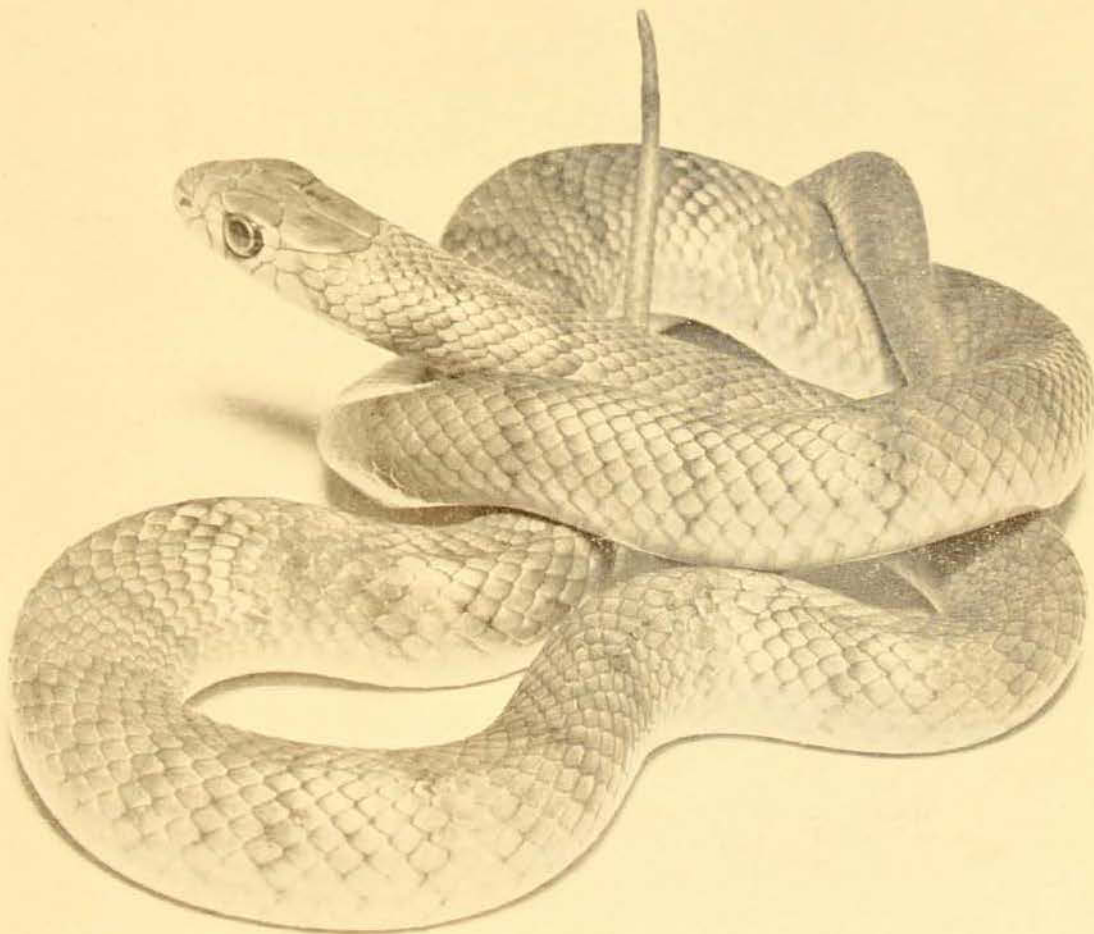


The
**AUSTRALIAN
MUSEUM
MAGAZINE**

Vol. X, No. 12

Price—TWO SHILLINGS



Young Common Brown Snake.

THE AUSTRALIAN MUSEUM

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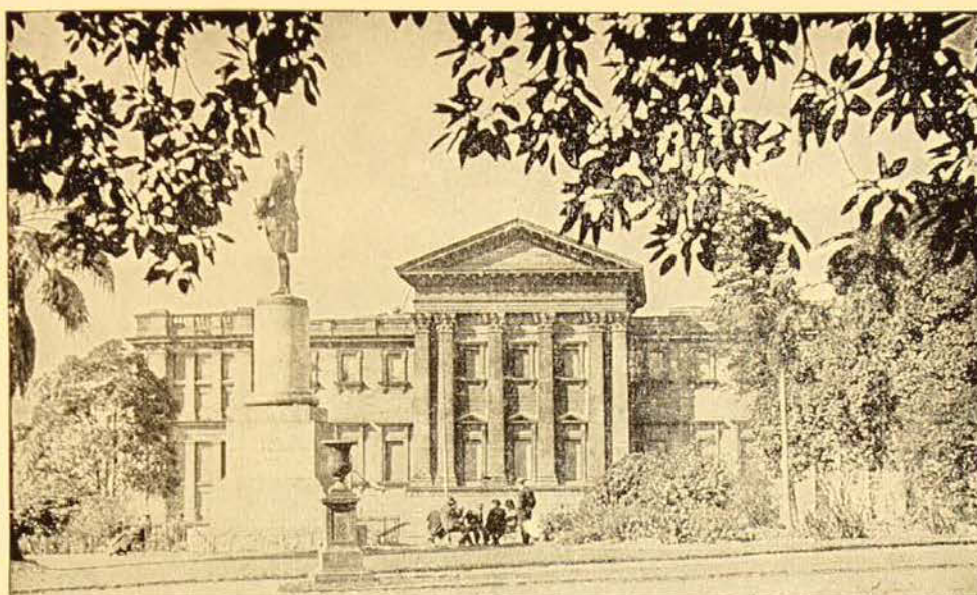
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THE AUSTRALIAN MUSEUM MAGAZINE

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

● OUR FRONT COVER. The common Brown Snakes are a widely distributed group of dangerous Australian snakes. They are quick-moving and aggressive and their venom is very potent. A bite from any of the larger specimens (an adult may attain a length of seven feet) can prove fatal. The photograph on the cover shows a young specimen of a banded variety of the common Brown Snake, *Demansia textilis* (Dumeril et Bibron). Most young Brown Snakes bear a banded head, whilst many have dark cross bars on the body. These gradually disappear with age.



Aerial view of Broken Hill looking from north-east to south-west. South Broken Hill lies towards the left-hand corner. Furthest from the camera the surface plant of The Zinc Corporation and New Broken Hill Consolidated occupies the centre of the top third of the picture. The open-cut shows up as a huge excavation towards the centre of the picture and the line of lode extends diagonally towards the left-hand corner. It is marked by workings, few of them any longer in use. Large white "mullock" dumps flank each side of the line of lode and on the right of the line of lode the old slag dump of the B.H.P. forms a large flat-topped black mound a little below the centre of the picture. Argent Street, the main street of Broken Hill, runs in the right-hand corner of the picture (see article on p. 393).

Photo.—Zinc Corporation Ltd.

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December 15, 1952.

The Australian Museum Scientific Expedition to Central and North-west Australia

By H. O. FLETCHER

THE recent Australian Museum Scientific Expedition to Central and North-west Australia was made possible by the generosity of a well-known Sydney business man who made available sufficient finance to purchase vehicles and keep the party in the field for four months. More than 10,000 miles were travelled in that period.

Donations of equipment were also made by Amalgamated Wireless (Australasia) Ltd., who lent a two-way wireless set, the expedition's mobile Station call-sign being 9LK. Eveready (Australia) Ltd., donated electrical equipment, while John Harvey Instruments of Sydney presented the expedition with a Geiger-counter for detecting the presence of radio-active minerals and an ultra-violet lamp used for tracing the important mineral Scheelite.

The party consisted of Mr. E. O. Rayner, Geologist, of the Geological Survey of New South Wales and four members of the Australian Museum staff, Mr. J. A. Keast, Ornithologist and Photographer, Messrs. R. Mackay and N. Camps, Preparators, and the author, Palaeontologist and Leader.

Photographs for this article by J. A. Keast.

The main work of the expedition was to examine certain geological horizons containing Permian marine fossils in the country between the Daly and Fitzmaurice Rivers, south of Darwin. At the same time an attempt was to be made to collect some of the rarer, quaint and interesting animal life for which Australia is famous.

Many of these rare species are restricted to the more inaccessible parts of Central and North-west Australia where they live under desert and semi-desert conditions. In adapting themselves to an environment in which only specialized forms could exist many have developed along strange and bizarre lines.

A great deal of country popularly referred to as desert and semi-desert in Australia is not desert in the strict sense of the word. The country carries a sparse vegetation including a variety of trees and shrubs while immediately after rain, as if by magic, plants appear and the country becomes clothed with many beautiful and delicately perfumed wild flowers. The more delicate plants which appear so quickly become mature rapidly, develop seeds and just as fast die and disappear



Above—The Henbury meteorite craters, 8 miles south-west from Henbury cattle station, Central Australia. There are thirteen craters of varying size, the largest having a diameter of 200 yards, and a depth of 50 feet.

Left—In trouble on the track to Ayer's Rock. A good deal of sand had to be traversed, and occasionally the vehicles had to be extricated from soft sand.

until the next rains. Inland Australia for the most part knows only two seasons, the dry and the rainy seasons, with the latter in most years lasting perhaps for no more than a day or two.

The route chosen for the expedition was one which traversed a good deal of what was virtually zoologically unsurveyed semi-desert country which carried little or no surface water. The more important areas where protracted field-work was carried out included Ayer's Rock, The Granites and Tanami goldfields, the Forrest River and Port Keats Missions and North Queensland.

The expedition left Sydney on the 7th April and travelled by means of two Ford

utility trucks fitted with canopy tops. Alice Springs was reached on the 18th April after passing through Broken Hill, Port Augusta and Kingoonya and then travelling north along the little-used western track. This journey of 2,275 miles was covered without undue trouble, although unexpected and torrential rain south of Alice Springs caused some anxiety.

Alice Springs is now a town of considerable size and is a welcome sight to any traveller who may be making for it from any point of the compass. Nestling in a valley of the Macdonnell Ranges it is fortunate in possessing an almost inexhaustible supply of fresh water obtained by wells and bores from river gravels underlying the town.

Well-constructed houses possess beautifully kept gardens and wherever possible trees have been planted so that altogether Alice Springs is an unexpected sight and is certainly not what one would expect in a town which is almost the geographic centre of Australia.

The Macdonnell Ranges extend in an east-west direction for about 400 miles and consist of a general arrangement of parallel valleys and ridges. They are bare rocky hills, for the most part carved by weathering into arresting contours. A number of gorges or gaps, of which the Standley Chasm and Simpson's Gap are outstanding examples, are striking features of the Macdonnell Ranges. They were formed by streams running in a north-south direction and as the land was gradually elevated their erosive effect was able to keep pace with the uplift. It is impossible to give an adequate description of the magnificent colouring effects of these ranges. The rocks are sometimes a brilliant red, changing

to more subdued colours at different times of the day and with a changing light.

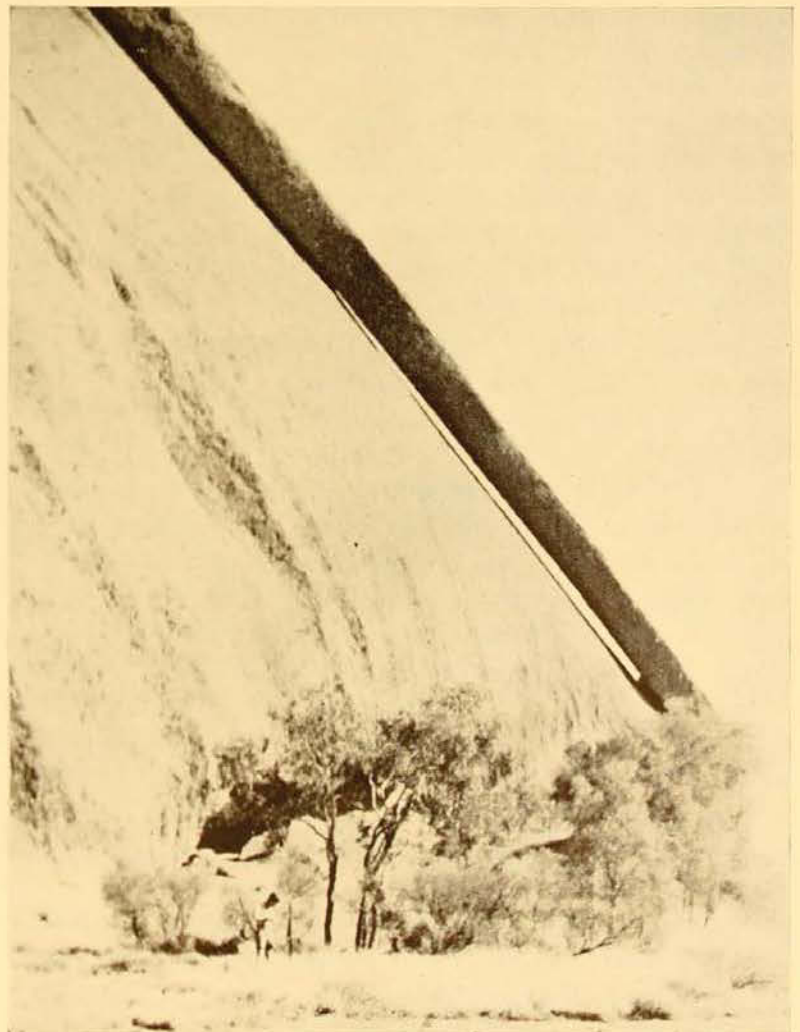
On the 23rd April the expedition left Alice Springs for Ayer's Rock, about 290 miles to the south-west.

The track had been graded but very heavy sandy country was traversed, including the bad Palmer River crossing. Many miles of thickly timbered country with an abundance of desert oaks, gums, acacias, mulga and other growth was passed through until on the afternoon of the second day Mt. Connor was sighted away to the south.

Mt. Connor stands in solitude and rises abruptly from the desert to a height of 800 feet. It is roughly two miles long by three-quarters of a mile wide and can be climbed only from the south-west corner.

The following afternoon, after passing through Angas Downs and Curtain Springs cattle stations, we obtained our first view of Ayer's Rock towering above the undulating sand-ridge country to a height

A spectacular feature of the north-west face of Ayer's Rock is a large slab or pillar of rock, 200 feet in length, attached both at the top and bottom, but sprung away from the main mass along a considerable part of its length.





Left—Alice Springs township, situated in a valley of the Macdonnell Ranges. A view from Memorial Hill, looking towards Heavitree Gap in the background.

Below—Mining for Wolfram and Scheelite at Mt. Doreen, 215 miles north-west of Alice Springs.

of 1,180 feet. In appearance it is reminiscent of a giant fortress, as its outline is smooth and unbroken with smooth sides rising abruptly and vertically, in fact at times overhanging slightly.

This great rock mass is one and three-fifths miles long, about the same width and at least five miles round its base. The rock is composed of a fine conglomerate which was originally laid down as horizontal strata in Pre-Cambrian times about 1,500 million years ago. During this vast amount of time the rock mass has been subjected to great earth movements, with the result that the strata have been tilted to such an extent that they are now vertical.

A very curious feature at the north-west corner of Ayer's Rock is a huge curved pillar or slab of rock which, although it is attached to the main rock both at the top and bottom, is quite separate from it along a considerable part of its length. When viewed from the side a long narrow slit of daylight can be seen between it and the parent rock. This phenomenon was caused by a type of weathering known as exfoliation, an effect brought about by rapid temperature changes such as occur in Central Australia.

Continual collecting was carried out in all directions from Ayer's Rock and particularly in the sand-hills west of the "Rock", where rare species of some of the smaller furred mammals were collected. These included the interesting Fat-tailed Rats and Mice, the extraordinary and well-



developed fat tail being a reserve food supply which can be called upon when food is scarce.

From the top of Ayer's Rock the five huge bluffs of Mt. Olga can be seen about 25 miles to the west. Mt. Olga rises to a height of 1,500 feet from the plain level and it could be said to represent a rock mass like Ayer's Rock which has been slashed into five blocks by great cuts extending from the top to the very base of the rock forming huge vertical ravines.

On the return journey to Alice Springs the expedition visited the famous Henbury meteorite craters located in a valley about 7 miles west of the Henbury cattle station and about 50 miles south of the Macdonnell Ranges.

Within an area of half a mile square thirteen craters have been recorded of

Wyndham is situated on the shore of the Cambridge Gulf, Western Australia.



varying sizes but the largest one is oval in outline and about 200 yards in diameter. The craters have gently sloping outer surfaces and they are not very conspicuous until one stands on the rim and sees the steeper inner slopes. Pieces of meteoric iron weighing as much as 300 pounds have been collected from the crater area.

The next stage of the expedition was from Alice Springs to Wyndham, a distance of almost 1,000 miles, for the most part through uninhabited waterless country. On the 7th May Alice Springs was left behind and the bitumen road to Darwin followed through the Macdonnell Ranges for about thirteen miles. A track to the north-west was then traversed for 215 miles until Mt. Doreen was reached, the most western cattle station in the Northern Territory, possessing an area of 2,000 square miles.

From Mt. Doreen to the Granites goldfield, a distance of 121 miles, the track continues over semi-desert country which for the most part is covered with cork-bark trees, although scrub-mallee, small gums and spinifex were also abundant. From a distance the country appears to be grey-green and almost a forest, but a close-up view proves the trees to be very scattered, shadeless and growing to heights of rarely more than 10 feet.

The Granites consists of a series of low rounded hills of granite boulders rising from flat desert and almost treeless country. On one of the hills are situated the build-

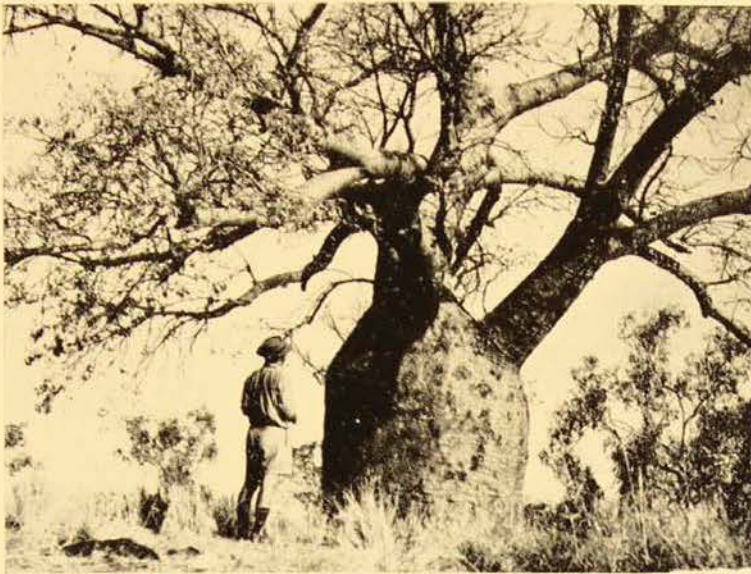
ings occupied by Mr. Gordon Chapman and the two other families which represent the total white population.

For weeks past we had been experiencing delightful weather, hot days and very cool nights with cloudless skies. Our visit to The Granites coincided with a very unseasonal heat-wave and for many days and nights the temperature rarely dropped below 97° and at times exceeded 109°.

At The Granites the expedition was fortunate enough to trap an Orange-backed Bandicoot, a rare species which had not been collected by a scientific party since it was described in 1898. Reports however, indicated that the miners in the early days used to eat the bandicoots to augment their food supply and of course they have always been a source of food supply as far as the natives are concerned. Nevertheless not another bandicoot was seen during our visit although several interesting field rats and mice were collected.

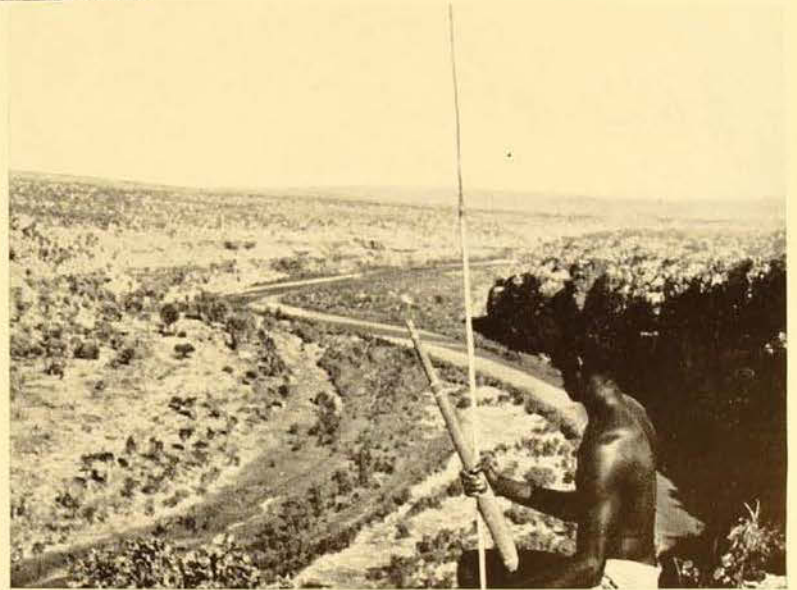
The members of the expedition were reluctant to leave the hospitality of the Chapman family but the time soon arrived for the expedition to continue on its journey northwards. North of The Granites one enters the big ant-hill country and for many miles the vehicles zig-zagged their way through ant-hills some of which attained considerable height.

The Tanami goldfield, 64 miles from The Granites, is now deserted with the exception of Mr. Harold West and his wife who



Left—The " Bottle-tree " of North-west Australia.

Right—View of the upper reaches and near the head of the navigable waters of the Forrest River, North-west Australia.



look after the buildings and mining equipment. A lot of gold has been taken from this field but recently a Company, after spending many thousands of pounds in exploratory work, failed to secure any gold.

Tanami proved to be an exceptionally interesting locality from a scientific point of view and most of the specimens collected, particularly the bird life, proved to be rare species with a very limited distribution.

Shortly after leaving Tanami, the expedition crossed the border into Western Australia and, passing the Gordon Downs and Flora Valley cattle stations, finally arrived at Hall's Creek, a small township set in amongst stony and very barren hills.

The trip from Hall's Creek to Wyndham through Turkey Creek is a most interesting one, the track for the most part follow-

ing valleys in the very hilly country, the rocks still consisting of the ancient Pre-Cambrian types we had been following since leaving Ayer's Rock. Baobab or " Bottle-trees " now became fairly common. They are most intriguing trees and seem quite out of place as far as Australian scenery is concerned. There are three stages in the yearly life of a " Bottle-tree " as first of all it is bare of all leaves, then it becomes covered with white to yellowish flowers followed by a mass of green leaves. The bottle or trunk of the Baobab tree does not contain liquid although when gashed with an axe an abundant supply of a sweet mucilaginous juice may be obtained.

Nearing Wyndham, 250 miles from Hall's Creek, the blue waters of the Cambridge Gulf gave the party the first view of the sea since leaving Port Augusta.

We had crossed the continent and the first stage of the expedition had been completed.

Wyndham is reputed to be the hottest town in Australia and is said to put Marble Bar in the shade with its continual mid-summer temperature of 120°, the heat being held by a hill immediately behind the town, from which it radiates each night.

The goal of the expedition was the Forrest River Mission situated about 50 miles up the mangrove-lined and crocodile-infested Forrest River. The entrance to the river is on the west side of the Cambridge Gulf and because of the high tides, as much as 25 feet, it is only possible to navigate the river on the rise and fall of the tide. At low water little or no water is left in the river and it is necessary to anchor and await the following tide.

The expedition members were transported to the Mission in their launch skillfully managed by the native skipper who unerringly followed the snake-like course of the channel through ravines and past mangrove and grassy mud-flats.

The Mission is situated almost at the head of the navigable part of the river and is ideally situated on the edge of a large open plain. It has an area of 10,000 acres but is surrounded by a vast native reserve extending to the coast on the west. The

Mission started its work in 1896 and although since that time has met with many reverses it is now running very smoothly under the guidance of the Rev. Keith Coaldrake, the Superintendent.

Five miles to the west and separated from the Mission by a range of hills 400 feet in height, is the fresh water upper portion or source of the Forrest River. It consists of a number of large permanent waterholes including Camera Pool and Stevenson's Pool containing millions of gallons of crystal clear fresh water.

During our visit, recently installed pumping equipment was set in motion and water from Camera Pool was pumped into a 10,000-gallon tank on top of the range from which it gravitates into another large storage tank on the "Jump-up" immediately above the Mission buildings. The first water to come through was blessed by the Bishop of North-west Australia.

Camera Pool and Stevenson's Pool are favourite spots of the natives for fishing and swimming. This mirror-surfaced pool, supposedly never deepened, is covered a great deal with water-lilies and is a delightful spot. Game is plentiful and huge flocks of geese and ducks fly from one pool to the other when disturbed.

At the foot of the cliffs near Stevenson's Pool are a great number of beautifully executed rock paintings and drawings. The designs were much the same as we had seen at Ayer's Rock and The Granites, consisting mainly of human hands, faces and many types of animals, some easily recognizable others apparently only conventional designs. In one place at



Above—A Forrester River native, decorated for a corroboree and holding sacred boards.

Right—Three members of the expedition receiving "Churinga" boards after being initiated into the Umbalgari group of the Jeidji tribe at Forrester River.



Stevenson's Pool the present generation is represented by an excellent portrayal of an aeroplane.

A corroboree was held in our honour at a secret and sacred dancing ground situated in the hills about six miles south of the Mission. Before we could attend the corroboree it was necessary for the members of the expedition to be initiated into the tribe. After an impressive and lengthy ceremony we were presented with our Churinga boards, the most prized of all native possessions. We thus became warriors of the Umbalgari tribe. Dancing proceeded right throughout the day by the natives who had prepared for the occasion by decorating themselves with bird feathers and daubing their bodies with ochres of various colours.

Returning to Wyndham well satisfied with the results of our collecting at the Forrest River we rejoined our vehicles and set out for Darwin, via Auvergne, Victoria River, Jasper's Gorge, Victoria River Downs and the dry river road to Katherine. On this track a good deal of road work was necessary to get the vehicles through, particularly over many steep and narrow creek crossings.

Darwin was reached on the 16th June and immediately enquiries were made regarding access to the Port Keats Mission which is situated in the country lying between the Daly and the Fitzmaurice Rivers. This is an important area as zoologically it was almost unknown, while fossils of importance had also been recorded from several localities on the coast. These fossils are of Permian geological age and it was of interest to see how they compared with fossils of similar age found in Western and Eastern Australia.

It was necessary to charter a plane to fly the party into the Port Keats Mission and this operation was successfully carried out in an Avro-Anson 7-passenger plane. The journey of 154 air miles was accomplished in a little over an hour. The party was welcomed by the Superintendent, Father Docherty, who gave us every assistance and very ably organized the Mission natives to

collect reptiles and other natural history specimens for us. They were rewarded with tobacco and cigarettes and even the tiny four-year-old youngsters preferred cigarettes to sweets. They were inveterate smokers and very accomplished in the art.

Several trips to the coast were organized by boat and overland by the Mission truck which, although of ancient vintage, made its way through the thickly timbered forest country with great success. Natives were sent ahead of the truck to look for fallen logs in the long grass which covered most of the country in between the trees. These grasses grow more than six feet in height in the wet season and during the dry become very hard and brittle and turn yellow or brown.

An important find was an unrecorded horizon of Permian fossils which is restricted to two low ridges at the Mission. The fossils were well preserved marine forms and included at least twenty-five species of pelecypods, brachiopods, gastropods and a large ancestral form of the present-day Nautilus shell.

The fossil fauna is similar to that found in the North-west Basin of Western Australia and its presence at Port Keats is additional evidence regarding the ancient shore-lines of the Permian times.

After returning to Darwin the expedition visited many mining centres in the Northern Territory and North Queensland. Security regulations forbade any collecting or photography at Rum Jungle, 66 miles south of Darwin, but our visit to this area of radio-active minerals was of interest.

It is now generally believed that a belt of radio-active minerals stretches from within a few miles of Darwin almost to Katherine, 220 miles to the south. This area takes in Rum Jungle, Edith and also the new discovery near the Florina track. Aerial tests over this area by Mineral Resources Bureau geo-physicists have confirmed the existence of these radio-active deposits.

After collecting had been carried out in the Gulf Country and the north coast of Queensland the expedition returned to Sydney on the 6th August.



Ayer's Rock, 1,180 feet high, photographed from 8 miles across the plain to the west. The country is dry and vegetation sparse. A withered mulga is in the right foreground.

Adventures with Centralian Birds

By ALLEN KEAST, B.Sc.*

IT was nine o'clock on the last morning but one of our camp at Ayer's Rock and I was preparing to shoot some cine sequences for the Expedition's film. Like its predecessors the day was cloudless and sunny, the air clear and warming again from the dawn temperature of 45 degrees, and our pet anathema, the flies, were "rediscovering" those expedition members engaged in preserving the mammals trapped during the night and birds shot earlier in the morning.

Equipment on the frequent sorties from camp varied but on this occasion I carefully folded a small tent and battered old umbrella, the latter the subject of many cryptic comments throughout the trip. Together they formed a small photographic "hide", the umbrella being opened, its handle pushed into the ground and the tent draped over it. The photographer, hidden beneath such a structure, is able to get quite close to timid animals to photograph them. To-day I planned an attempt on the eagles that were always to be seen at the

top of the Rock—a rather windy place to erect the tent. Small wonder the final comment as I left was: "What time will you come floating past. We'll put the billy on."

We had camped on the plain a hundred yards out from Maggie's Spring, the permanent pool at the foot of the steep southern slope of the Rock. The path to the western slope, which was the route to the top, was along half a mile of dirt track, on which dingo footprints could always be seen early in the mornings. The track skirted the Rock's south-western aspect, passing through gums and mulgas and crossing open spaces of sparse, dry grass and spinifex.

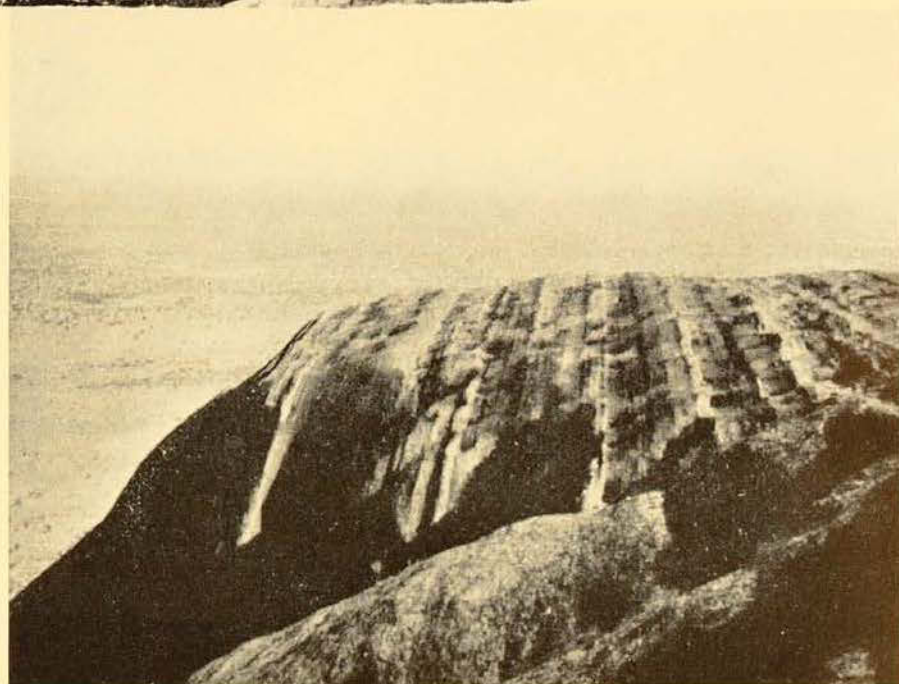
The slight diversion to Maggie's Spring was well worth the effort, for the sand at its margin provided a continuous record of the animals that drank its cool, clear waters. The day before I had brushed away all the footprints. Here, however, were the tracks of two kangaroos, five emus, and the characteristic trail of a large goanna. Kangaroos were not numerous about Ayer's Rock at the time of our visit

* Photographs by the author.



Left—View from the top of Ayer's Rock looking north-west towards Lake Amadeus. The tree in the foreground, the only one on "the top", is a favoured roosting place of the eagles.

Right—This view of the rock structure on the summit of Ayer's Rock shows very clearly the vertical bedding of the mass.



and were timid, coming in silently to drink when we were not in the vicinity. Not so the emus which would come striding past the camp to peer at the strange beings that had visited their domain. There were usually five of them, all fully grown, for no breeding had occurred for several months. The pool "record" showed that they drank daily whereas the 'roos did so only spasmodically. Dingos, although they were fairly numerous, visited the pool rarely.

At the base of the Rock on the south-western corner are a series of caves and broken rocks, the haunt of the little Thick-tailed Marsupial Mice and some house mice. The presence of the latter was a great surprise to us for one doesn't expect to meet this pest in the desert two hundred miles south-west of Alice Springs. Aboriginal paintings adorn the walls of several caverns, animal and human figures, shields, boomerangs, and mystic religious symbols. The native fig, a dense tree with small

yellow fruits clings here and there in fissures about the base of cliffs—it is an important food of native and bird alike.

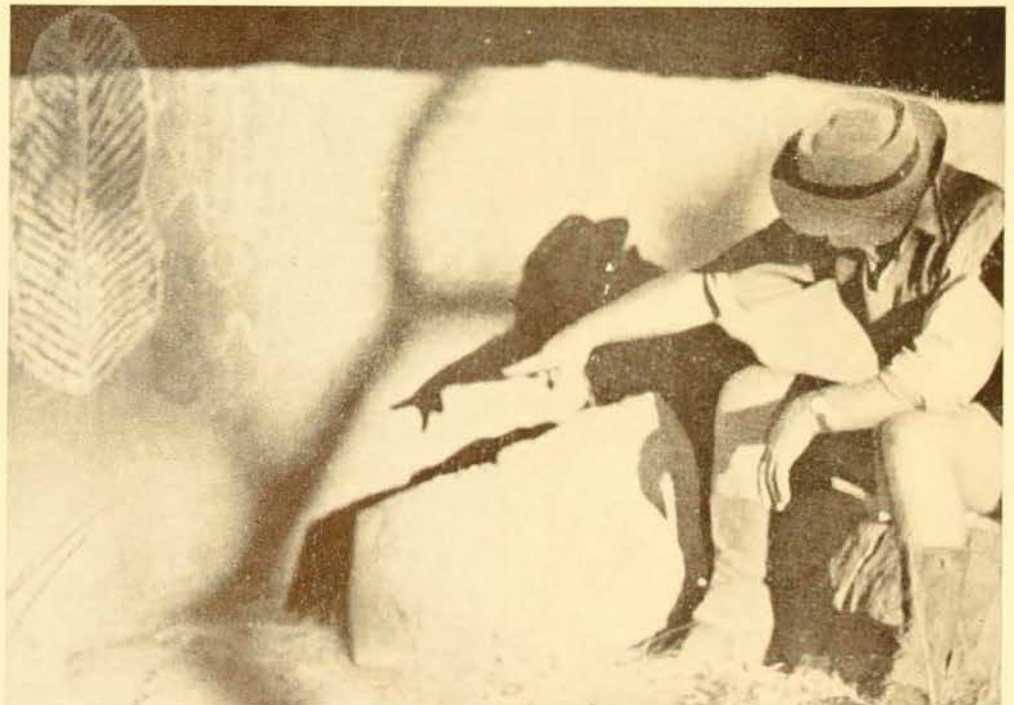
Around a bend I surprised a group of Red-breasted Babblers squabbling on the ground. They streamed away in irregular procession as I approached, to alight in some saplings fifty yards ahead. On the preceding days I had met parties of them in the mulgas. Much of their feeding is on the ground and about the bases of shrubs and they are always in parties and very noisy. Their behaviour is erratic and they are much addicted to chasing each other up through the branches or from tree to tree. But, on this occasion, the theme varied. A Little Falcon, which neither I nor the babblers had noticed, suddenly dived towards the party which scattered into the nearest undergrowth. The disappointed falcon, just a second too late, swept upwards again, alighted on a dead limb but almost immediately dashed after a Black-faced Woodswallow that was fluttering about a dead shrub. Here, too, the falcon was unsuccessful for a few seconds later he was seen in swift pursuit of a panic-stricken Pied Butcherbird, the pair of them zigzagging between the trees until they could no longer be seen.

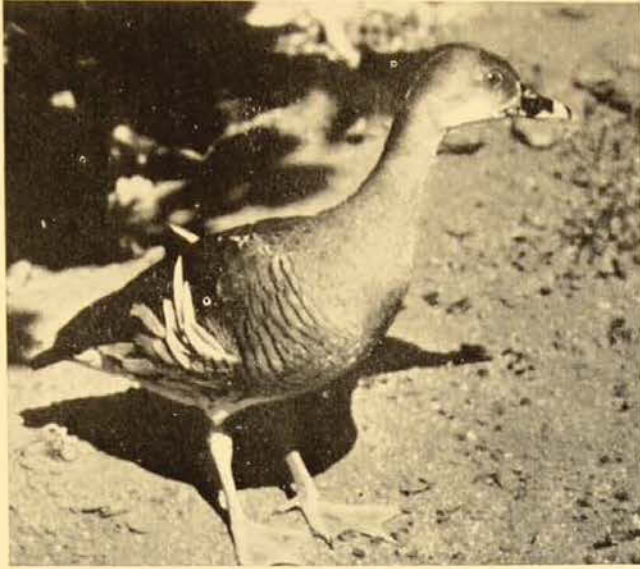
On a clear grassy space I again met the Crimson Chats. A party of them could always be seen just here, running over the

ground or perched individually on low vantage points. The males were just coming into the vivid scarlets characteristic of adulthood and contrasted strikingly with the brown females. Pipits were also numerous about the base of the Rock and this morning I disturbed six in a few yards. A little way ahead a large party of Zebra Finches called to each other from a thicket. About them hopped and fluttered a pair of Willie Wagtails, chasing the insects disturbed by the noisy finches. The wagtails were petulant in choice of company. A few minutes later they had abandoned the finches and were down amongst the pipits, wagging their tails and chattering on the grass. Then they chased each other across a clearing into a gum sapling, a short period of hunting followed, and they were saying "sweet pretty little creature" to a spritely Red-capped Robin in a mulga.

This was to be my third trip to the top of the Rock. One always gets a decided feeling of elation on starting up the steep but well-trodden slope to the top, and this morning was no exception. Behind is the plain—flat, red, and stretching into the haze. Ahead is the coarse rock face and, above, the towering summit outlined against a deep azure sky. Periodically one pauses for a "breather" and to gaze back. Halfway up the Rock a grand, all-encompassing view is to be had. Eucalypts,

The Leader of the Expedition indicating some of the typical cave paintings of the area.





The Plumed Tree Duck is a nomad, leaving the "Centre" in bad seasons. The last left shortly before our visit.

watered presumably by the spasmodic run-off from the Rock, grow only about the base. Contrasting with their pale green are the belts of dark-green mulga and scattered desert oaks beyond, the yellow-brown spinifex, and red sand. Mount Olga is silhouetted against the skyline to the west, five giant bluffs twenty miles away, its base lost in bluish haze so that it appears to be suspended in the sky. And behind, doubtfully visible as a slight irregularity on the skyline are the Petermann Ranges, rugged, desolate, and visited by only a handful of white men. Lake Amadeus, too, can be seen from Ayer's Rock, a glimmering patch of white in the far north-west, in bygone ages a great and permanent body of water, to-day a shallow basin whose salt surface is dissolved for but a month or two each year.

Mid-way up the Rock one can look into small caverns on an adjacent face, splashed white as if by a brush—the roosting places of hawks. In a side gully one can see a series of shallow pools; they were swarming with shrimps at the time of our visit. In depressions a few withered clumps of grass grow. Here we saw old rabbit excreta. How and why do rabbits climb the Rock? We are still wondering.

Peregrine Falcons occasionally flash past the climber, hunting, I surmised, the venturesome pipits that sometimes seek food amongst the grass-clumps in the fissures. And then, as one draws near the top, the

Wedge-tailed Eagles come and inspect one. They live about the summit, surveying their domain from the crags, and soaring on the winds that sweep up the walls. Their behaviour towards the climber was always the same, they would sweep low overhead on the downwind, turn, and return high above where the air was still.

My attempts to get some movie sequences of the eagles were unsuccessful for they refused to venture down to the meat I spread out for them. I was not blown off the Rock either but my couple of hours in "the hide" did give the opportunity of jotting down some impressions of the bird life of Central Australia.

The Museum Expedition visited the "Centre" during drought-time, a circumstance that materially modified the numbers and diversity of bird-forms seen. There was no water along the rivers, natural waterholes were empty, and surface water was restricted to that from bores. Consequently, ducks, cormorants, coots, herons, and other waterbirds, were nowhere to be seen. Nomads and migrants, including the songlarks and cuckoos, had moved from the area and even the Budgerigahs and Cockatiels, numerous in the mountains and along the Finke in normal seasons, were absent. And there was no evidence of the breeding, usual at this time, amongst any of the sixty-odd species that were present.

The majority of bird species occurring in Central Australia are widely-ranging forms and hence familiar types to the visitor from the east. Amongst the common hawks are the Nankeen Kestrel, the Sparrow Hawk, Brown Hawk, Whistling Eagle and Fork-tailed Kite, the latter two forms concentrating in hundreds about the cattle stations when cattle are killed. The Galah is a common parrot where there are gums and the Pink Cockatoo, Mulga and Port Lincoln Parrots, are well distributed. We found the delicate pink and blue Bourke Parrakeet common to the south of Alice Springs, especially in the Henbury area where they flocked to the bores at dawn to drink. The magnificent Princess Parrakeet was rare however. There are several species of honeyeater. The Yellow-throated Miner, Spiny-cheeked and White-plumed Honeyeaters, well-known inhabitants of inland

New South Wales, were numerous. The Grey-headed Honeyeater, a species confined to Central Australia was the most common form at Ayer's Rock. The Singing Honeyeater, a bird superficially like the well-known Yellow-faced Honeyeater, thrived in the more desolate areas of mulga.

The Fairy Martin, Welcome and White-backed Swallows are nomads, as are the Brown and Rufous Songlarks. There are several pigeons. The little Plumed Pigeon lives on the stony plateaux and ridges in the mountains. The Harlequin Bronzewing, an inhabitant of the "Centre" on occasions, was only seen on the Barkly Tableland during our visit. The Common Bronzewing, rarely noticeable during the day, whirrs in to the waterholes to drink at dawn and dusk. Crested Bronzewings are well distributed and up to twenty came at a time to a small homestead fountain at Jay Creek.

Amongst the most interesting birds of Central Australia are a number of shy inhabitants of the spinifex, including the Rufous Field Wren, the magnificent blue Turquoise and White-winged Wrens, and several species of grass-wrens, dull in colour, unobtrusive, and difficult to stalk. In contrast, the large Bustard, the size of a domestic turkey, is a conspicuous sight along the bush tracks. It is a popular table delicacy.

One of the objectives of the expedition was to get skins of the Night Parrot, a nocturnal species no specimen of which has been taken for over fifty years. It is the size of a small rosella, predominantly green

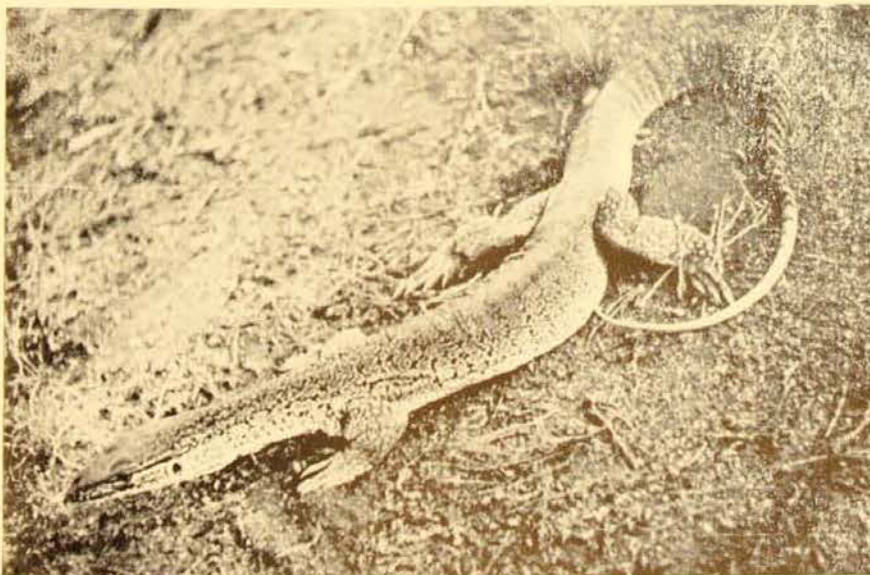


The Pink Cockatoo, a distinctive inhabitant of Central Australia.

in colour, and is exclusively an inhabitant of the dry spinifex plains which it leaves to visit waterholes after dark. It formerly occurred as far south as the Gawler Range in South Australia and in the 1880's was not uncommon in the Alice Springs area. In 1923, the veteran bird-collector, Lawson Whitlock, financed by the late H. L. White, spent four months searching for the bird but was unable to obtain a specimen.*

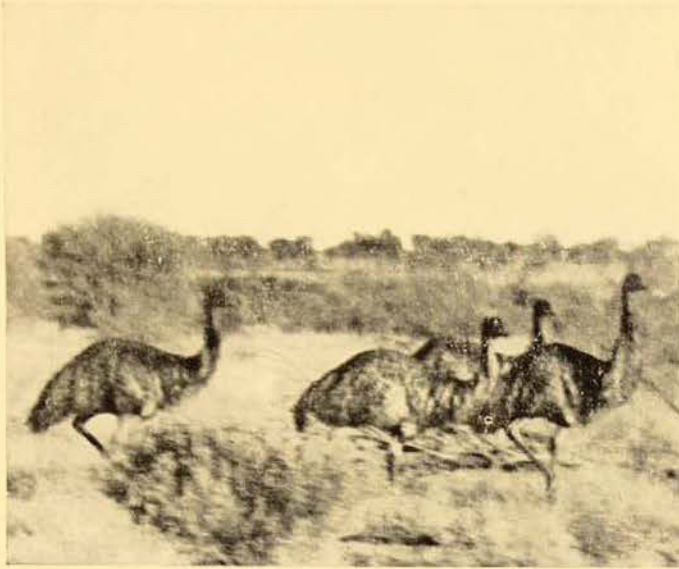
Despite widespread publicity since that date no definite information has come to light concerning the Night Parrot in recent times.

* See F. Lawson Whitlock (1924), "Journey to Central Australia in Search of the Night Parrot", *The Emu*, Vol. XXIII, p. 248.



A desert goanna at Ayer's Rock.

No opportunity was lost during the recent expedition to get information about the bird. Of the people questioned only a few had ever seen it and they not for the



A group of Emus pass close to the camp when returning from the waterhole at the base of the Rock.

last twenty years. All have heard of it, for the bird is now almost a legend on the cattle stations and amongst the townspeople of Alice Springs. We carried out nocturnal vigils beside bores, at Maggie's Spring, along the chain of pools high on the slopes of Ayer's Rock, and at the Tanami Rock-holes, but no parrots ever came to drink. Extensive diurnal traverses of the spinifex failed to reveal any traces of the rare quarry.

That the Night Parrot is extinct in the settled areas of Central Australia there seems little doubt. But the area is a vast one and it would be a bold person who would deny that they may occur further out, in the Petermanns, the Rawlinsons, and along the Western Australian border. And what is the cause of the disappearance of the Night Parrot? It is almost certainly the domestic cat gone wild and possibly the fox, both introduced and highly efficient predators, that to-day range widely over our inland.

Review

AUSTRALIAN SPIDERS. THEIR LIVES AND HABITS. By *Keith C. McKeown*, F.R.Z.S. With text illustrations and 17 pages of photographs, xiv and 274 pp. Angus and Robertson, Sydney, 1952. £1 1s. 0d.

This book is a revised and enlarged second edition of "Spider Wonders of Australia" published in 1936. It is a popular compilation of extracts derived from many sources. The author, though

not a recognised authority on spiders, has gleaned diligently of the habits of spiders and his present contribution is largely made up of quotations from the published papers of various authors and from letters received from his correspondents.

The format of the work is attractive and the book well illustrated, and the publishers are to be congratulated on their efforts to produce a work on Australian spiders.

A. MUSGRAVE.

Shrimps: An Ayer's Rock Mystery

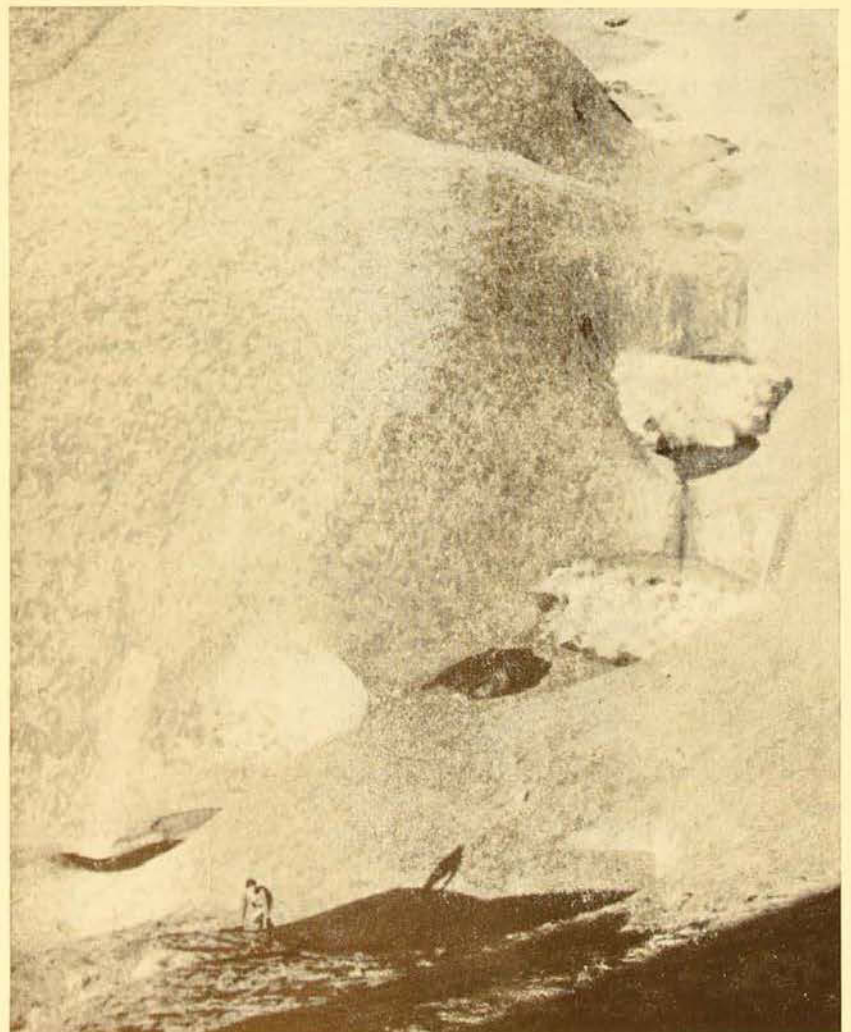
By FRANK McNEILL

THE huge mass of Ayer's Rock, lonely and bare, rises abruptly 1,180 feet above the sandy spinifex plains of Central Australia. To the average museum collector its steep, dry slopes would have little appeal. Nevertheless this place had a surprise in store for two of a venturesome trio of the recent Australian Museum Central and North-west Australia Expedition. While scaling the flaking inclines more than 800 feet up, they came upon numbers of actively swimming crustaceans living in some tiny pools in shallow depressions. The creatures were of an unusual type that could be expected in out of the way places, but surely never previously found in such a unique situation. In the driest times the pools evaporate entirely, and therein lies the interest of the find.

Of all Crustacea, these members of the group known as the sub-class Branchiopoda (meaning "gill foot") are the only ones that have no known marine prototypes, yet, strangely enough, they have no aversion to salty water. Different kinds are found in most countries of the world, many being remarkable for their appearance in drier areas where salt lakes and salt-pans exist, and where a minimum rainfall occurs. They all breathe through numbers of leaf-like limbs, each of them divided into a number of lobes which have gill plates on their outer sides, serving as respiratory organs like the gills of the better known crustaceans such as crabs and crayfish.

The Ayer's Rock specimens were of three markedly different types. Most conspicuous were shield shrimps (*Apus*); others

The small pools on Ayer's Rock more than 800 feet above the level of the plain. The Rock itself is illustrated on page 385.



were fairy shrimps (*Branchinella*); and a third smaller kind encased in delicate horny bivalve shells which have only their technical name, *Limnadopsis*. While the two firstnamed are conspicuous members of their group, the Ayer's Rock examples were rather stunted in growth. In other parts of Australia, shield and fairy shrimps may be one and a half inches in length. Whenever found they rarely fail to create intense interest. Quite commonly the people of remote inland parts send specimens to the museum asking for an explanation of their mystery finds. It is often the case that the creatures have never before been encountered by the oldest residents. The shrimps may suddenly appear in some shallow sheet of water following rainfall at the end of a prolonged dry period, and quickly develop to their full adult proportions. It is no wonder that the fairy shrimps particularly attract attention when found. One writer aptly describes them as "fairies in every sense of the word—graceful and easy of movement, and clothed with delicate draperies (as one might term their many foliaceous limbs), often so beautifully transparent that the shrimps seem almost to be endowed with

the fairies' magic cap of invisibility. Such colours as some of them exhibit are largely the result of refraction—evanescent, iridescent greens and blues, which appear at times on some of the appendages over a ground of translucent creamy white with reddish trimming". The play of colours is aided by the uncommon method of swimming on their backs, usually while feeding at the surface.

The characteristic shell-like carapace of the shield shrimps all but covers a somewhat similar body to that of the fairy shrimps. A segmented tail that projects behind ends in a pair of long tapered filaments; this and the shield are coloured shades of iridescent green.

The seeming mystery of the sudden appearances of the shrimps lies in the fact that their eggs are capable of the remarkable faculty of resisting drought. It is thought probable that the eggs fail to hatch if not subjected to some sort of drying. The great advantage of this provision of nature can readily be seen. Without it, the creatures could be wiped out with the first complete evaporation of their often insecure little puddles. As it is, those eggs that remain behind when a pool dries up and the shrimps die, can endure until a later rainy season. The usual thing is for two kinds of eggs to be produced. Those laid frequently throughout favourable seasons or periods are in large numbers. Eggs of the dry season, however, are very much fewer in number but of far greater vitality.

Judging from the wide distribution of certain fairy and shield shrimps in the Australian region and their penetration into the very centre of the continent, it is certain that eggs have been air borne over great distances. High winds would whip up and bear aloft eggs in the frequent dust and sand storms of the inland. Again, they could be carried to distant places in particles of mud which adhere to the feet of wading birds. The presence of the shrimps more than 800 feet up on Ayer's Rock is a remarkably interesting record of the height to which eggs may be borne. In the absence of wading birds in this area of Australia, the only reasonable explanation in this instance is the agency of wind.



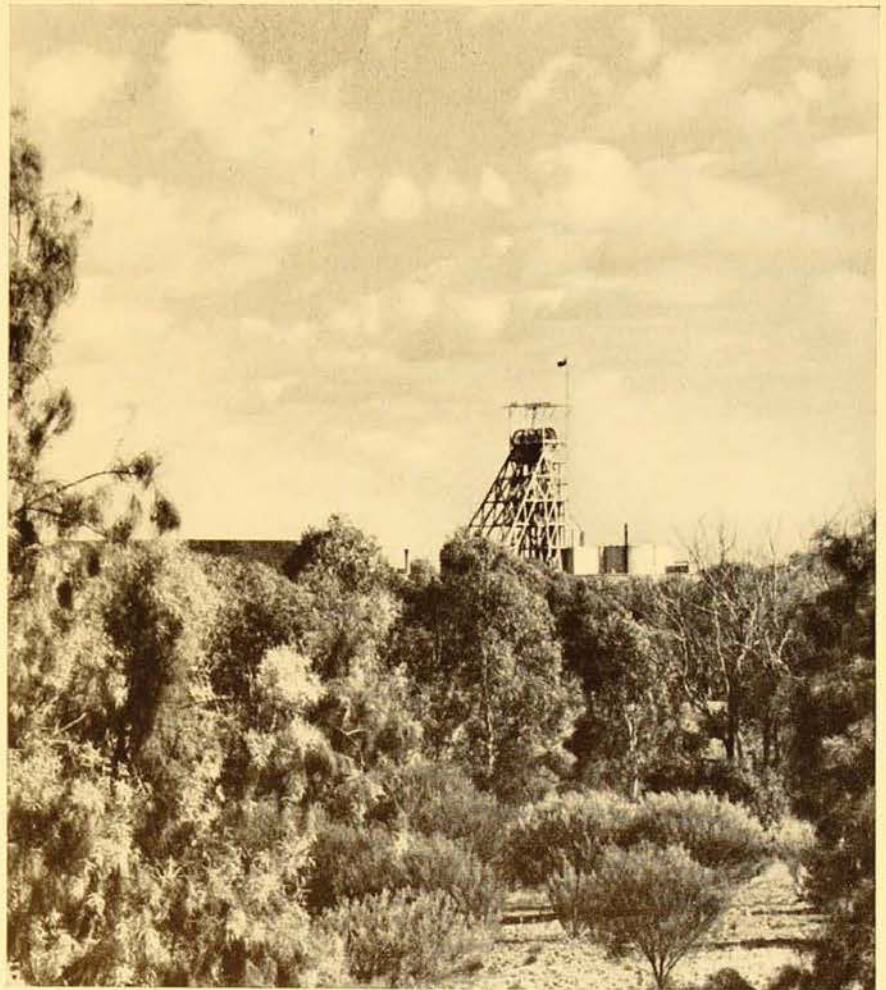
The three kinds of freshwater shrimps found high up on Ayer's Rock.

Broken Hill—II

By R. O. CHALMERS

The head-frame of the main shaft of the Zinc Corporation is seen from one of the plantations to the south of the city. An Athel (*Tamarix articulata*), is seen on the left-hand side.

Photo.—Zinc Corporation Ltd.



THE great Broken Hill Lode which runs roughly north and south can be likened to a giant coat-hanger. The central curved part which outcrops on the surface forms the two-miles-long hill itself, but the ore body curves down and continues underground for considerable distances both to the north and south. The Broken Hill Proprietary Company commenced work on the centre of the outcrop and later, on each side, companies like the British, Block 14 and Junction North came into operation. The top part of the ore-body consisted of minerals formed by oxidation of the primary lead and zinc sulphides. Minerals such as cerussite (lead carbonate), anglesite (lead sulphate), embolite (silver chloro-bromide), smithsonite (zinc carbonate),¹ were gouged out in vast

quantities. These very rich oxidised minerals gave place at depth to the primary ore, galena (lead sulphide carrying silver) and sphalerite (zinc sulphide). The record of technical achievement became very impressive about the turn of the century. Fresh mining problems had to be solved as the structure of the lode varied from lease to lease. Experts from abroad introduced up-to-date methods of timbering in the mines and even initiated on a limited scale, at this early stage, the now general practice in Broken Hill of filling up those stopes from which the ore had been completely extracted with mullock (i.e., the residues left after the crushing, separation and concentration of the ore). Underground movements in some of the mines caused tremors sufficiently great to destroy surface plant and buildings. The huge open cut was excavated to relieve the tremendous pressure causing these devastating movements. The cut produced much ore and though disused for many years it still runs for a mile lengthwise along the top of the hill, a great jagged 300-foot-deep trench.

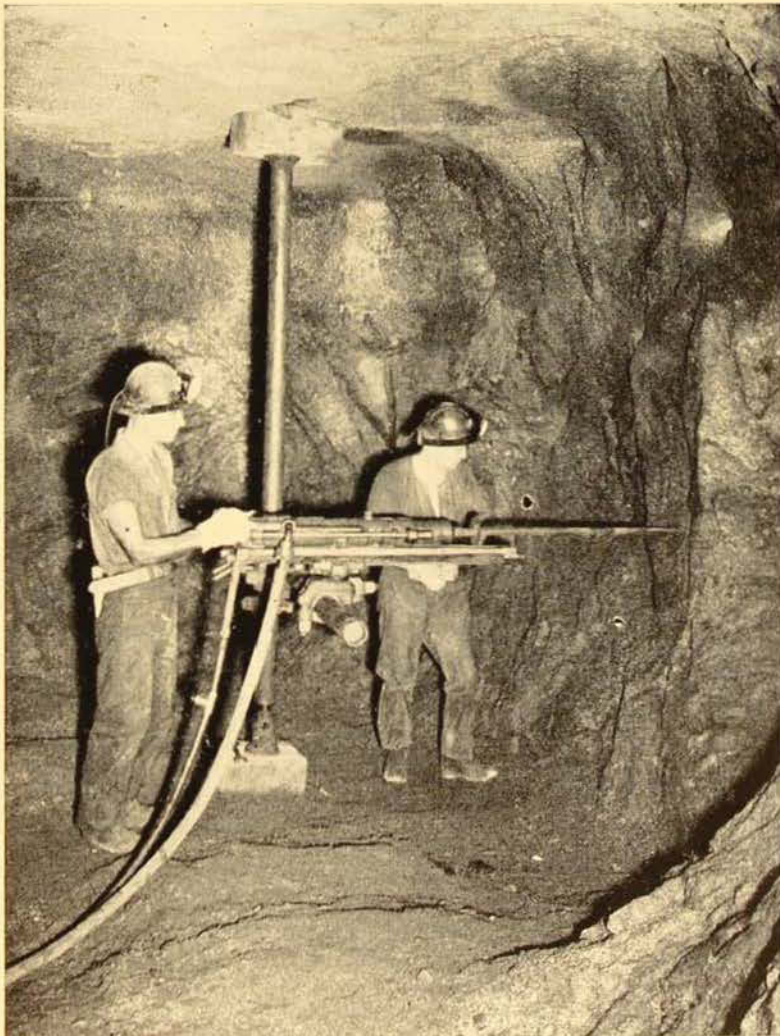
¹ For descriptions and illustrations of some of these minerals, see Hodge-Smith, T., "The Broken Hill Proprietary Block 14 Company Limited Mineral Collection", AUSTRALIAN MUSEUM MAGAZINE, III, pp. 81-83, 1933; and Hodge-Smith, T., "A Recently Acquired Collection of Minerals", *loc. cit.*, V, pp. 111-112, 1933.

By the turn of the century, due mainly to the water shortage, the smelters had been removed to Port Pirie, thus transferring elsewhere the discomfort of a continually polluted atmosphere.

Problems connected with treatment of the ore arose. Extraction of the silver-bearing galena from the finely crushed ore offered no special difficulty but the successful extraction of sphalerite was not achieved immediately. At one stage, 6,000,000 tons of tailings, containing all the zinc, flanked the slopes of the outcrop, huge man-made hills, awaiting an advance in technique to retrieve the wealth that lay in them. The development at the beginning of the century by Australian metallurgists and chemists of special flotation processes solved the problem. Sphalerite was no longer just a nuisance but a product as important as the galena. After the extraction of the sphalerite, the now completely barren tailings of fine crushed rock and gangue mineral were dumped as

great mullock heaps once more and though much of it was used for filling underground, some of these still stand to-day.

By 1910 it became clear that the life of the oldest mines in the central portion of the hill was limited. Yet the wealth already produced by these mines had been the means of initiating important related industries in other parts of Australia. The Broken Hill Associated Smelters at Port Pirie has already been mentioned. Another vast undertaking, the Electrolytic Zinc Company of Australia, became established near Hobart in 1916, where metallic zinc of more than 99% purity is manufactured. Tasmania, of course, was chosen as being the only part of Australia where abundant supplies of cheap electricity necessary for the process are available. These developments meant that for the first time the total huge output of Broken Hill ore was processed in Australia. Hitherto a large percentage of concentrates was exported for smelting overseas. The sulphur dioxide produced from roasting of zinc ore



Miners drilling underground.

Photo.—Zinc Corporation Ltd.

on the mainland, instead of polluting the atmosphere, was used for the manufacture of sulphuric acid, the most important of all industrial chemicals. Largest of all, the Broken Hill Proprietary iron and steel works at Newcastle were opened in 1915, financed by the great wealth of the Broken Hill lode.

In 1924 when last an article appeared on Broken Hill mining in this MAGAZINE² the Broken Hill Proprietary, working to a depth of 1,500 feet, dominated the scene and twelve mines in all were operating. To-day the picture is entirely different. The central part of the lode was practically worked out by 1940 and only a few ruined buildings, partly dismantled chimney stacks, old head frames and slag dumps bear witness to the great activity of earlier times on this portion of the field. Broken Hill Proprietary no longer works in the field. Its place has been taken by newer giants at each end of the line of lode. North Broken Hill had a somewhat chequered career for some years following its inception in 1896, but to-day it is one of the big established mines. Whatever portion of the original outcrop was worked by the North has long since gone and mining to-day is carried out from depths of 1,700 to 2,600 feet. Developmental work preparing new sections for mining goes on incessantly at depths of 3,000 feet. As ore extraction is pushed further and further along this great underground northern extremity of the "coathanger"-shaped ore body it will soon become too laborious and uneconomical to truck the ore long distances underground back to the present main shaft for hauling to the surface, so a huge new main shaft of elliptical shape is being steadily sunk about $\frac{1}{2}$ a mile to the north of the present main shaft. Still further to the north, where there is absolutely no surface indication of any ore body, geological and geophysical exploration together with deep diamond drilling is being used to detect possible further northerly extensions of the ore body. The oldest mine still working is Broken Hill South which began in 1888. It is situated immediately at the south end of the original outcrop,

about $2\frac{1}{2}$ miles distant from the North mine. It, too, is a very large mine now, working at depths well exceeding 2,000 feet. Further progress to the south is limited by the leases of the Zinc Corporation.

The Zinc Corporation came into existence in 1905 for the purpose of recovering the zinc ore from the huge tailings dumps. Mining began in 1911 and by 1935 annual production of ore had been raised to 376,000 tons a year. Active geophysical exploration and diamond drilling had by now shown that a great workable southern extension of the ore body existed. Consequently a new plan was entered upon, involving complete reconstruction of surface and underground workings, the sinking of new main shafts and ventilation shafts. This was completed by 1939. By 1941 the annual production was 500,000 tons. A new company, New Broken Hill Consolidated (N.B.H.C.) has been formed to explore and develop the southern leases of the Zinc Corporation. The haulage shaft of this new company lies about half a mile to the south of the present Zinc Corporation's main shaft. Throughout the Zinc Corporation and N.B.H.C. leases the ore body consists of more than one component. The topmost lode is first encountered at the great depth of 2,400 feet at the N.B.H.C. haulage shaft. Diamond drilling has proved that it continues at a depth of 2,900 feet. Another lower lode has been traced here to a depth of 3,500 feet, i.e., well over half a mile down. No lower limit of ore has yet been exposed by drilling on either section. In a longitudinal direction drilling has traced the ores to 400 feet south of the N.B.H.C. haulage shaft. The mining and ventilation systems of the two mines are completely co-ordinated. The ventilation problem is of great magnitude because rock temperature at a depth of 3,000 feet in Broken Hill is 106° F. The volume of air circulating is five times that demanded by legislation in the much deeper gold mines of the Rand in South Africa. All ore from both mines at present is hoisted up the Zinc Corporation main shaft but at a later stage, as mining extends more and more to the south, all haulage of ore will be through the N.B.H.C. shaft close to which a new concentrating mill is already

² Hodge-Smith, T. Excursion to Broken Hill, AUSTRALIAN MUSEUM MAGAZINE, II, 2, 1924, 64-67.

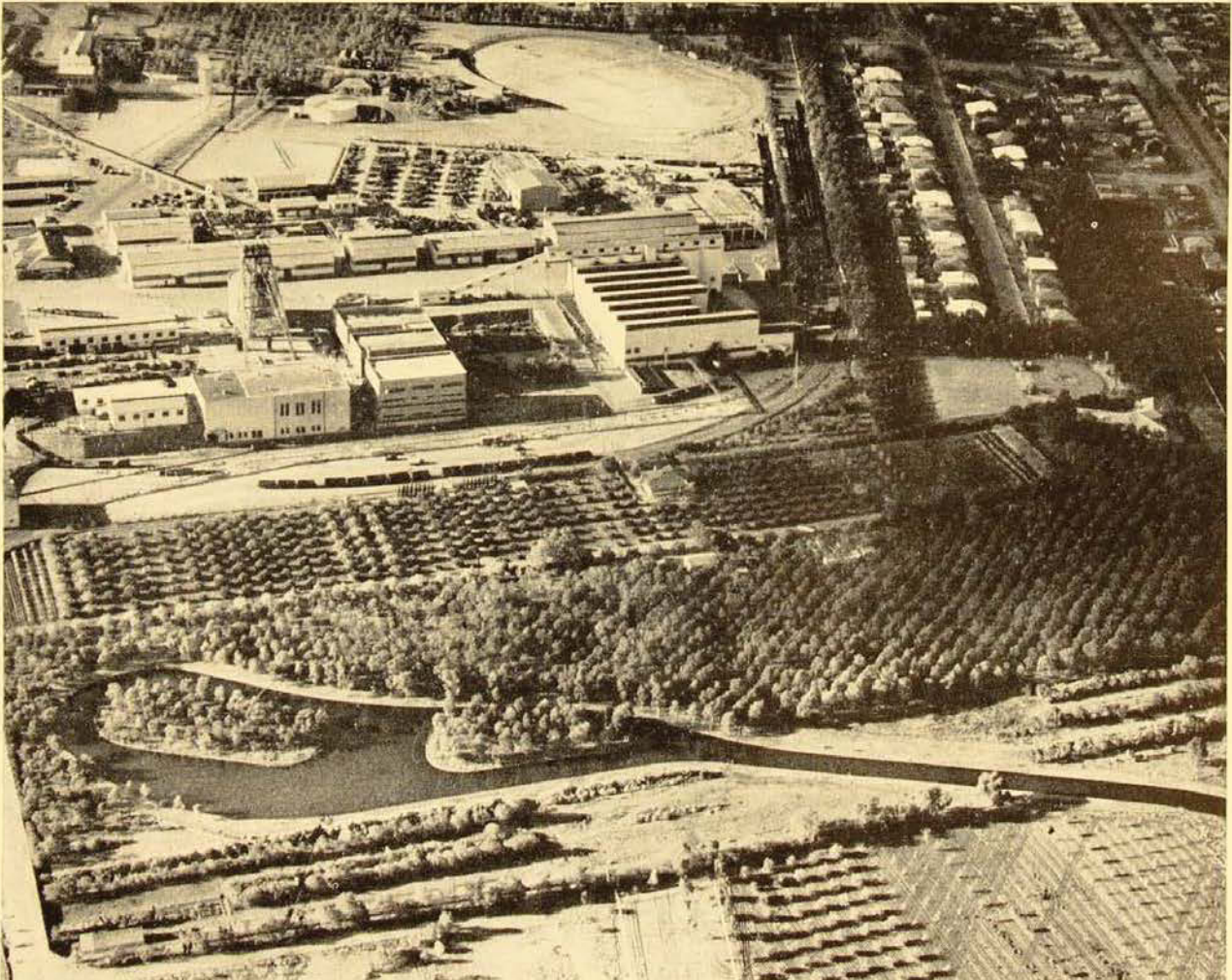
erected. Combined annual production from the two mines is hoped to be 1,000,000 tons by 1955.

The story of Broken Hill would not be complete without an account of improvements that have taken place in so many directions other than mining. The sand drift problem has virtually been checked by the active work of the mining companies, the Municipal Council and the N.S.W. Government, in fencing off areas on the town boundaries to permit of natural regeneration of local flora, supplemented by large scale planting of shrubs and trees both local and imported. The local river gum (*E. camaldulensis*) and a magnificent North African Tamarisk, the Athel (*Tamarix articulata*), are notable examples of trees that thrive markedly. What has been achieved in 15 years in a virtually rainless region is astonishing and one can imagine what future progress will be made

now that the completed pipeline from the Darling means an end of water shortage.

Lead poisoning and dusted lungs are now unknown in the mines. From 1922 on the work of the Bureau of Medical Inspection has brought about steady improvement resulting in the complete eradication of these diseases. The phenomenal wealth of the Broken Hill lode has made possible amenities such as modern child-care centres, kindergartens, play centres, parks, sports grounds, holiday camps and the rest on a scale unknown in any other Australian city.

Much has certainly transpired since the 1880's when the early pastoralists on Mount Gipps station gazed reflectively at the ironstone capping of the solitary "hill of mullock" and wondered if beneath its well wooded flanks there lay riches comparable with those of Thackaringa and Silverton.



Aerial view of the head-frame of the main shaft and surface workings of The Zinc Corporation. A citrus plantation lies immediately adjacent to the workings, followed by another plantation of native and introduced trees suitable for the arid climate. The artificial lake is filled from waste mine waters.

Photo.—Zinc Corporation Ltd.

The Shells of Rivers and Lakes—II

By DONALD F. McMICHAEL, B.Sc.

Of the two major groups of molluscs found in freshwater, the Pelecypods, or bivalved shells are represented by three distinct groups; the freshwater mussels, the "little mussels" or Corbiculinas, and the "pea shells" or Family Sphaeriidae.

All these groups are burrowers, living partially or completely buried in sand or mud, only moving around occasionally to a new position. Their tracks are sometimes seen on the sandy bottoms of streams, and usually a little digging around the end of the track will reveal the shell, foot extended as it works itself into the correct position. This large fleshy foot is pushed out into the sand or mud, the tip is spread out to serve as an anchor, and the shell moved along as the foot is withdrawn again. When handled the animal quickly retreats into its shell which then closes and is held shut by the strong adductor muscles. In the larger freshwater mussels, this gives ample protection against most enemies, as the shell will break before it can be prised open.

When the molluscs are stationary, they remain with the hinder end of the shell projecting from the bottom mud, with the valves gaping slightly. From this end, two short fleshy siphons project into the water, the lower drawing water into the mantle cavity inside the animal where food and oxygen and dissolved salts are extracted from it. The water is then discharged out of the upper siphon, removing waste products with it. An average size freshwater mussel has been estimated to filter more than six gallons of water per day in this manner.

The freshwater mussels were originally grouped into one family, most species being placed in the genera *Unio* and *Anodonta*. Recent study of these molluscs suggests that there are five separate

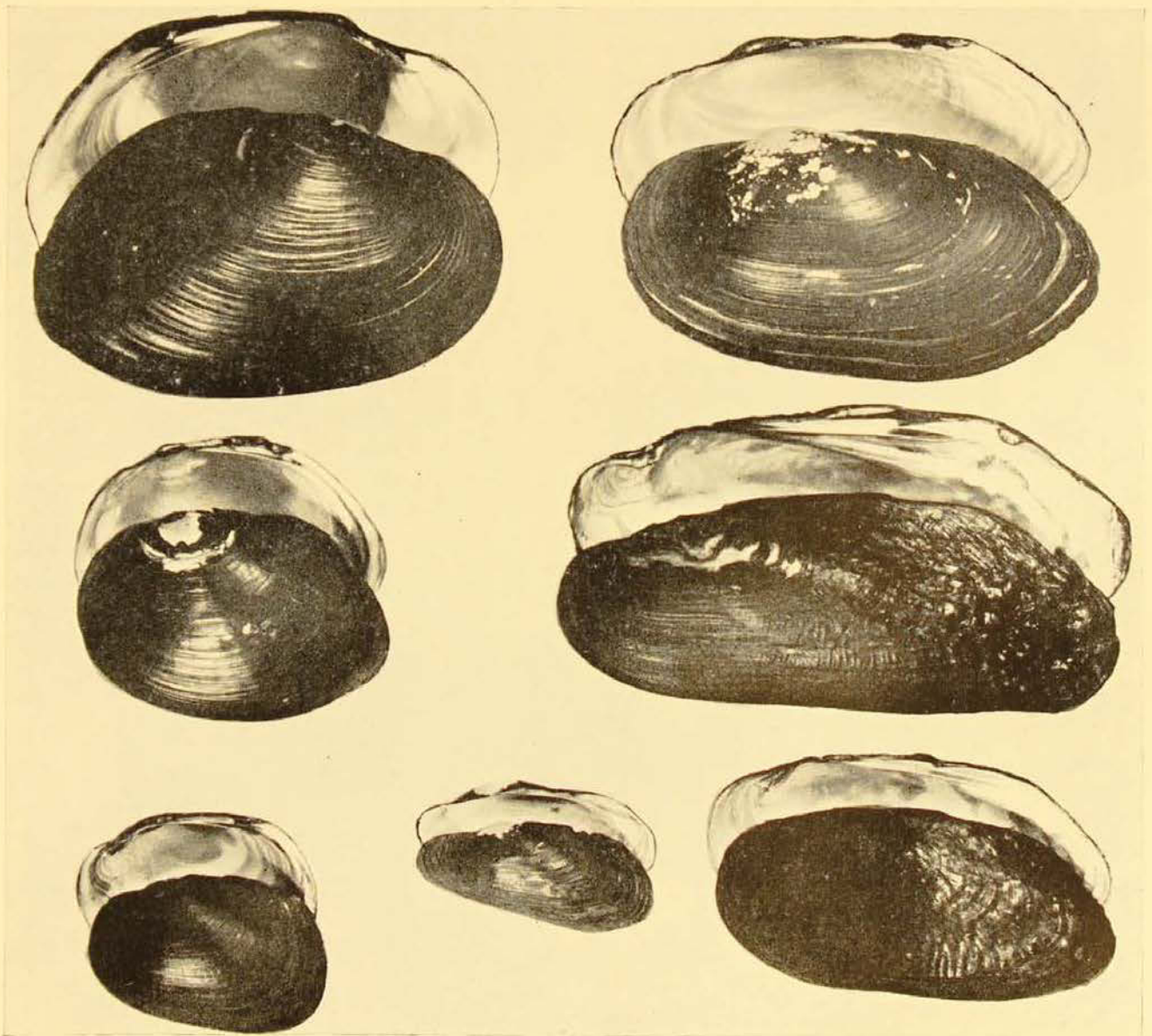
families, of which the Austromutelidae are well represented in the Australian region, and represent the most primitive stage in the evolution of this group. Two sub-families of the Austromutelidae are known from Australia, the Lortiellinae, a rare group from the North-west of Australia, and the widely distributed Velesunioninae. The former are long thin fragile shells, about two inches long, and only a half an inch high. *Lortiella froggatti* is known from North Australia, but another species, *Lortiella rugatus* found in Western Australia has not been recorded since 1840.

The Velesunioninae are represented by five distinct genera, of which the commonest is *Velesunio*. From inland New South Wales, comes the very widely distributed Balonne River Mussel, *Velesunio balonnensis*, which was illustrated in part I of this article. It occurs throughout the Murray-Darling River system, except in South Australia, where a much more rounded species, *Velesunio evansi*, is found. *Velesunio balonnensis* is also found in the coastal rivers around Sydney, but is not found elsewhere on the New South Wales coast. It seems to have crossed the Great Dividing Range, where the headwaters of the Macquarie River, a tributary of the Darling, and the headwaters of the Cox River, a tributary of the Nepean River, are only a few miles apart. From the Yarra River at Melbourne, these mussels are always large solid shells, and have been called *Velesunio danellii*, but they are probably only large specimens of the common *balonnensis*. All these mussels are medium sized, about two or three inches long, and one to two inches high. The shells are thin, with small flattened teeth, oval in shape with a brown to greenish-grey periostracum (the thin outer coat of the shell). They are often greatly eroded, and show irregularities in their growth stages.

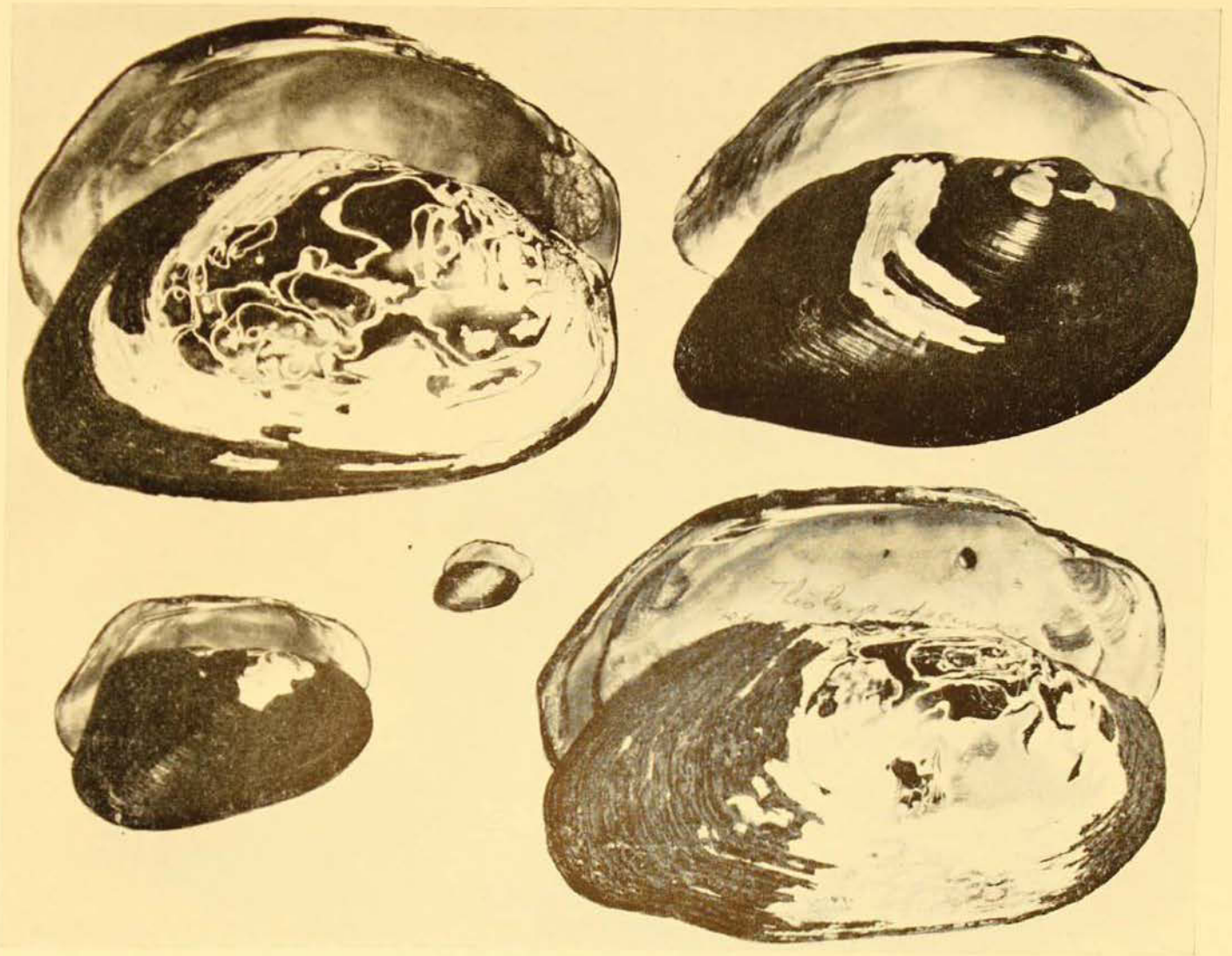
Paralleling the distribution of this group is another genus, *Alathyria*, which are all large heavy shells, thick, eroded, with a coarse periostracum, and with heavy thick hinge teeth. The muscle scars are often very deep, and the inside of the shell is chalky white, stained with pinks and browns. *Alathyria jacksoni* is the commonest species, and its young stages are illustrated, as they have often been confused with the *Velesunio* series. In the Macquarie River at Dubbo, this species is found more than six inches in length, a fact which was commented on by the early explorers. The common mussels found in the Hunter River are a distinct species,

Alathyria profuga, which are smaller and more rounded than *jacksoni*. From North Queensland comes a closely related species, which has been named *Quaesithyria wardi*. It shows some slight differences from the *Alathyrias* and seems to be related to the large *Microdonta anodontaeformis* from New Guinea.

The only mussel found around Perth, Western Australia, belongs to a distinct group and is called *Westralunio ambiguus*. It varies considerably in shape, and is sometimes quite chalky, the shell being easily broken, and very dirty. This is probably due to the conditions under which



On the left from top to bottom are *Velesunio danellii* from the Yarra River, Melbourne; *Velesunio evansi* from the lower Murray River, South Australia; and *Westralunio ambiguus* from the South-West corner of Australia. In the middle, bottom row, is *Lortielia froggatti* from North-West Australia. On the right from top to bottom are *Centralhyria wilsoni*; the New Holland Mussel, *Cucumerunio novaehollandiae*; and the closely related "*Hyridella*" *websteri* from New Zealand.



The three figures on the left show the growth stages of the common inland New South Wales species, *Alathyria jacksoni*; on the bottom at the right is *Quaesithyria wardi* from Northern Queensland, and above it, *Microdontia anodontaeformis*, a related species from New Guinea.

the shell is formed. The shell illustrated is clean and harder with a shiny black periostracum.

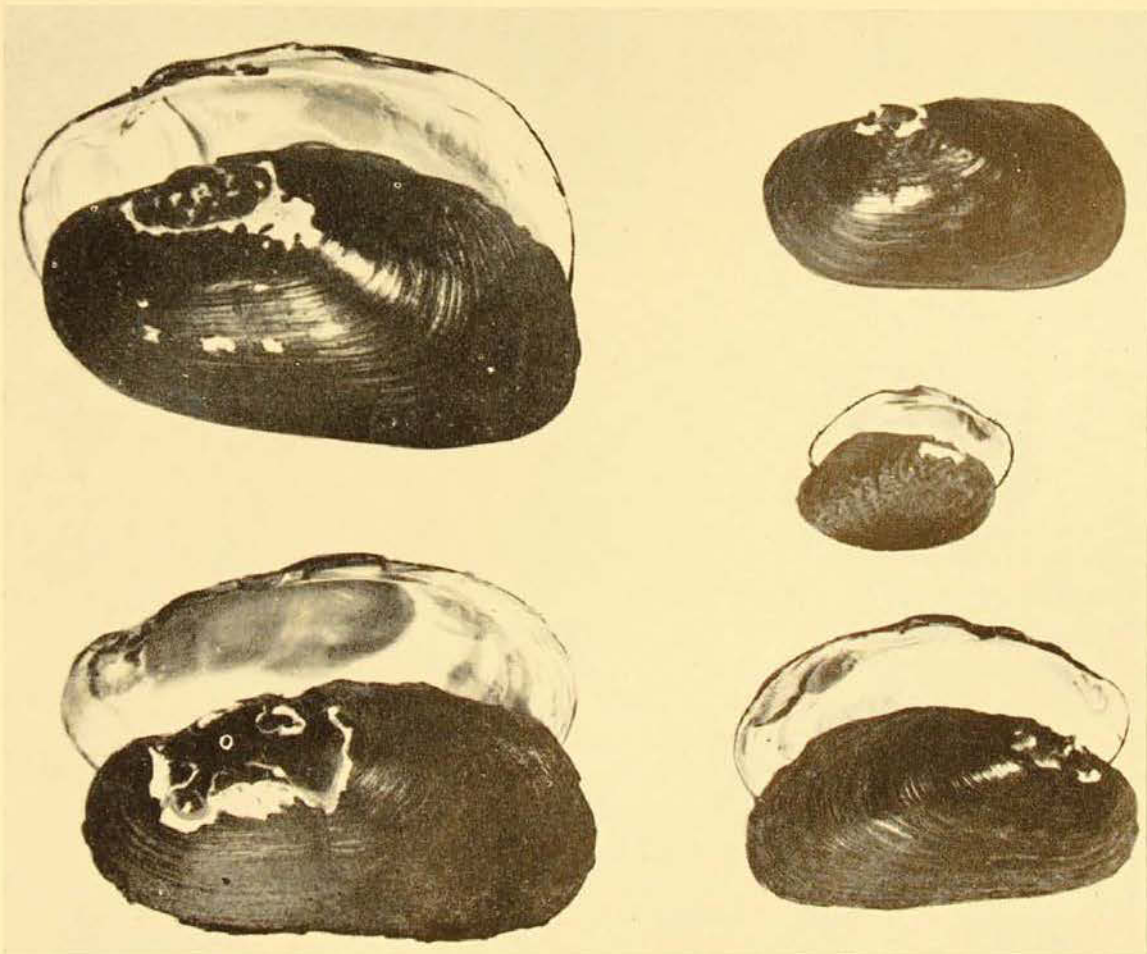
From central Queensland, about the level of the Tropic of Capricorn, another genus, *Centralhyria* extends right across Australia. These shells are elongate, with the top and bottom borders more or less parallel, a fairly thin shell, and small thin teeth. The inside of the shell is usually blue, and the outside varies from yellowish-green, through brown to black. *Centralhyria stuarti* grows very large, up to five inches long, while *Centralhyria wilsoni* is smaller but these shells are difficult to determine, and may represent one very variable species.

The family Unionidae, in its modern form, includes a number of groups of highly evolved mussels, in which the teeth are more complicated in structure than in Velesunioninae and the beaks of the shell are marked by wrinkles and foldings. The Australian subfamily Prophehyridellinae, includes four genera, *Prophehyridella*, *Protohyridella*, *Rugoshyria*, and *Hyridunio*. They are all very similar, being small to medium sized shells, with wrinkled beaks, and the cardinal teeth stout, upright, and with deep complicated muscle scars. *Prophehyridella nepeanensis* is common in streams along the New South Wales and Victorian coastline. It is a rectangular shell, the young stages showing the

wrinkling of the beaks, although these are usually eroded in the adults, which are darker in colour, the young being usually a light brown. In Victoria, a closely related species is *Prophehyridella narra-canensis* which has more strongly marked wrinkles, and a shell tapering at the posterior end. One peculiar species is confined to the Glenelg River in Victoria and South Australia. It is named *Protohyridella glenelgensis*, has a very wrinkled shell and is small, growing only to about one inch by three-quarters of an inch. *Rugoshyria depressa* is an elongated thin species from many of the rivers of Eastern Australia. It has a tapering posterior end, bluish inside, and a small series of wrinkles around the beak. Several different forms have been named, but all are very similar to *depressa*. *Unio guppyi* from the Solomon Islands belongs to this genus.

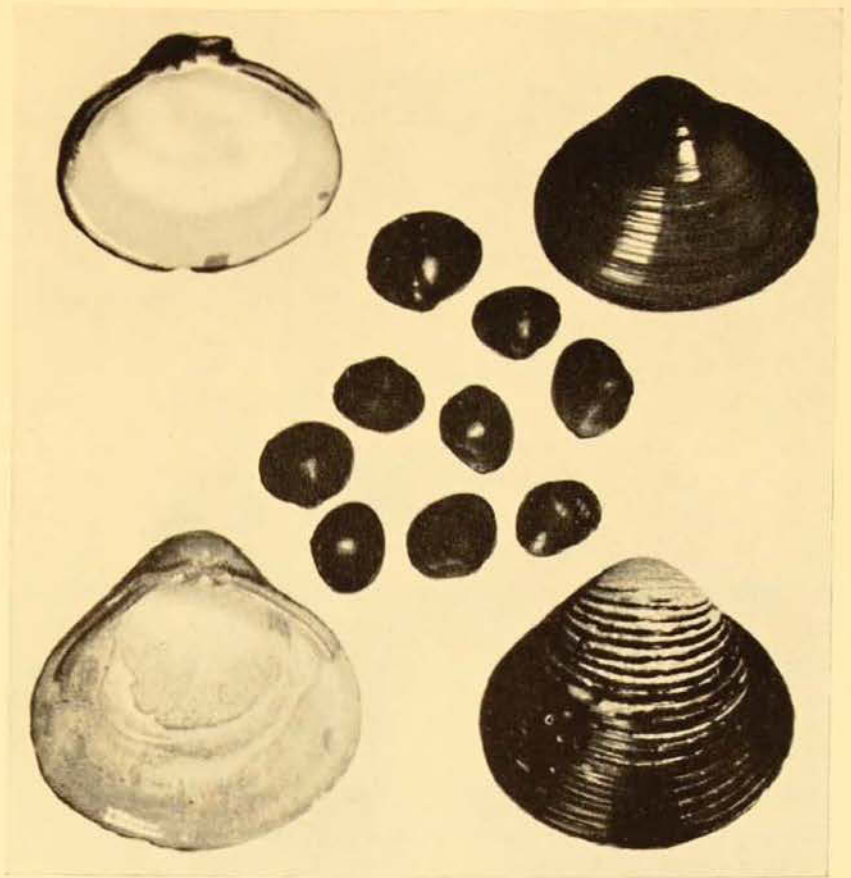
The last species of this group has been known as *Hyridunio australis*. Formerly, many of the Australian mussels were classified as *Hyridella australis* but it was uncertain as to which species the name belonged. Twenty years ago, the name was thought to belong to the species illustrated, and the generic name was changed to *Hyridunio*. At the moment, further research has indicated that it does not belong here after all, but for the present, the name can be applied to this somewhat kidney-shaped black species, with a flat shell which is common in the New South Wales coastal rivers.

The last group of mussels belongs to the family Margaritiferidae and contains only one species in Australia, and one in New Zealand. This is the subfamily Cucumerunioninae, and the Australian species is *Cucumerunio novae-hollandiae*, the New



The top two figures show the adult (left) and younger stage (right) of *Prophehyridella nepeanensis* from the coastal rivers of New South Wales, the latter showing the characteristic wrinkles on the beak; middle right, *Protohyridella glenelgensis*, a small much-wrinkled shell from the Glenelg River, Victoria; at the bottom left is *Hyridunio* "australis", from the coastal streams of New South Wales, and right, *Rugoshyria depressa* which has a similar distribution.

The top two figures show the inside and outside of *Corbiculina australis*, common in the larger rivers around Sydney, and at the bottom, the peculiar *Corbiculina maroubra*, whose habitat is unknown. The tiny shells in the middle are *Sphaerinova macgillivrayi*, typical pea-shells from ponds and dams near Sydney.



Holland mussel. It grows up to six inches long, about two inches high, and is an elongate black shell, with numerous coarse wrinkles all over it; it is found only in the New South Wales coastal rivers between Brisbane and the Hunter River. A very similar shell occurs in New Zealand, where it is known as *Hyridella websteri*, but it almost certainly belongs in this genus. These relationships between the freshwater molluscs of Australia, New Zealand, New Guinea and the other Pacific Islands are very interesting to the zoologist, and present many problems concerned with the ancient land masses and geological history of the Pacific region.

A distinct family of freshwater bivalves is the Corbiculidae which are known as "little mussels", although they are not very closely related to the freshwater mussels. They are small shells, about half an inch round, yellowish, with white to purple inside, and tiny teeth near the beaks. Well marked growth lines are seen on the outside of the shell, and numerous species have been named. *Corbiculina australis* is common around Sydney, in the muddy bottoms of the larger rivers. From

Maroubra Beach near Sydney, a distinct large species, with very strong growth lines is found. Where it comes from is a mystery, although there is a brackish-water lagoon nearby. The other species are too numerous to mention, and their identification is based on very small differences in their teeth and shape of the shell.

The last family of freshwater bivalves are the Peashells, or Family Sphaeriidae. These are tiny shells, about a quarter of an inch in diameter, greenish-grey in colour, and very delicate. They are found in the muddy ooze at the bottom of small ponds and swamps, and only six species are known from Australia, although there are certainly many more. Some years ago, a complete book was published on the seventeen British species, from a country not much bigger than Victoria! The Australian species are placed in a separate genus, *Sphaerinova*, the species illustrated being *Sphaerinova macgillivrayi* from rivers and ponds around Sydney.

In the final part of this article, I will deal with the Australian freshwater snails and limpets, belonging to the class Gastropoda.

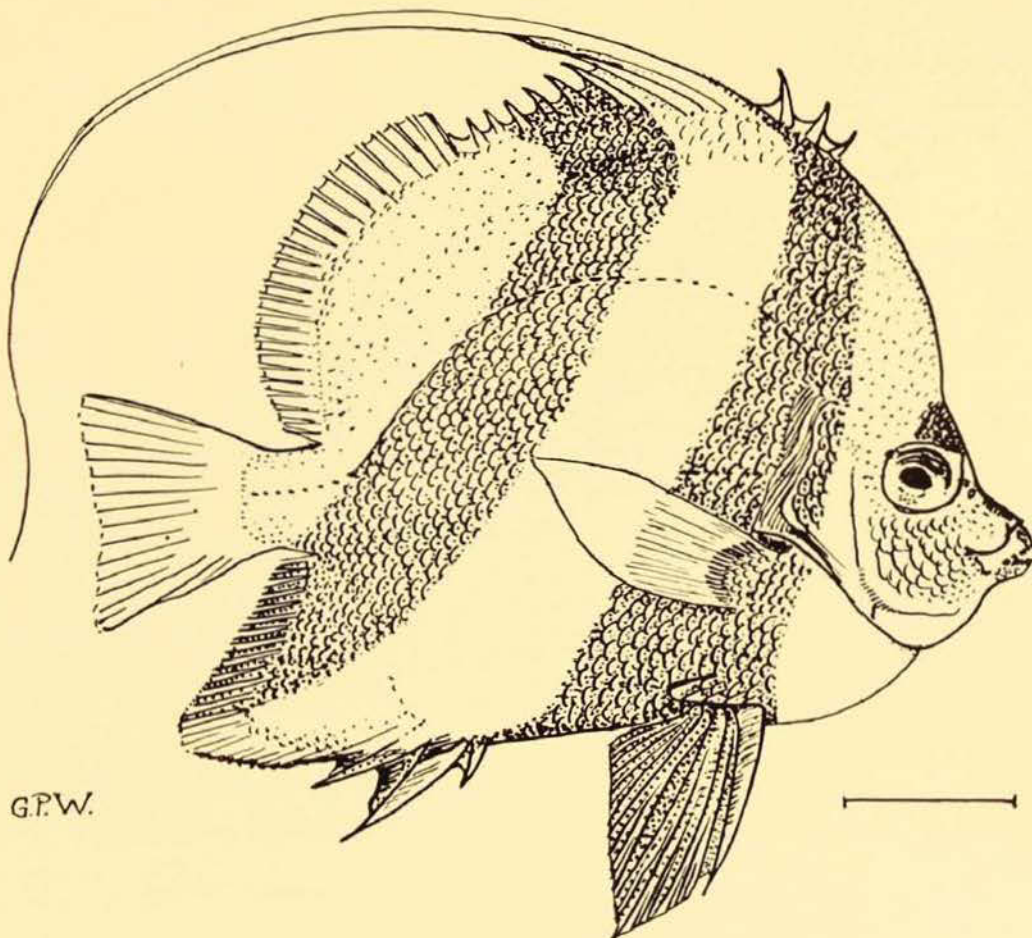
An Outline Classification of Australian Fishes

By G. P. WHITLEY

SO many people have asked me for a simple guide to enable them to classify or identify fishes that, in the absence of any modern book on the subject, I have drawn up the following starkly simplified scheme which, it is hoped, will be helpful to beginners and serve as a basis for future study.

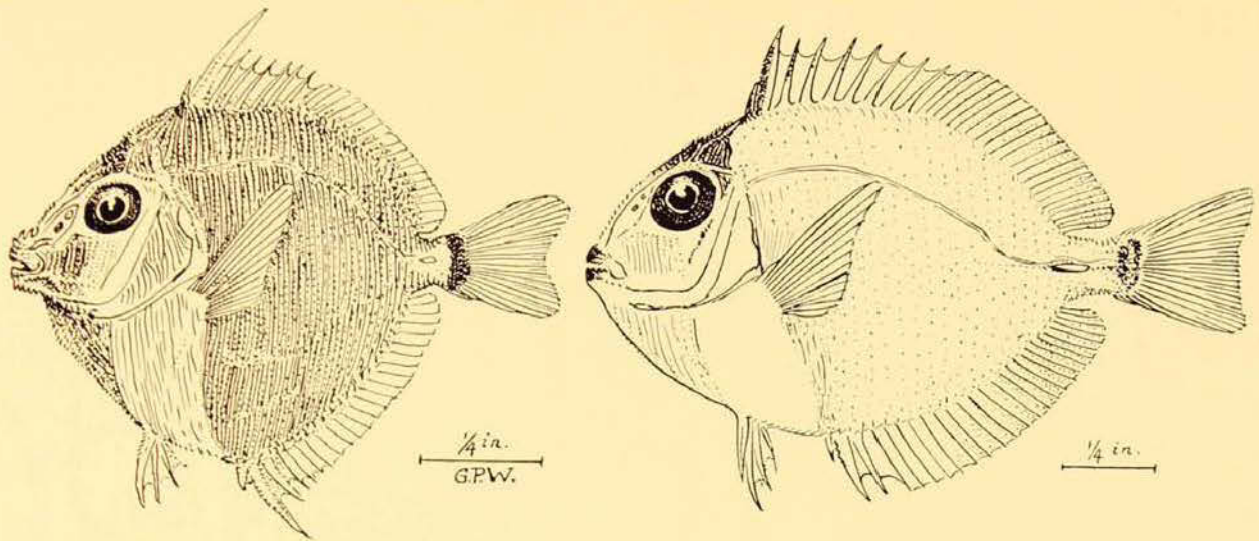
By "fish" I mean a cold-blooded, back-boned animal breathing through gills and moving by means of fins. Thus the jellyfish, shellfish, starfish, and even the silverfish are forthwith banished to their proper places amongst the invertebrates, and no longer considered. Whales and porpoises breathe air with their lungs and are warm-blooded animals so are also excluded. There are many ways in which we could classify our fishes, now we have narrowed

them down and defined them. We might separate them into freshwater and salt-water kinds. Or, as most beginners do, we might sort them into their colours; red ones, blue ones, black, banded, spotted, and so on. The fishmonger might select all the edible ones, fresh, in the round or filleted, and canned or processed. But zoologists, after many years of trial, have found that it is better to class like with like, not according to use or habitat or superficial similarity, but (since the doctrine of evolution became accepted), by classing animals in a kind of "family tree", the roots of which are hidden, but whose trunk begins with the forms of simplest organization, branching to the more complex types, and ending with the extremely specialized ones. The simplest kind of "fishes" are the



Pennant Coral Fish (*Heniochus acuminatus*) from Iluka, New South Wales, an unusual member of the Order Percomorphi.

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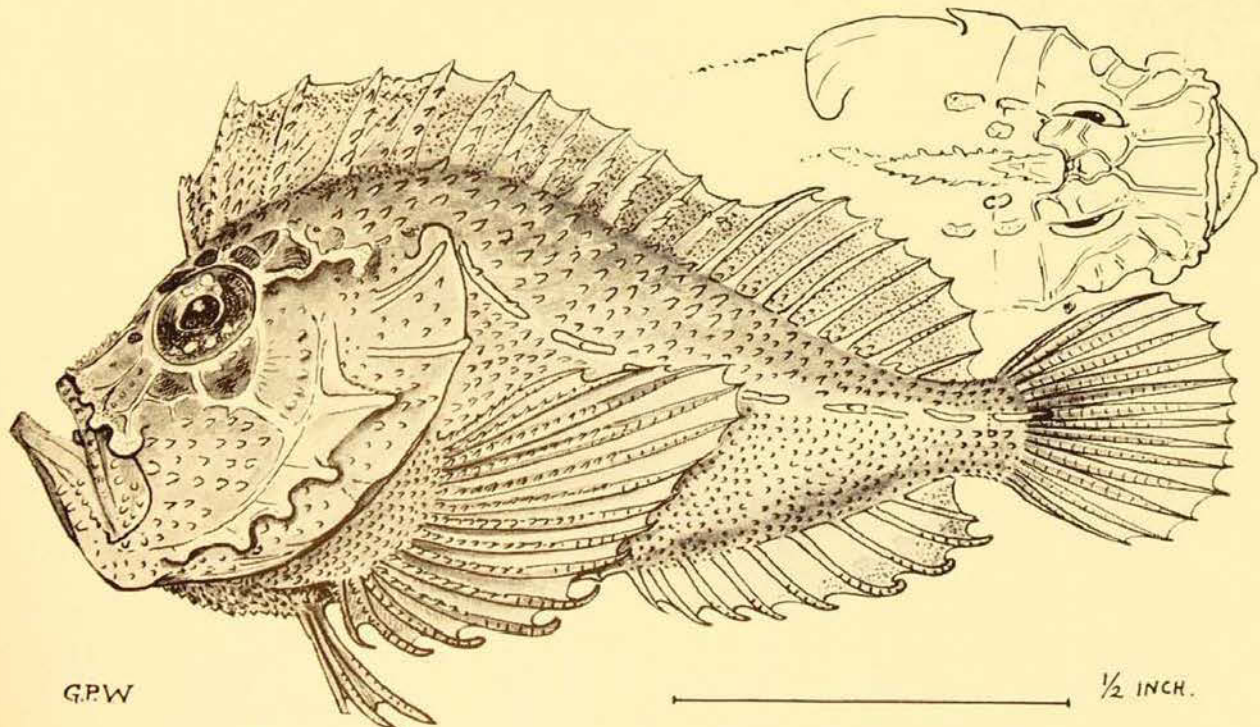
Juvenile Tangs (*Teuthis*) from New South Wales, members of the great Order Percomorphi. Left, a postlarva, twice natural size, from Maroubra; right, a larger one, $1\frac{1}{2}$ times natural size, from Byron Bay.

G. P. Whitley, del.

lancelets which have no jaws and are little more than elaborate worms with a primitive backbone. Next come the lampreys, still with no jaws, but having a skeleton of gristle. Then come the cartilaginous sharks and rays which, in general, have five pairs of gill slits and no bony gill-cover or operculum.

The majority of fishes belong to the sub-phylum Pisces, or ordinary bony fishes. These have been subdivided according to their kinds of scales, whether they have spines or only soft rays in the fins, and

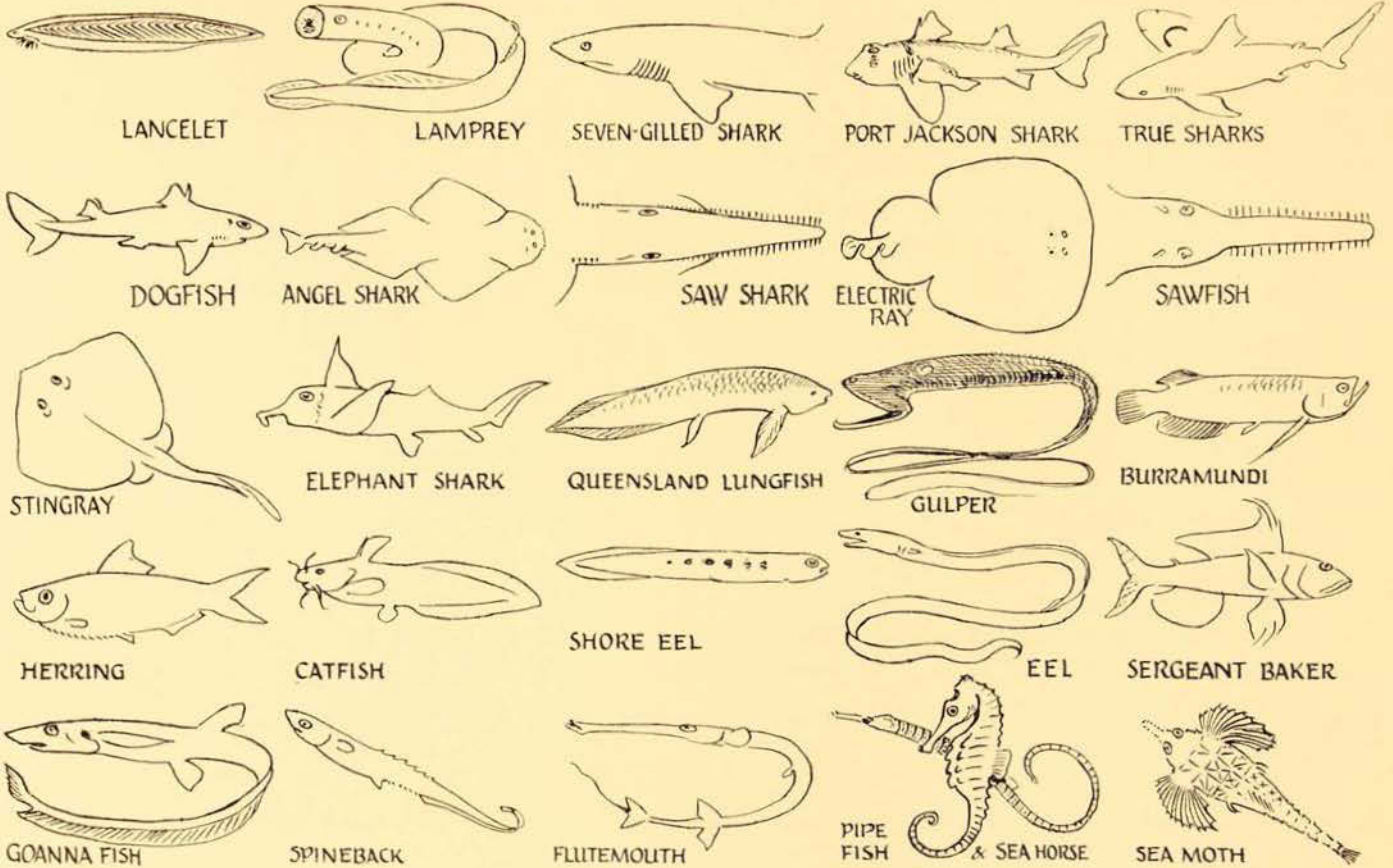
according to the bones in their skeletons. Broadly speaking, so far as Australian fishes are concerned, soft-finned fishes with many separate bones are regarded as more primitive and ancient than those, higher in the scheme of evolution, with their bones fused into more economical units and with spines as well as soft rays in their fins. We also notice degenerate fishes, like some eels, which have lost the spines and scales which were probably possessed by their remote ancestors; they may be likened to adventitious roots upon the evolutionary "family tree".

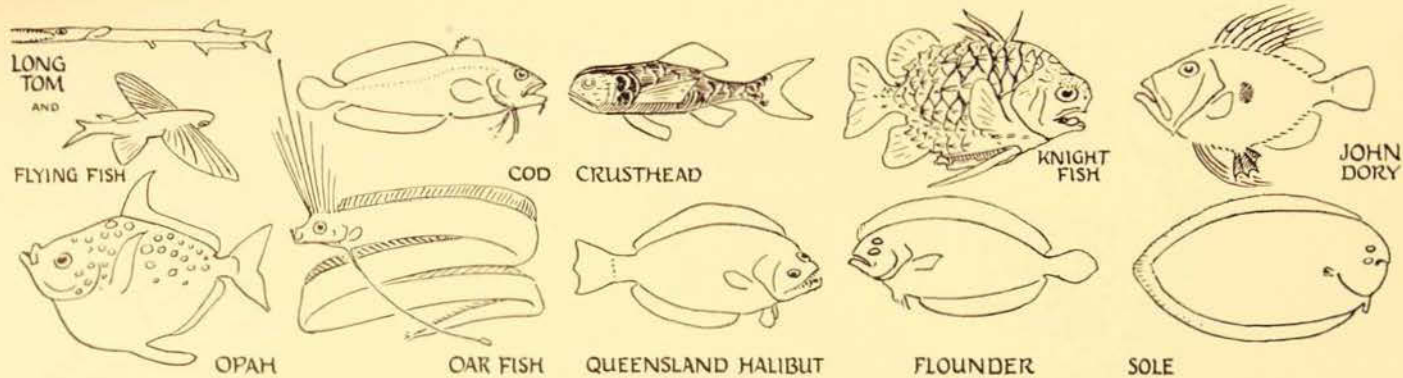


This Velvet Fish (*Kanekonia queenslandica*) from Albany Passage, Queensland, is one of the mail-cheeked fishes of the Order Cataphracti.

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CHART OF AUSTRALIAN FISHES—I





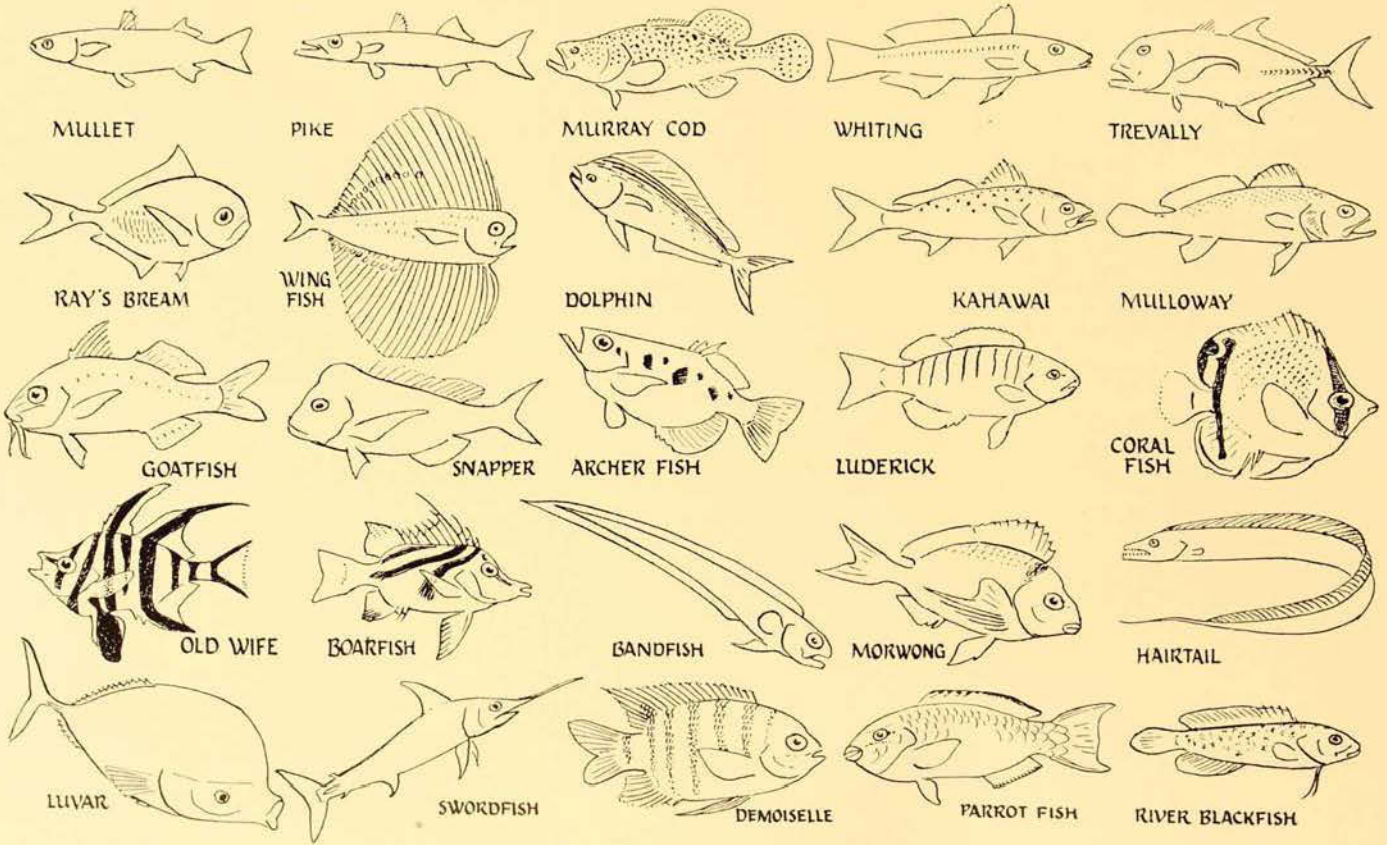
G. P. Whittey, del.

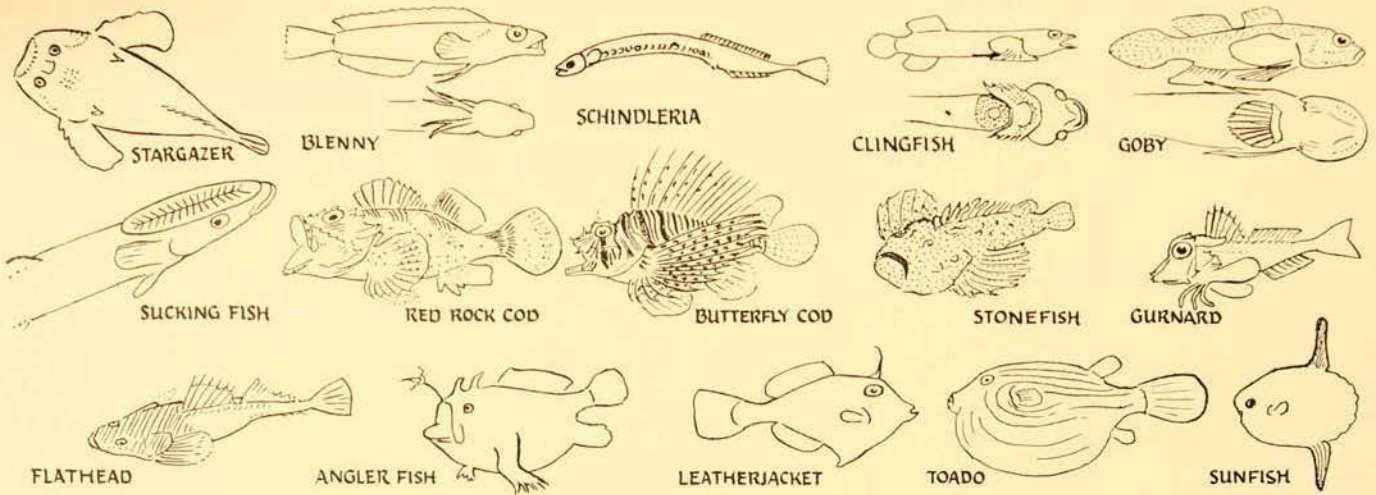
The Orders to which our principal fishes belong are:—

Branchiostomi (*Lancelets*); Hyperoartia (*Lampreys*); Hexanchea (*Seven-gilled Sharks*); Heterodontoidea (*Port Jackson Sharks*); Euselachii (*True Sharks*); Tectospondyli (*Dogfishes*); Squatinoidei (*Angel Sharks*); Pristiophori (*Sawsharks*); Narcobatea (*Electric Rays*); Batoidei (*Sawfish, Shovel-nose, Skate, Stingray, Devil Ray, etc.*); Chimaeroidei (*Ghost Shark and Elephant Shark*); Dipneusti (*Queensland Lungfish*); Lyomeri (*Gulper*); Osteoglossoidei (*Burrundi*); Isospondyli (*Herrings, Anchovy, Sand Salmon, Whitebait, certain deep-sea fishes and pelagic larvae*) [also the introduced *Salmon and Trout*]; [Eventognathi—not Australian (the introduced *Carp and Goldfish*)]; Nematognathi (*Catfishes*); Synbranchia (*Shore Eels*); Apodes (*Eels*); Iniomii (*Sergeant Baker, Bombay Duck, Lizard Fish,*

Cucumber Fish, Lantern Fish, Lancet Fish); [Cyprinodontes—not Australian. Introduced *Mosquito fishes, etc.*]; Lyopomi (*Sea Lizard or Goanna Fish*); Heteromi (*Spineback*); Aulostomi (*Flutemouth, Bellows Fish, Razor Fish*); Theracostei (*Pipefishes, Sea Horses, Sea Dragons*); Hypostomides (*Sea Moths*); Syntognathi (*Billfish, Long Toms, Carfish, Flying Fish*); [Labyrinthici—not Australian. Many introduced aquarium fishes.] Anacanthini (*Whiptails, true Codfish, Unicorn Cod*); Xenoberyces (*Crusthead*); Berycoidei (*Disc Fish, Nannegai, Roughy, Pineapple Fish, Squirrel Fish, Knight Fish*); Zeoidei (*John Dory and other Dorics, Rough Diamond Fish*); Selenichthyes (*Opah or Moon Fish*); Allotriognathi (*Vilfin, Oar Fish, Ribbon Fish*); Psettoidea (*Queensland Halibut*); Heterosomata (*Flounders and Soles*).

CHART OF AUSTRALIAN FISHES—II





G. P. Whitley, del.

Perciformes—the vast majority of Australian fishes (*Hardyheads, Mullet, Threadfins, Sea Pike, so-called Cod, Murray Cod, Pigmy Perch, Grunters, Red Bullseyes, Soldier Fishes, Whiting, Tailor, Trevallies, Ray's Bream, Wingfish, Dolphin, W. Australian Jewfish, Palmer, "Salmon" or Kahawai, Hussars, Bass, Chinaman Fish, Butterfly Fish, Triple-tail, Pony Fishes, Silver Belly, Mulloway, Goatfish, Emperors, Snapper, Bream, Bullseyes, Archer Fish, Nursery Fish, Sweep, Drummer, Chad, Luderick or Blackfish, Butterfish, Batfish, Coral Fishes, Angel Fish, Old Wife, Boarfish, Knife-jaw, Bandfish, Kelpfish, Morwong, Trumpeter, Frostfish, Hairtail, Barracouta, Spinefeet, Tangs or Surgeon Fish, Moorish Idol and numerous other kinds*); Plecostei (*Mackerel, Tunny, Queensland Kingfish, Luvar, Swordfish and Marlins*); Amphiprioniiformes (*Anemone Fishes and Demoiselles*); Pharyng-

ognathi (*Parrot Fishes, Rock Whiting, Tube-mouth*); Gadopseiformes (*Slippery or River Blackfish*); Jugulares (in a broad sense) (*Smilers, Grubfish, Stargazers, Dragonets, Blennies, Messmate Fish, Torsk, Frogfish, and several other families with jugular ventral fins, and Schindleria with no ventrals*); Xenopterygii (*Cling Fish*); Gobiodea (*Gobies, Gudgeons, Old Glory, Blind Goby, and Blind Gudgeon, Mudskippers*); Discocephali (*Sucking Fishes*); Cataphracti (*Red Rock Cod, Scorpion and Wasp Fishes, Butterfly Cod, Stonefish, Gurnards, Velvet Fish, Red Indian, Flatheads, and several other families, of "mailchecked" fishes*); Pediculati (*Handfish, Angler Fishes, deepsea Batfish*); Plectognathi (*Tripod Fish, Filefishes, Leatherjackets, Boxfish, Toadoes, Porcupine Fish, Sunfish*).

Fishes, like ourselves, mammals, birds and all other backboned animals, belong to the Phylum Chordata, but they are sorted into five subphyla, viz.:

- (1) Cephalochordata, the lancelets.
- (2) Cyclostomi, lampreys and hag-fishes.
- (3) Plagiostomata, sharks and rays and ghost sharks.
- (4) Choanichthyes, the Queensland Lungfish.
- (5) Pisces, all true bony fishes.

The subphyla are divided into Classes, Subclasses, Superorders and Orders but only the living Australian Orders are listed at present to avoid complication. The characters upon which the Orders are distinguished are too technical for easy explanation, being largely based on anatomy and osteology. Each Order is further divided into families, genera, and species. There are more than six hundred families of fishes, probably about twelve thousand generic names have been published (though many of these names are not valid¹) and many thousands of species of fishes have been described from various parts of the world. The 2,200-odd different species of Australian fishes are classified into more

¹ Such names, given (though not taken) in vain, have been aptly (if not whimsically) christened *nomina vana* by Dr. George Gaylord Simpson in his masterly "Principles of Classification" (Bulletin of the American Museum of Natural History, 85, 1945), which any serious student desiring to pursue further the subject of zoological classification is strongly advised to read.

than forty Orders, as tabulated on pages 404 to 407 and as selectively illustrated in the accompanying thumbnail sketches. For the lettering of my sketches, I have to thank Miss V. I. Beattie.

The system shown is substantially the same as the arrangement in the Fish Gallery of The Australian Museum which also includes, in their proper order, such foreign fishes as sturgeons and bony pikes.

It may be noticed that two of the above Orders, Amphiprioniformes and Gadopseiformes, differ terminally from the others in spelling. A case has been argued in favour of the use of the ending -iformes for names of all Orders of Animals by the Committee on Fish Classification for "Fishes of the Western North Atlantic", a great work which is being written by leading zoologists in co-operation. There may be changes of names in future and, if so, such well known ordinal terms as Coleoptera, Foraminifera and Primates might become Scarabeiformes, Globigeriniformes and Hominiiformes respectively. But the names I have used here are mainly the more conservative ones found in standard text-books² and fish literature. Hardly any two authorities are in complete agreement as to the names and limits of groups!

² Notably agreeing with those in Professor T. I. Storey's excellent new General Zoology (McGraw-Hill Book Co., 2nd ed., 1951), a *vade mecum* for all students of zoology. On the other hand, the -iformes convention is followed by W. A. Gosline in his "Unofficial Addendum to the Recent Fish Sections in Berg's 'Classification of Fishes'". The latter is a Russian work published in 1940.

JUST WHAT DO FISHES EAT?

I was more than surprised to receive the following interesting note from Mr. John Walkley, Christ College, Hobart, Tasmania, on the feeding habits of an Australian species. Since the observation has been confirmed by Mr. Walkley's father, it certainly sheds a little light on a somewhat murky spot in our scanty knowledge of fish.

"We lived for many years", he writes, "at Ulverstone, which is at the mouth of the Leven river, on the north-west coast. The district is well known for its extensive cultivation of green peas; much of the crop is processed for market at a cannery on the riverbank. Many of the unshelled peas, rejected because of splits, wormholes, and certain minor defects, are discharged into the stream, whence they are carried down to the sea.

"Year after year we have caught quantities of fish about the entrance to the river, chiefly mullet and 'Cocky Salmon', and have noticed, when cleaning our 'catch', that the mullet are invariably full of green peas. Only in rare cases have we found peas in the 'Cocky Salmon'.

"Among the other debris discharged by the cannery are pieces of barracouta fish and rabbit, together with slices of apple, but we have never yet recovered any of the latter fruit from these fish, although it was clearly evident that pieces of barracouta and rabbit are commonly present in these two fishes".

TARLTON RAYMENT, F.R.Z.S.