E. Warren explains the matter fully:

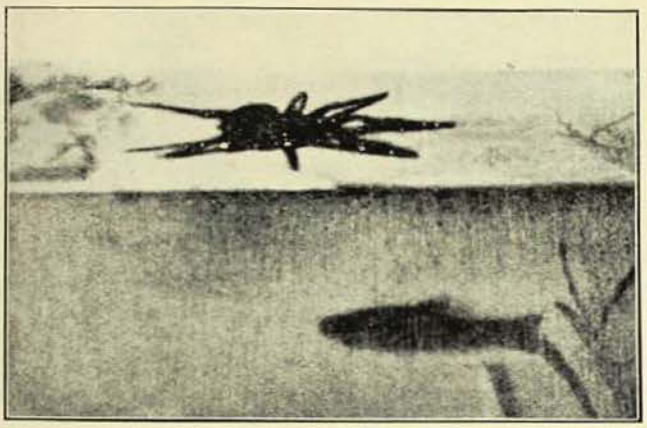
While the chewing action was proceeding a copious fluid was spread over the tissues of the prey. The fluid was clear and slightly yellowish in colour, and seemed to have the consistency of thin syrup. It gushed out of the mouth in such volume that I noticed a good sized drop run over the surface of the body of the lizard. This fluid had a powerful digestive effect; it acted immediately on the tissues and rapidly softened them, and the chewing action of the chelicerae [fangs] and pedipalp-endites [leg-like feelers] was greatly assisted thereby. The digestive fluid was gradually sucked back into the mouth and then gushed out again suddenly over the chewed tissues. This slow insucking and sudden expulsion of the digestive fluid from the mouth was maintained as a regular pulsating action during the whole time of feeding. There were about two systoles per minute. The divarication and closing together of the chelicerae were much more frequent, but it was noticed that the outgushing of the digestive fluid seemed to occur just as a divarication was on the point of commencing. The continuous flow of digestive fluid over and through the tissues of the prey must accelerate very greatly the processes of digestion. The fluid in the course of time seemed to become heavier and thicker through the solution of the food. In the course of an hour the whole body of the lizard, with head, limbs and tail, had been kneaded into a round wet mass permeated with the digestive fluid and continuously being chewed by the chelicerae. The singularly flexible and sensitive tarsi of the pedipalps served admirably as hands for pressing the softened body of the prey against the chelicerae.

When we turn to the cases of spiders capturing fish recorded from other parts of the world we find that there are quite a number. The first account of which we have any knowledge is that of Professor Edward T. Spring, of Eagleswood, New Jersey, dating back to 1859. His description is detailed and worth giving in full:

I was over on the South Amboy [New Jersey] shore with a friend, walking in a swampy wood, where a dyke was made, some three feet wide, when we discovered in the middle of this ditch a large black spider making very queer motions for a spider, and on examination it proved that he had CAUGHT A FISH.

He was biting the fish, just on the forward side of the dorsal fin, with a deadly gripe, and the poor fish was swimming round and round slowly, or twisting its body as if in pain. The head of its black enemy was sometimes almost pulled under water, but never entirely, for the fish did not seem to have enough strength, but moved its fins as if exhausted, and often rested. At last it swam under a floating leaf at the shore, and appeared

to be trying, by going under that, to scrape off the spider, but without effect. They then got close to the bank, when suddenly the long black legs of the spider came up out of the water where they had possibly been embracing the fish . . . reached out behind and fastened upon the irregularities of the side of the ditch. The spider then commenced tugging to get his prize up the bank. My friend stayed to watch them while I went to the nearest house for a wide-mouthed bottle. During the six or eight minutes that I was away, the spider had drawn the fish entirely out of the water, when they had both fallen in again, the bank being nearly perpendicular. There had been a great struggle



An African spider (Thalassius spenceri) resting on the surface of the water prior to attacking a fish which is seen approaching below.
[After *N. Abraham.*

—and now, on my return, the fish was already hoisted head first more than half his length on the land. The fish was very much exhausted, hardly making any movement, and the spider had evidently gained the victory, and was slowly and steadily tugging him up. He had not once quitted his hold during the quarter to half an hour that we had watched them. He held, with his head toward the fish's tail, and pulled him up at an angle of 45° by stepping backwards. How long they had been there or how far they had come we cannot tell. We saw no web anywhere about.

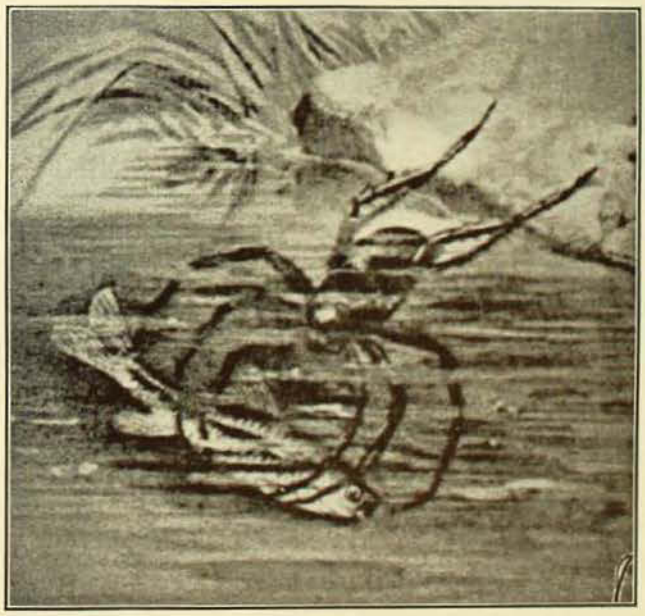
The time would not permit a longer stay, so we reluctantly bottled the pair. I thought I had missed dipping up the spider, and looked along the bank, but on turning to the bottle he was there. The fish was swimming weakly at the bottom of the water that I had dipped in, and the spider standing sentinel over him on the surface, turning when he turned, and watching every motion. We stopped the mouth of the bottle so that the spider could not escape, and went to see the fine place of the late Mr. Stevens above on the hill. Returning in about three hours, we found, to our disappointment, the spider dead at the bottom, but the fish was alive. He lived for twenty-four hours. The spider was three-quarters of an inch long, and weighed 14 grains; the fish was 3¼ inches long and weighed 66 grains.

The next record, published in 1876, is that of T. M. Peters of Alabama. He watched a spider drop some fifteen feet from a limb of a tree into the water and capture a small fish.

In 1893 Dr. McCook published an account by Francis R. Welsh of Philadelphia, describing how a spider attacked and killed two sun-fish, each about two inches long, that he had in a basin in his room.

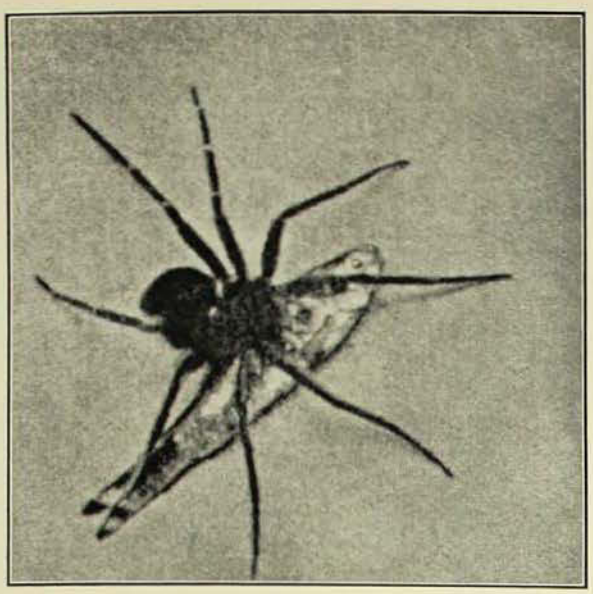
The next record is that of W. T. Davis of Staten Island, where a small fish was captured by one of several *Dolomedes* spiders which were resting on the surface of the water in a small shaded pool.

South Africa provides our next information, when the Rev. Nendick Abraham, in 1905, while collecting aquatic insects in a stream at Greytown, Natal, observed a spider (*Thalassius spenceri*) attack and capture a fish. His account is a particularly interesting one, but, on account of its length, cannot be quoted here.



Thalassius spenceri in the act of attacking a fish. Note how the hind pair of legs retains its hold on the stone.
[After *N. Abraham.*

Dr. Thomas Barbour, of the Museum of Comparative Zoology, Cambridge, Massachusetts, made a similar observation in Florida, the spider in this case being a species of *Dolomedes*, and the fish *Gambusia affinis*. In 1922 D. R. Crawford, Instructor in Fish Culture at



Thalassius spenceri eating the fish after it has been dragged out on to the bank. [After *N. Abraham.*

the University of Washington, recorded spiders destroying trout fry 2¼ inches long. C. M. Breder, while in Panama as a member of the Marsh-Darian Expedition, collecting fishes, reptiles and amphibians for the American Museum, made further very interesting observations on the subject.

In September, 1925, Mr. E. A. Fuchs witnessed a spider capture a fish one and one-fourth inches in length after a considerable struggle, at Atlanta, Georgia, U.S.A.

Mr. Wallace Adams, of the Steinhart Aquarium in San Francisco, recorded in 1927 the destruction of Pigmy Sunfish by a spider.

F. Pickard-Cambridge records observations by A. N. Stenning in South Africa, who states that spiders of the genus *Thalassius* have often been observed to capture fish.

Mr. C. H. Robson refers to the capture of small fish by a spider in New Zealand.

Mr. O. Lloyd Meehean made very interesting observations of the wholesale destruction of small catfish in 1934 at the United States Fish Hatchery, near Tishomingo, Oklahoma, where the ponds were seriously depleted by the depredations of these spiders. He also records *Dolomedes sexpunctatus* killing catfish up to two and three-eighths inches in length, spider destroying sunfish in Louisiana and a case of a minnow (*Gambusia patruelis*) captured by a spider at Natchitoches.

In the *Revue Britannique* for 1835 (Vol. xvii, p. 177) a Dr. Morsten is said to have discovered in the forests of Australia a huge spider which catches fishes. He is quoted as saying that "I have several times seen them enter the marshes and then descend to the bottom of the pools, whence they presently reappeared bearing small fishes. I have, however, never seen them eat any of these".

It will be seen from the above that quite a number of instances of the capture of fish by spiders have been recorded, and it is very probable that many have been observed but remain unpublished. In addition to the recorded cases of fish destruction, there are a number of records of the capture of frogs, tadpoles, lizards, snakes, and birds, but, in spite of the great interest of the subject, space precludes our treating of them here.

In Mr. Wadey's account he states that the fish was caught in a web spun under the ledge of a rock. In view of my own and the recorded observations, it would appear unlikely that the web played any part in the actual capture of the fish, and was possibly merely the retreat of the spider.

In conclusion, I must refer to three extremely interesting articles by E. W. Gudger, of the American Museum of Natural History, published in *Natural History* for the years 1922, 1925, and 1931, to which I have been greatly indebted for information.

In view of the interest of the subject, I append a list of publications dealing with the capture of fish by spiders for the benefit of those who may desire to pursue the matter further:

Abraham, N.: Observations on Fish- and Frog-Eating Spiders of Natal. *Annals Natal Museum*, 1923, v, pp. 89-94, 9 figs.

Adams, W.: *Bulletin of the New York Zoological Society*, 1927, p. 77.

Barbour, T.: Spiders Feeding on Small Cyprinodonts. *Psyche*, 1921, xxviii, pp. 131-32.

Chubb, E. C.: Fish-Eating Habits of a Spider. *Nature*, 1193, xci, p. 136.

Davis, W. T.: A Spider Fisherman. *Entomological News*, 1891, ii, p. 47.

Gudger, E. W.: Spiders as Fishermen. *Natural History*, xxii, 6, Nov.-Dec., 1922, pp. 565-568, fig.

Gudger, E. W.: Spiders as Fishermen and Hunters. *Natural History*, xxv, 3, May-June, 1925, pp. 261-275, illustrated.

Gudger, E. W.: Some More Spider Fishermen. *Natural History*, 1931, xxxi, 1, pp. 58-61, ill.

McCook, H. C.: American Spiders and their Spinningwork. Three vols., 1889-1892.

Meehean, O. Lloyd: Spiders that Fish. *Natural History*, xxxiv, 1934, pp. 538-540.

Peters, T. M.: A Spider Fisherman. *American Naturalist*, 1876, x, p. 688.

Pickard-Cambridge, F.: *Proceedings Zoological Society, London*, 1903, p. 158.

Robson, C. H.: *Transactions and Proceedings of the New Zealand Institute*, x, 1877, pp. 200-201.

Spring, E. A.: [Letter regarding a fish caught by a spider.] *Proc. Acad. Nat. Sci. Philadelphia*, 1859, xi, p. 255.

Wadey, A. E.: The Spider and the Fish. *South Aust. Nat.*, xvi, 3 (24 July, 1935), pp. 32-33, plate.

Reviews

A Cluster of Bees. By Tarlton Rayment. (The Endeavour Press, Sydney, 1935.) 8vo., pp. 752, 66 plates and 100 text-figures. 21s.

With the publication of Mr. Tarlton Rayment's book, *A Cluster of Bees*, another volume is added to the increasing library of Australian natural history. Its appearance is the more welcome since the life-histories of our Australian bees have for long awaited a recorder, a fact all the more unaccountable in view of the undoubted fascination of the complex lives of these wise little creatures.

Mr. Rayment's book caters both for the specialist and the general reader, since, interspersed through the book, there are scientific designations of the characters of the genera, which include the Australian species of bees, and in a further section there are descriptions of one hundred species new to science. The greater part of the volume is composed of popular accounts of the lives and habits, the curious behaviour and instincts of one of the most interesting groups of insects—chapters which will provide unbounded delight to the unscientific nature lover, but also provide a wealth of hitherto unpublished information for the more serious worker. It might have been an advantage had these two elements been concentrated in separate sections of the book. Among the new species there are descriptions of an Ichneumon wasp, a Thynnid wasp, and a thrips, the latter already described by Messrs. Kelly and Mayne.

Mr. Rayment's black and white plates and text-figures must be commended for their clarity, and for the inclusion in many of the plates of details of structure which are invaluable to the scientific worker.

The publishers are to be congratulated on their enterprise in producing the book with such lavish illustration. The paper, typography and binding leave nothing to be desired.

K.C.McK.

Feathered Friends: A Gould League Annual. Edited by Neville W. Cayley. (Angus and Robertson, Ltd., Sydney, 1935.) 8vo. Pp. 55, six coloured plates and many half-tones. Price 2s. 6d.

This attractive booklet is issued by the Gould League to celebrate the first quarter century of its existence. It consists of a series of well written articles describing some of the most interesting members of the bird fauna of New South Wales.

Mr. M. S. R. Sharland contributes an account of the Lyre-bird, for which, quite unnecessarily it seems to us, he prefers the name Lyretail; the very successful photograph by the author of a male Lyre-

bird in display is worthy of special note. Mr. Norman Chaffer writes of the Satin Bower-bird, " builder, painter, decorator ", and excites our admiration of the wonderful artistry and extraordinary habits of these intelligent birds. Mr. A. H. Chisholm's article is entitled " Australia's Birds on a World's Basis ", and in it he covers much ground in his usual inimitable style. The White-eared Honeyeater is the theme of Mr. K. A. Hindwood, who describes its friendly habit of perching on one's clothes or head to collect material with which to line its nest.

The Black-backed Magpie, the " Piping Crow " of the early colonists, is the subject of an interesting article by Mr. David Leithhead, in which he does full justice to the robust personality of this fearless bird. The little Heath-Wren, which makes its home chiefly on the sandstone ridges of the Hawkesbury series of rocks, is described by Mr. P. A. Gilbert, and the better known Blue Wren, a familiar visitor to Sydney gardens, by Mr. Neville W. Cayley.

The booklet is well illustrated by a fine series of photographs and by a number of coloured plates executed by Mr. Cayley, whose work as a bird artist is well known to the public.

All bird lovers will welcome this handsome booklet, on which the authors, the Gould League, and the publishers are to be warmly congratulated.

C.A.

Brownie, the Story of a Naughty Little Rabbit. By Dorothy Wall. (Angus & Robertson, Ltd., Sydney, 1935). 4to., pp. 54, with many illustrations. Price 4s. 6d.

Miss Dorothy Wall has written several highly entertaining books for children, and her latest one, "Brownie, the Story of a Naughty Little Rabbit", is a diverting tale profusely illustrated in the author's own inimitable style.

Brownie is an engaging little creature with a genius for getting into mischief. He narrowly escapes being made into rabbit pie by the ill-tempered but undoubtedly long-suffering Farmer Skinty, whose vegetable garden frequently suffers from Brownie's depredations.

In the course of his adventures the little rabbit meets many quaint bush folk, Mrs. Platypus, Mrs. Possum, Puffkins the Kangaroo Rat, and other fascinating creatures. His conversation with the superior Mrs. Chiddy the Echidna, who has such a low opinion of the intelligence of rabbits, is particularly amusing. Much interesting information regarding the habits of these little Australian animals is conveyed in a light and entertaining manner.

This book would make a delightful gift for any child, and indeed few grown-ups will fail to be amused by the really charming illustrations.

N.B.A.

Cormorants and Fish

THE Cormorant is generally regarded as an enemy of the fisherman, but investigation shows that the bird is perhaps not so black as it is painted. Recently war was declared on the cormorants in the Queanbeyan district in the belief that they are destructive to trout, and the opportunity was taken to have some stomachs forwarded to the Museum for investigation. Unfortunately only six stomachs were received, and this number is perhaps too small to make the results conclusive, but it is significant that the contents consisted chiefly of the remains of Yabbies (*Parachæraps bicarinatus*) and Carp (*Carassius*); one small fish could not be identified from the fragments available, but it was neither a trout nor a carp.

As both the carp and the yabbie are generally regarded as pests, it would seem that the cormonant is doing more good than harm.