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Regent Honeyeater.

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THE AUSTRALIAN MUSEUM

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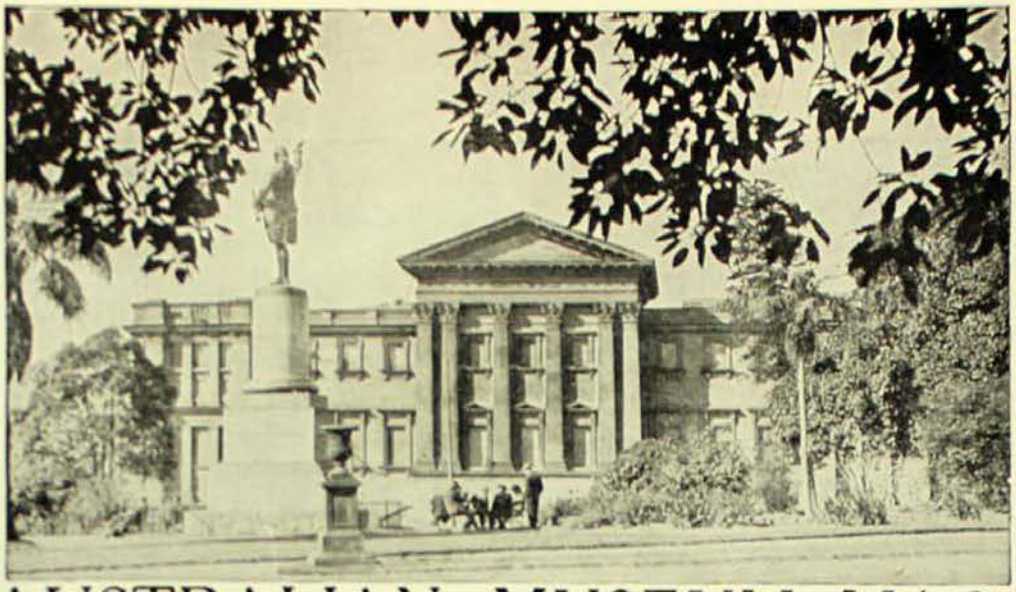

THE AUSTRALIAN MUSEUM MAGAZINE

(Photography, unless otherwise stated, is by G. C. Clutton.)

● OUR FRONT COVER. The Regent Honeyeater (*Zanthomiza phrygia* Shaw) is by Lilian Medland. It is one of a series of post cards issued by the Trustees of the Australian Museum.

This showy Honeyeater takes its name from its black and yellow plumage, in which feature it resembles the Regent Bird, and it is also called the Wartyfaced from the peculiar warty excrescences which occur upon the bare skin of its face; while the scientific name *phrygia* makes comparison of its laced feathers with the famed embroideries of the ancient Phrygians.

The Regent Honeyeater is a bird of the interior, ranging from Southern Queensland to South Australia, but comes down to the coast at times under the influence of drought or other unfavourable conditions. It is gregarious and is largely insectivorous, catching its food on the wing as well as picking it from amongst the blossoms. It has a pleasant plaintive song of a few notes only.

The bird builds a fairly large cup-shaped nest of bark, softly lined, which is placed at varying heights in a rough-barked eucalypt. The eggs are very beautiful, two or three in number, warm salmon with indistinct reddish spots at the larger end.

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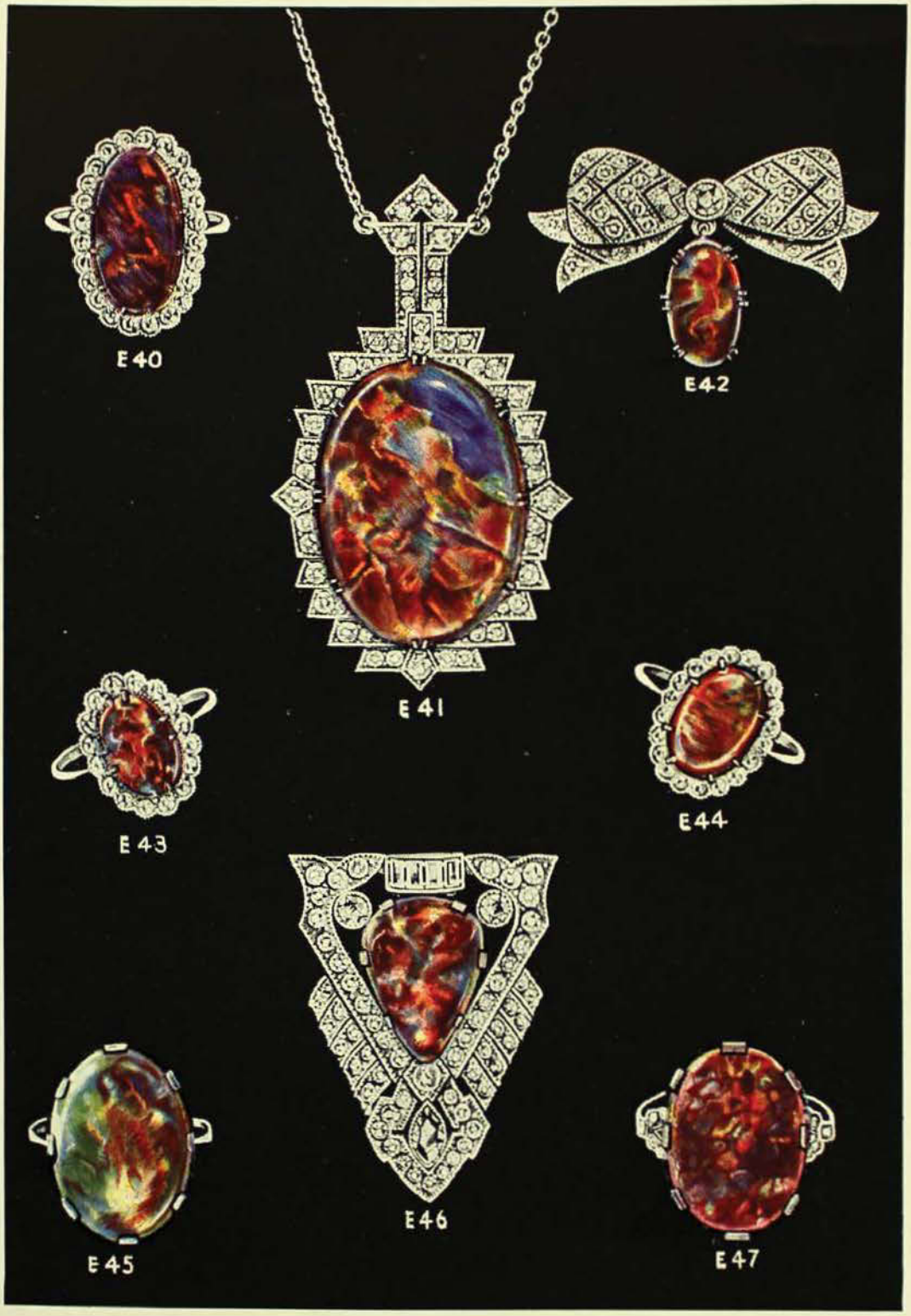
Green-backed Mangrove Heron at nest.



Australian Opals.

Blocks by courtesy of Percy Marks.

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MAGAZINE

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Vol. VII, No. 1. June–August, 1939.

The Percy Marks Collection of Opals

FOLLOWING the policy of the Trustees of the Museum to modernize the display galleries of the Museum the opal display has been removed to a new location, and an attempt made to make the display tell a story of the opal to the "Man-in-the-Street". So impressed was the well-known firm of Percy Marks, jewellers, of Sydney, with what had been accomplished that they became interested immediately.

They quickly noted the blanks in our story, and just as quickly presented to the Museum a charming and valuable collection of Australian opals which not only completed the story, but augmented handsomely the material we already possessed. In making the donation, the firm expressed the hope that it would help to create interest in this beautiful Australian gemstone.

One of the results of this welcome gift is that our collection now contains material from every opal field in Australia, for previously the Grawin, Tintenbar, and Andamooka fields were not represented. Also the collection illustrates the full range of colours and patterns that have made the Australian opal famous the world over.

This public-spirited action of the firm of Percy Marks is all the more welcome as the supplies of opal from Australian fields are dwindling, despite the fact that prices are high. The Australian black opal is the most beautiful gem in the world, and Lightning Ridge, New South Wales, is the only place where the true black opal is obtained. The production of opal in New South Wales today is less than one-sixth of what it was in 1920. The production curve, though somewhat irregular, is rapidly falling. In not so many years hence it is likely that this beautiful gem will be exceedingly rare. Then, indeed, it would be a difficult task to present the natural history of the opal that has done so much to bring the name of Australia before the world.

The collection contains fifty-eight pieces, and perhaps those specimens showing the rare colours and patterns of the black opal from Lightning Ridge, New South Wales, similar to those shown in the frontispiece, are the most striking,

though the depth of colour of the semi-black opals of the Grawin, New South Wales, field is hardly less pleasing. The Andamooka, South Australia, semi-transparent opal, with its wide colour pattern, contrasts well with the less transparent and much more closely patterned light opal of Coober Pedy, South Australia. Among the Queensland opals with their characteristic ironstone matrix are some from Winton showing colours not often seen in opal. The difference between the light opal of White Cliffs, New South Wales, and Lightning Ridge, which incidentally produces both the light and the black opal, is clearly shown in some beautiful specimens from both fields. Lastly are the curious, almost transparent, opals which are found filling the steam holes in an ancient (Tertiary) lava flow at Tintenbar, New South Wales.

The whole collection has been incorporated with the existing collection, and is to be seen in a bay of the wall case on the southern side of the Mineral Gallery. Included in the display is a map of Australia cut out in polished wood with the opal localities marked by an opal from the particular locality. A photograph of the White Cliffs field by the late E. F. Pittmann, and one of Coober Pedy field by Mr. H. O. Fletcher give a splendid idea of the extremely arid conditions under which the miners work.

A general label explains that the widely distributed mineral opal consists of silica and varying amounts of water, that is, it is a hydrous silica. The only variety of importance as a gemstone is the precious opal, though the fire opal is also cut. The colours displayed by precious opal are not due to any pigment, but to ultra-microscopic cracks filled with silica and capable of breaking up light into its component colours. The two main varieties of precious opal are black opal and light opal, the former being the more valuable variety. The main factors controlling the value of opal are the amount of fire (red colour), the pattern of the colours, and the depth of colour.

T. HODGE-SMITH.

Dr. Richard Dehm, lecturer on geology in the University of Münich, and Dr. Joachim Schröder, Curator of the Geological Collections, arrived in Sydney on April 3. They are on a journey to British India and Australia for the purpose of making a geological and palaeontological study of these countries for comparison with allied problems in the geology of Germany.

They have brought camping equipment with them, and intend to travel by car through parts of South Australia, Victoria, New South Wales, and Queensland, to collect fossils and data on stratigraphical geology on behalf of the Bavarian Academy of Science and the University of Münich. The Commonwealth and State Governments have informed the Secretary of State for Dominion Affairs that all possible facilities will be accorded to these visitors, who will be in Australia for four or five months.

The Green-backed Mangrove Heron
(Butorides striata)

By K. A. HINDWOOD*

IN various parts of the world many birds have had the word "Mangrove" prefixed to their common names. The reason is obvious, though not always is the term well used, for quite a number of supposedly mangrove-haunting species are just as often found in forest country. Actually an area of mangroves is a forest, except for an entire absence of ground growth. Fortunately for the naturalist such places are seldom spoiled by man; certainly in settled districts fishermen turn over the soft mud in quest of bait, and gourmands search the bases of the trees for oysters, but these activities do not disturb the bird-life overmuch.

Within a few miles of Sydney one may observe a true mangrove-frequenting species; this bird is the Green-backed Mangrove Heron. Along the quiet reaches of the harbour Mangrove Herons live and breed, and are likely to do so for many years. While they are not absolutely confined to mangroves, one is almost certain to observe them there at any time of the year. Birds very closely related to our Mangrove Heron occur throughout the tropical and temperate regions of the world, though they do not seem to be so closely associated with mangroves as the Australian species.

The shape, size, and not a few of the actions of the Mangrove Heron suggest a Bittern. Its legs are short, and for a true heron it is not at all graceful. In general dimensions it approximates to a domestic fowl. The length overall is some seventeen inches; this includes the bill, which is three inches long. The feathers of the head and nuchal crest are greenish-black; the white throat is marked with blackish feathers. The rest of the underparts are dusky-grey or brown. The wings and back are dark glossy-green, but the colours of these feathers are such that in a subdued light they appear dark grey; in sunlight they reflect a beautiful glossy-green with a bluish tinge. The legs are a bright orange-yellow.

The extensive mud-flats of estuaries and tidal rivers are much favoured by the Mangrove Heron. In the pools left by the falling tide and along the reedy edges of the stream the birds find an abundance of shrimps, small fish, and crabs. No particular method is used in procuring food, though the common practice is to fish from the mud or a suitable half-submerged snag. The hunched appearance of the body, together with a ludicrous running gait, imparts to the bird an air of melancholy and remorse; such an effect is heightened by the lack of movement of the neck, which is so held that the back of the head appears to be resting on the shoulders. A constant downward flicking of the tail is noticeable at all times.

Some years ago I remember watching an adult bird fishing as the tide was covering a sand-spit. Perched on a partly submerged log, it was waiting for any fish that might chance to pass by. The water was then only a few inches deep. Presently the attitude of the bird became tense, the head was drawn well into the shoulders and the body flattened until it was parallel with the water. Expectant, alert, and poised, the Heron waited. Suddenly and with wonderful rapidity out shot the javelin-like bill as though released from a steel string, to be withdrawn holding a squirming fish. A quick sideways movement and the unfortunate fish disappeared head first down the throat of the bird. Fishing was good, and the rising tide had almost half covered the Heron before it flew to a nearby spit in search of smaller fry.

* Photographs by the author.

Young Mangrove Heron, six days old.

Mangrove Herons show great control when fishing along the edge of a mud-flat. On perceiving a fish or shrimp, which may be several feet away, they quickly make towards it and then act with extreme caution. One leg is raised and slowly placed in front of the other; sometimes it will be held poised above the ground for as long as twenty or thirty seconds, then down it comes ever so slowly. All this time the body is gradually assuming the striking position; at the precise moment, out goes the bill and in comes the fish. Another way in which they catch fish is to dive head first into deep water, though this method is not commonly used.

When commencing to build, which is during the month of September in the Sydney district, the birds use sticks about as thick as a lead pencil as a foundation. As the structure progresses, the twigs become thinner and shorter, until those comprising what may be termed the lining are no thicker than a knitting needle. The centre of the platform of the nest is depressed about an inch below the rim, thus preventing the eggs from rolling out in windy weather. The number of sticks in an average nest was found to be about 220. Normally the time taken in building the nest is some two weeks; nests are generally twelve inches in diameter, with some of the larger twigs protruding. Two main conditions appear to determine the situation chosen by the birds—the suitability of the branch or branches for nest placement, and the presence of abundant top foliage to screen the eggs or young from predatory birds. While nests may be found near the centre of a mangrove forest, others are built on the outer fringe, at heights varying from a few feet to thirty feet from the ground.

Generally two families are reared during the breeding-season, which continues until January, when well-grown birds of the second brood are to be observed at the nest or in the nesting-tree. Sometimes the same nest is used for the second clutch. Nests in mangroves are admirably situated, for such places offer the maximum of seclusion and protection from interference in close proximity to good feeding-grounds. The shallow waters of the rising and falling tides abound with suitable food, and there is a plenitude of crabs on the mud-flats.

The eggs of the Mangrove Heron are ovate in shape and greenish-blue in colour; they measure a little more than one and a half inches in length by one and a quarter inches in width. When first laid the dull close-grained surface is often partly smeared with lime, though they soon become soiled with mud. The brooding bird leaves the nest for the mud-flats or shallow water, and when she again covers the eggs they become discoloured with mire from her feet; particularly is this so when feeding-grounds are near the mouths of narrow estuarine creeks where the mud is usually soft and clinging.

Attitude adopted by young Mangrove Herons at the approach of danger.

Three eggs appear to be the usual number laid; sometimes four are found in a nest, though this is unusual. The few records available from northern Australia indicate that two eggs usually form a clutch in that part of the continent.

When studying the habits of the Mangrove Heron it was found that nowhere in the literature relating to the species had the period of incubation been stated. Therefore it was necessary to discover a pair of birds building, mark the eggs as they were laid, and then, by daily visits to the nest towards the close of the third week, ascertain when they hatched. It was found that the eggs are laid on alternate days, and that incubation almost certainly begins with the laying of the first egg, as is generally believed to be the case with most herons. The knowledge gleaned indicated that the period of incubation was not the same in all three eggs of a clutch, so a check was made on a second nest. In the first nest examined the periods of incubation of the three eggs were: (1) 25 days, (2) 23 days, (3) 21 days respectively in the order of laying; and in the second nest

Normal attitude of young Mangrove Herons.

(1) 24 days, (2) infertile, (3) 21 days. Thus it was apparent that there is a lessening in the period of incubation in successive eggs laid. This variation may be caused by the brooding bird becoming more attentive as the clutch neared completion; in any case, it tends to eliminate the differences in the sizes of young birds of the same nest, which is most marked when four eggs are laid.

The early morning visits to nests in search of information were always a source of great pleasure. A goodly portion of the tracks to both areas of mangroves where eggs had been marked was through bushland, and, in passing, I often watched the beautiful Yellow-tufted Honeyeaters bathing at sunrise among the dew-laden leaves of a sapling. Other birds there were in plenty and in great song, for it was spring, and many happy memories were gathered by the wayside.

An examination of the embryo before hatching shows that it is lying lengthways in the shell, which position it has assumed after about two weeks of incubation. The neck and head are bent sharply downwards, with the bill between one

wing and the body and pointing upwards. The edges of both the upper and lower mandibles are considerably hardened; the former has on it the small, white, cone-shaped protuberance called the egg-tooth, which rests against the leathery inner membrane of the egg. Some time before hatching this membrane is pierced by the egg-tooth, and the young bird commences to breathe the air contained between the inner sac and the top portion of the shell.

The egg-tooth, which is situated on the bend of the top blunt mandible, tapers to a fine point, and, because of the position of the head of the young bird within the egg, is directed more or less upwards and outwards. From the position of the tough inner lining of the egg after the young bird has hatched, it would seem that the sharp tip of the egg-tooth is of considerable assistance in perforating this membrane as the body of the imprisoned bird slowly revolves on the long axis of the egg. There appear to be two distinct actions by the young bird when it is hatching. Firstly, the tap against the inner wall of the egg, mainly concerned with the cutting of the leathery membrane by the egg-tooth, and, secondly, a pushing outwards by the entire end of the bill. This latter movement I have watched; it produces a crunching sound, not very apparent unless one is very close to the egg, caused by the minute fracturing of the egg shell. As previously stated, the ends of the mandibles are furnished with a hard covering, distinct from the egg-tooth, and it is by this means that the bill is used as a battering-ram against the shell. Consequently, as the body rotates, both the inner soft, but tough, lining is cut and the egg fractured, until a cap or the top portion of the egg is released. Hatching is then completed by the bird pushing itself out of the lower part of the shell with its feet. The extent of rotation within the egg must be almost 360 degrees, for in most cases the shell is cut completely round and presents an uneven serrated appearance. The empty shells are merely pushed over the side of the nest by the adult bird. With many other species of birds the shells are carried some distance from the nest. The time taken by the young Heron in emerging from the shell is probably several hours from the time it is first pipped. While the young bird is quite unconscious of what it is doing, it frequently utters soft croaks within the egg; the attempt to emerge from the egg gives the impression of a desperate struggle. With the domestic fowl the time taken in hatching is said to be some five or six hours, and in the case of the American Eagle, a much larger bird, as long as eighteen hours.

The young birds are covered with grey down for nine or ten days. Feathers then begin to show through the down, and by the end of the third week after hatching cover most of the body. When the young are first hatched the parents are most attentive and seldom leave the nest unattended. Well-grown nestlings are left much to themselves except at feeding times. At the approach of an intruder they will adopt the protective, or rather obliterative, attitude common to all herons and bitterns. No matter from which direction they are approached, the birds will face the intruder. The body is stiffened and narrowed, the neck elongated and the bill pointed upwards. It serves no purpose if one circles the nesting-tree: the birds move round also, ever so slowly. Always the striped feathers of the neck and body face the intruder. This action first appears when the young are six days old, though it does not become dominant until they are ten days old. The eyes of the birds are so situated that they both look towards the oncoming disturbance. Nothing less like a bird can be imagined, and no doubt the young birds escape the attentions of many possible enemies by this means. Old birds when brooding also use this ruse.

Should an intruder approach too closely, the young birds, after the age of three weeks, will make for the outer parts of the nesting-tree, for they are adept climbers; if further disturbed, they will sometimes drop into the water, or to the mud and make off rather clumsily, for they are, as yet, unable to fly. Often

they will jump from one branch to another, making use of their wings as a support, also the head and neck by hooking it over a convenient branch. The most vigorous shaking of the tree will frequently fail to dislodge them, so strong are their feet.

The curious observer must ever be on the alert, when investigating the home life of herons, lest he receive an unwelcome "baptism", for when unduly provoked or even when only slightly disturbed, the birds regurgitate partly digested food. This action is not without its advantages, as it gives an insight into the contents of the stomach, knowledge which could not otherwise be obtained except by dissection.

Between the visits of the parent birds the nestlings loll about, preen their feathers, stretch their wings over their legs, or scratch their heads. Occasionally they utter soft croakings like "Toc-toc-toc" and rapidly vibrate the lower mandible and loose skin of the throat, especially if they are hungry. On espying the old bird approaching, they crowd to the edge of the nest in anticipation. The parent is not upset by their seeming hunger, and her movements are unhurried as she makes her way from branch to branch until the nest is reached. Immediately the importunate youngsters surround her and attempt to take hold of her bill. The actions and excitement of the young birds apparently stimulate the feeding instinct. Soon one of them will grasp her bill, which she turns and then quickly regurgitates a soufflé of partly digested fish or crustaceans. One bird I was handling, and whose age was thirteen days, ejected thirteen small fish, mostly mullet about an inch long, and a mangrove crab.

The food of very young birds appears to be given them in a partly digested or fluid state, but, as they grow older, it is more or less undigested and larger. On leaving the nesting-tree the young herons shelter in the mangroves for a month or more. Here they are fed by their parent and taught the art of fishing for a living. Probably with the first brood this instruction is done by one adult only, for the other bird is occupied with a second clutch of eggs. In January immature birds of the first brood, distinguished by their striped appearance, may be seen feeding in shallow water or among the pools left by the falling tide; but they are still awkward in their movements, lacking the skill of the older birds.

Adult birds are more in evidence during the breeding-season than at any other time of the year. It is then necessary for them to seek food for their young continuously during the day. When the cares of nesting are over they keep much to the mangroves or other sheltered places, and, except when the tides are suitable for feeding on the flats, are seldom seen.

A certain restlessness of spirit no doubt causes some of the Mangrove Herons to wander from their breeding haunts. This can scarcely be considered a migratory movement, for many birds remain in the one locality throughout the year. Mostly it is the young birds that move about. Some years ago, in the autumn and winter months, a few Mangrove Herons were to be observed under the old cargo wharf at Manly, which was certainly an unusual place to find them.

Mangroves, apart from the ever possible presence of Mangrove Herons, are much frequented by forest birds during the breeding-season. Here they find greater security from molestation than on dry land. Thus, despite the slight discomfort of squelching mud, sandflies, and mosquitoes, bird-lovers will find much to interest them in these unfrequented places. Moreover, there is about a patch of mangroves an atmosphere that becomes irresistible to those who realize the knowledge that can be gleaned from within its rather gloomy exterior.

Aboriginal Drawings of the Carnarvon Range, Queensland

By N. GEARY

THE Carnarvon Range is about one hundred and fifty miles north-west of Roma, Queensland, and rises to a height of about three thousand five hundred feet. Four rivers have their source in this range, namely, the Dawson and Comet, which flow into the Pacific Ocean, and the Maranoa and Warrego, tributaries of the Darling. I have recently made a trip through the little-known portion of this range, parts which are seldom visited except by people living on stations in the vicinity, for there are no roads, only bridle tracks.

The head stockman of Mount Moffat Station very kindly offered to take me to several caves and aboriginal burying places, and, thanks to his skilled bushmanship, I was able to visit most of the places in my utility truck, although some had to be reached on foot.

Most of the high peaks are composed of basalt, and the intervening country is comparatively flat or undulating, with sandstone bluffs rising abruptly to heights of four to five hundred feet. Some of these bluffs may be as much as a mile in circumference at the base, others only a few hundred yards. It is in these sandstone mesas that the caves have been formed by weathering, and it is there that the drawings are found.

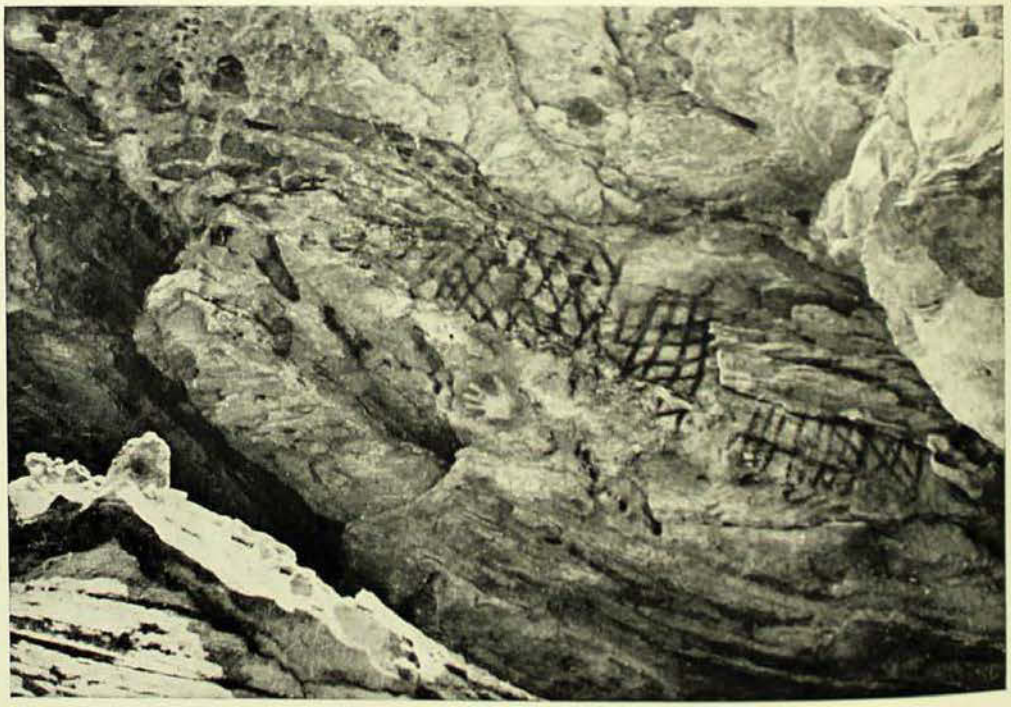
Strictly speaking, they are not drawings in every case, but silhouettes of hands, feet, or other objects, which are placed on the rock and outlined by means of blowing a powder on to the surrounding surface. In parts of the mountains there are to be found round stones which look like ironstone. When these are split they are found to contain a very fine powder, usually red or pink in colour, but sometimes yellow. This ochreous powder is mixed with saliva in the mouth and then projected on to the rock surface, against which a hand, for example, has been placed with the fingers outspread.

I am sorry to say that I was unable to find any aboriginal remains, for these had been removed and destroyed. The sandstone outcrop known as "The Tombs" had perhaps a hundred burial holes, but now these are all empty. These holes are formed naturally in the faces of cliffs or in cave walls; some are quite cylindrical in shape, and may extend ten or twelve feet into the rock. The diameter of the openings varies from eighteen inches to three feet. A number of these holes still contained the sticks on which the bodies had been laid, and by the look of them they might have been there for centuries. Apparently the same kind of wood was always used. It is from a tree which grows in the neighbourhood, and is called by the aborigines *boogooroo*; its timber is very hard and durable. The bodies were always wrapped in the bark of this tree, bound tightly in the usual crouching posture by cords made from human hair; I found portions of this cord in the burial holes. The pieces of wood had been cut into lengths by the use of fire, a much easier method than the employment of stone tomahawks.

The objects depicted are various. In one instance a whole human figure was outlined, but it was too weather-worn to be reproduced in a photograph. Many weapons are shown and the feet of various animals; in one photograph a pair of kangaroo's feet is shown, along with human hands, and at the entrance to one of the caves is what appears to be portion of a fishing net. On portion of a sandstone wall are grooves indicating where the aborigines sharpened their axes.

Silhouettes of aboriginal hands and implements, Carnarvon Range, Queensland.

Photo.—N. Geary.



Aboriginal design, Carnarvon Range, Queensland.

Photo.—N. Geary.

Australian Shells

Mitres

By JOYCE ALLAN

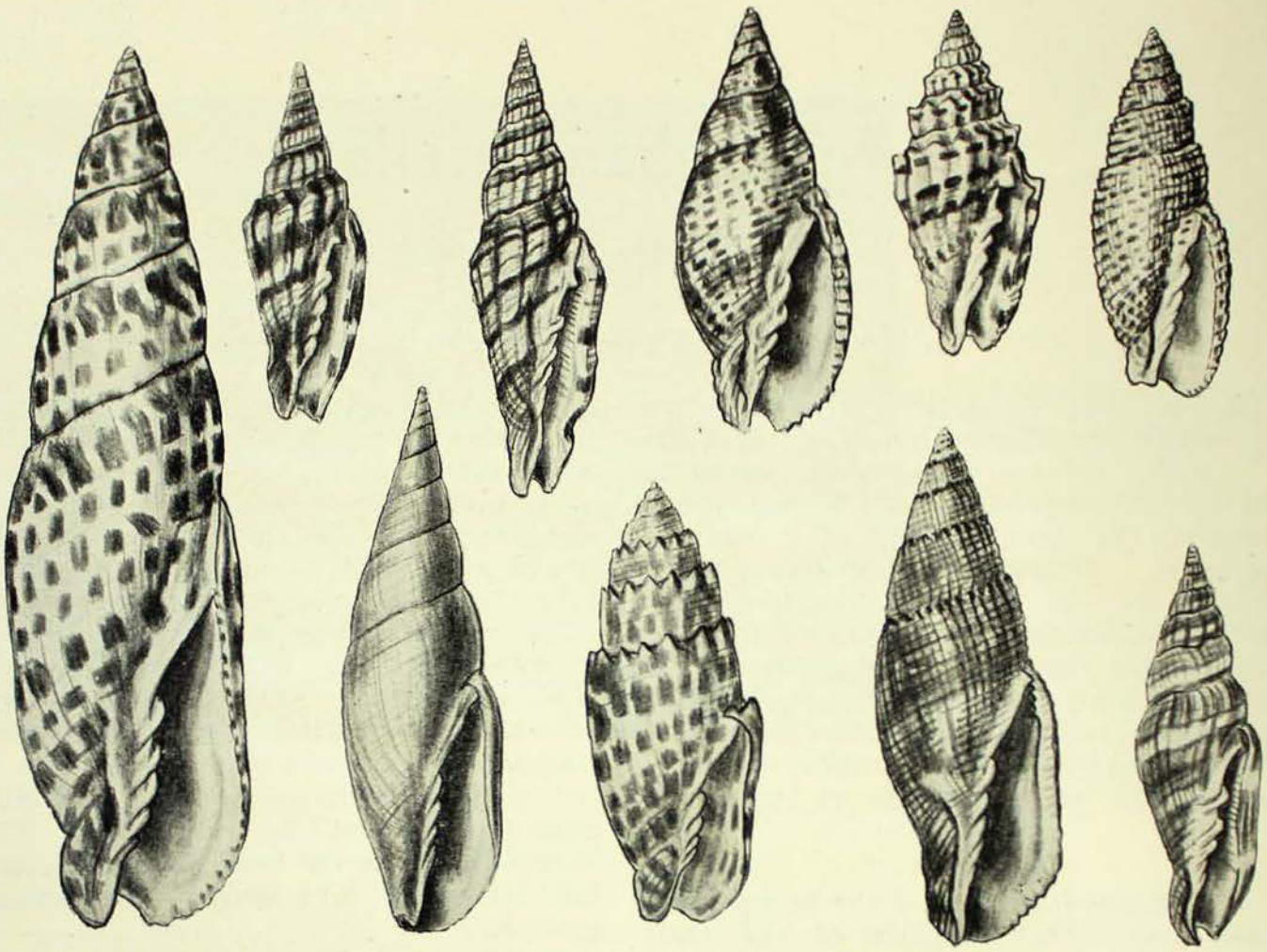
IN the previous article on Australian shells, an illustration of a whelk-like shell, *Volema cochlidium*, appeared on the first page of the article, but unfortunately the short account of it was not included. Briefly, this species, which belongs to the family Volemidae, is a very solid Northern Territory shell about four inches long and distinguished by a row of strong nodules round each whorl just below the suture. Mr. Melbourne Ward recently found numbers living together in the mangroves at Darwin.

MITRES.

The Mitres form one of the largest and most ornamental families of the shell world. There are many hundreds of different species scattered throughout tropical and subtropical waters, those living in the warmest waters being naturally the most brilliantly coloured. Many beautiful forms are found in tropical America, and they abound in the Indo-Pacific and in tropical Australia, especially along the Great Barrier Reef; only a few species are found in colder waters. The Mitres inhabit various stations and various depths. They may be strictly reef shells, hiding in holes and crevices under seaweeds or concealed under stones and dead coral, or may burrow in sand or sandy mud. The combination of colour, pattern and complex sculpture in many of them makes them favourite specimens for a collection. Owing to the fact that, when present, the epidermis on the outer surface of the shell is very thin, smooth and transparent, enabling this ornamentation to be well displayed, the Mitres make striking members of a coral reef fauna. The stream-lined shape of the shells and the series of plaits along the columella make identification, as far as family goes, a simple matter. It is said by some observers that the small longitudinally ribbed species crawl about fairly briskly over the sands, some covering themselves entirely with sandy mud, the disguised condition enabling them to move freely with comparative safety, while others, the heavier shelled forms, are very sluggish. Observers also state that if irritated some members of the family emit a strong smelling purple fluid. The Mitres belong to the family Mitridae, and fall naturally into several well-defined groups.

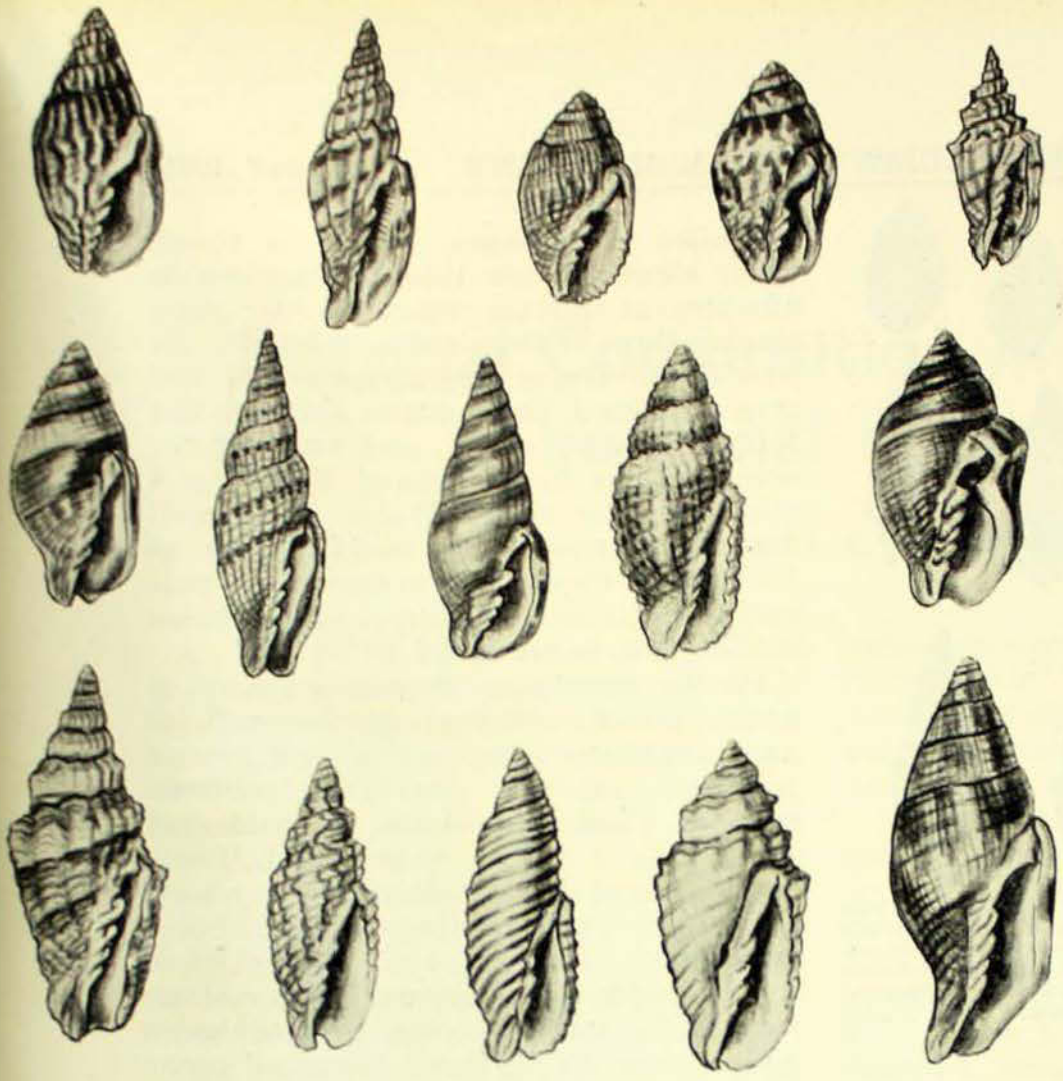
The most striking and best known are the orange-red spotted members of a small group common throughout the Indo-Pacific. They are the typical Mitre forms, and the two figured here are *Mitra mitra*, the largest Mitre in the family, sometimes reaching six inches long, and a smaller species, *Mitra pontificalis*, of the same colour and about half the size, but having a row of spines round each whorl just below the suture. The animal of this species is a beautiful creamy-white with opaque white dots. A third species, *Mitra papilis*, falls between these two. It is almost the size of *Mitra mitra*, but the coloured markings are deep scarlet as a rule and arranged not so much as square blotches, but as longitudinal marbling in revolving bands. It has the spines, though not so pronounced, of *Mitra pontificalis*, and is not so common as *Mitra mitra*.

Another group includes species characterized by brilliantly coloured bands of contrasting shades. They are slender,



Mitre shells. The large, well-known species on the left is Mitra mitra, and following it in the top row are Vexillum vulpecula, Vexillum taeniata, Nebularia cardinalis, Vexillum plicaria, and Scabricola sphaerulata; in the bottom row are Vicimitra contermina, Mitra pontificalis, Chrysame adusta, and Vexillum caffra.

graceful shells with longitudinal ribbing, none of them reaching more than three inches long, and, in common with the previous group, occur throughout the Indo-Pacific, some of them coming into northern Australia, especially along the Great Barrier Reef. These have been placed in the genus *Vexillum,* and the species can be separated with comparative ease as the markings or other characteristics common to each are generally constant. As this is a large group, only a few of the better known ones have been figured here. These briefly are: *Vexillum vulpecula,* an orange shell with brown bands and angulated shoulders, and a more elongated, slender, yellow species, *Vexillum taeniata,* about two and and a half inches long, with gracefully curving longitudinal ribs and broad white bands of colour on each whorl, with chocolate bands above and below these and a thread-like line in the centre of each one. There are several species about one and a half inches long, of which *Vexillum plicaria* has chocolate coloured bands on a white ground and a brown apex; *Vexillum caffra* is dark brown with two yellow bands on the body whorl and one on each remaining whorl; and *Vexillum intermedia,* a white and chocolate brown shell, has conspicuous cross sculpture as well as longitudinal ribbing. These all occur in Queensland as well as islands of the South Pacific. Others of this genus are *Vexillum lyrata,* a small white shell with thread-like longitudinal ribbing crossed by brown narrow bands, and *Vexillum gruneri,* only a little over an inch long, like a nodulose form of *lyrata,* with narrow brown bands on a white ground. A number of these



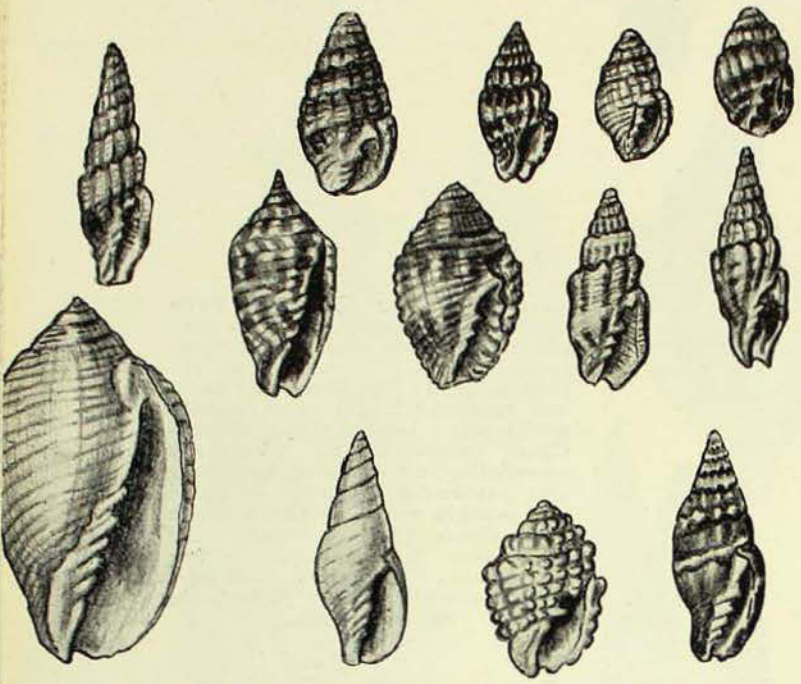
Some smaller Mitres. Five species, Strigatella paupercula, Vexillum lyrata, Strigatella retusa, Strigatella litterata and Vexillum gruneri are in the top row, while Strigatella scutulata, Pulchritima stigmataria, Vicimitra australis, Chrysame lugubris and Strigatella limbifera form the middle row. In the bottom row from left to right are Vexillum intermedia, Mitra variegata, Cancilla filiaris, Mitra sophiae, and Nebularia chrysostoma.

species have strongly marked plications inside the mouth of the shells.

There is a South Pacific and Queensland species about the same size as the previous ones, *Scabricola sphaerulata*, with brown spotted granulose sculpture and an orange mouth; another more swollen, smooth, white species, *Nebularia cardinalis*, characterized by its encircling rows of chestnut-red spots, and *Nebularia chrysostoma*, which is found also in north Australia; two slender, ribbed forms, *Pulchritima militaris*, which has a broad brown band round the base of the body whorl, and *Pulchritima stigmataria*, a striking, yellow-ash coloured shell with two rows of scarlet spots tipping the ribs.

Brown, yellow and white predominate in the colouring of many of the smaller species of Mitres—those about an inch long—and there should be no difficulty in identifying those figured here. *Strigatella paupercula* is chocolate coloured with well-defined, longitudinal yellow-white lines; *Strigatella retusa* is a more dumpy shell, with finer longitudinal lines and a narrow light coloured revolving line; *Strigatella litterata* has its brown body colour broken up by white-yellow revolving bands and hieroglyphic markings, and the two remaining species of this group of small shells, *Strigatella limbifera*, the outer lip of which acquires in the adult stage a peculiar tooth-like thickness and the white patches are replaced by a more or less regular band, and *Strigatella scutulata*, in which, although the colour marking is variable, it is more often formed of a yellow-white band on a dark brown background just below the sutures and a few scattered white spots on the lower part of the body whorl. These small shells are found at half tides in crevices of coral boulders on reefs, in similar positions to those occupied by small reef-living Purpura shells. This is in strong contrast to the sand-living habits of the long, slender, ribbed Mitres. Species of the genus *Strigatella* so far found in Queensland waters are *retusa* and *scabricula*.

Mitres of rather unusual appearance are *Chrysame lugubris*, a solid shell punctured with striae and cross lines, with a broad chestnut band above the sutures and forming most of the body-



Small Mitres. The five species in the top row are Pulchritima militaris, Pusia aureolata, Pusia discoloria, Pusia amabilis and Pusia dichroa: in the middle row, Imbricaria conica, Chrysame cucumerina, Arenimitra michaelis, and Costellaria intertaeniata, and in the bottom row, the large Cylindromitra crenulata, Mitra rosettae, Pusia nodosa and Pusia microzonalis.

whorl colour; *Mitra variegata,* with longitudinal, wavy orange-brown lines; *Cancilla filiaris,* with elevated narrow beaded ridges; a coarse white, nodulose, ridged shell, *Mitra sophiae*; and a solid, orange-red, white-blotched species, *Chrysame cucumerina.*

With the exception of a few southern Australian shells, *Vicimitra australis* from Victoria, South Australia and Tasmania, *Vicimitra badia,* which occurs in Victoria and South Australia, a South Australian species, *Mitra rosettae,* and the common large Sydney Mitre, *Vicimitra contermina,* formerly known as *Mitra carbonaria,* the remaining Mitres figured in this article are South Pacific forms and all small, other than *Chrysame adusta,* which is about two and a half inches long. The southern Australian species conform somewhat to the same brown polished, almost smooth appearance, relieved in some by lighter banding and very faint, striated sculpture. These species all have white animals which make a strong contrast to the rich brown shells. Two species, *australis* and *badia,* an unfigured species, are about one and a half inches long, and the Sydney one, *Vicimitra contermina,* which is found under stones at low tide in considerable numbers at certain times of the year, reaches three or four inches in length. In New South Wales several species of this type are found, the common northern one being *Vicimitra cookii,* and amongst the several forms found around Sydney and southern New South Wales is a small dark brown species like *cookii,* known as *Vicimitra rhodia.* Occasionally pale yellow shells and sometimes albino forms of these Mitres are found.

Of the remaining Mitres, a group of small, ribbed, nodulose species includes an orange-brown and white form, *Pusia aureolata,* another similarly coloured species, *Pusia discoloria,* a pink-grey shell with a broad white band, *Pusia amabilis,* and *Pusia dichroa,* a tiny shell elaborately banded with white and black or brown. There is also a very small white species in this genus, *Pusia nodosa,* remarkable for the conspicuous tubercles which cover its surface. These all occur in the South Pacific islands, as also does *Pusia microzonias,* and *amabilis* and *dichroa* have been found in Queensland as well. One of the prettiest of the small Mitres found in the South Pacific is *Arenimitra michaelis,* a white species with its ribs crossed or tipped with two bands of chocolate, and another is *Costellaria intertaeniata* with narrow chestnut bands on an ash coloured ground. The members of this group only measure a half to an inch in length.

Two other members of the family Mitridae dealt with in this article are *Cylindromitra crenulata,* a north Australian and South Pacific island shell, which belongs to a genus resembling more in its teeth and shape a large Margin shell than a Mitre, and a very pretty, small species with a similar distribution, *Imbricaria conica.* The former, a white shell about two inches long, with wavy clouds of chestnut-brown, can be easily recognized by its impressed revolving pitted lines, and the latter, an inch high shell, yellow-ash in colour, by the equidistant narrow brown lines encircling it and rectangular white spots mottling the body colour.

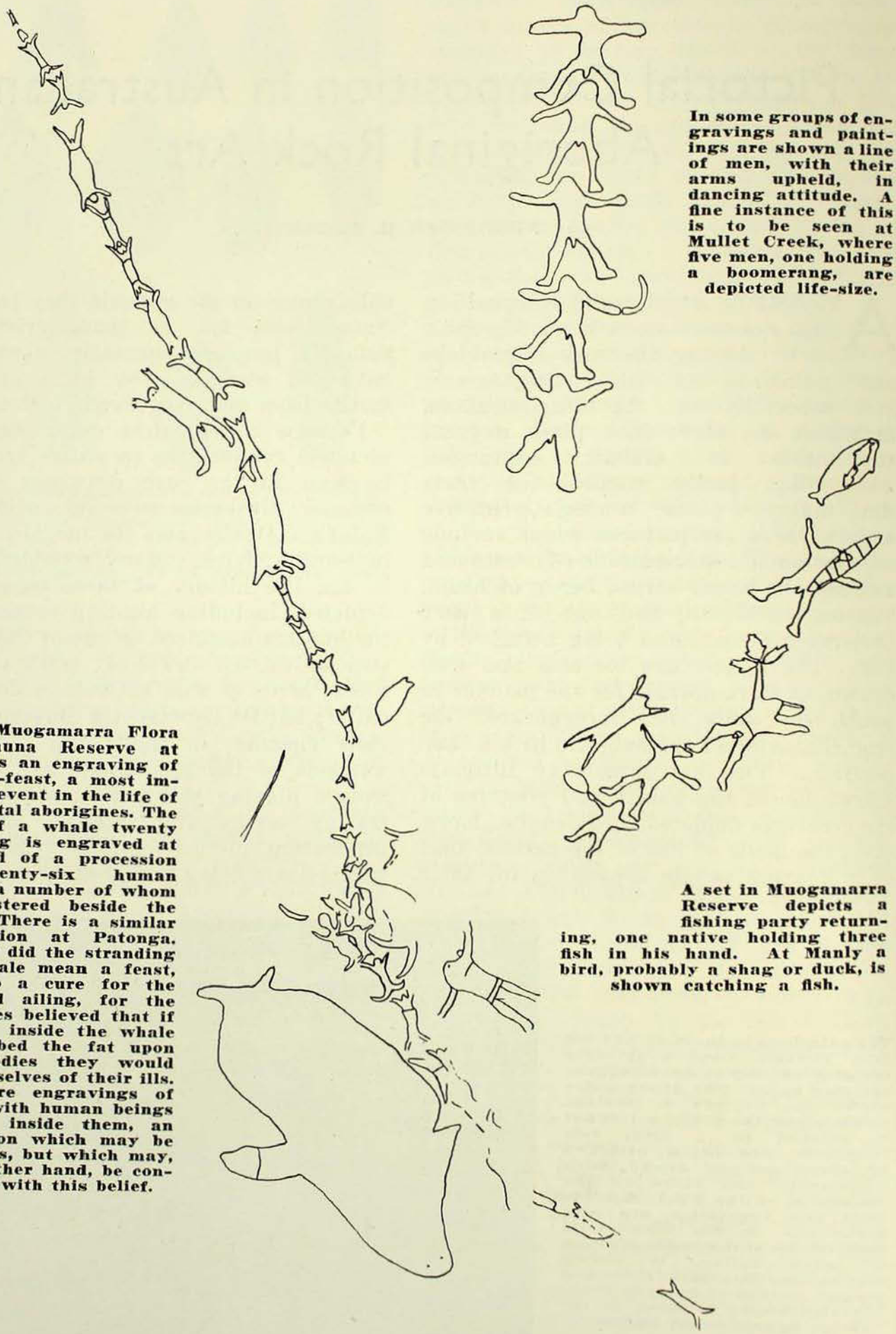
Pictorial Composition in Australian Aboriginal Rock Art

By FREDERICK D. McCARTHY

ATTEMPTS at pictorial composition are not uncommon in pictographic art. Among the rock engravings and paintings of the Aurignacians, and especially of the Magdalenians, in which era there took place a great stimulation in artistic expression which has justly earned for them the highest place among primitive artists, there are pictures which include impressionistic delineations of horses and antelope in linear series, herds of bison, hunting incidents, and one of a deer crossing a stream and being attacked by fish. The figures are forceful and well drawn, and are notable for the manner in which the artist has incorporated the true character of the subjects in his composition. This art reveals an intimate knowledge of the habits and postures of the creatures depicted, and denotes, moreover, the mode of life of the artists, that of a hunting people depending for their subsistence on the animals they portray. Naturalistic art is characteristic of nomadic peoples, especially when they have not absorbed new ideas and art motifs from more advanced communities.

Perhaps the greatest development of pictorial composition in native art is to be seen in the cave drawings of the nomadic Bushmen now inhabiting the Kalahari Desert and its neighbourhood in South Africa. Many notable events in the life history of these people are depicted, including hunting scenes with the hunters disguised as one of the game, such as ostrich and deer; cattle-stealing raids; herds of wild animals or domestic cattle; battles between the Bushmen and their enemies, in which the respective weapons of the combatants are shown; women playing ball games; scenes illustrating myths and legends, and one interesting picture of this type shows wrong-doers being punished by a culture

The paintings in the cave at Glen Isla, Victoria, form a splendid composition depicting kangaroo and emu hunts. The upper series shows the beaters at various points along the route, a lookout is perched in a tree, two kangaroos are being attacked by three natives armed with boomerangs and clubs as the conclusion of the hunt, and the trees and vegetation are also portrayed. In the lower left-hand corner of the series a group of seven natives is shown chasing emu into an enclosure, a popular method of hunting them. The significance of some of the large figures is not known.

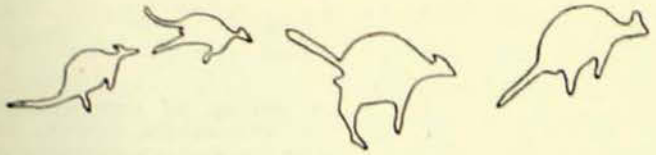


In some groups of engravings and paintings are shown a line of men, with their arms upheld, in dancing attitude. A fine instance of this is to be seen at Mullet Creek, where five men, one holding a boomerang, are depicted life-size.

In the Muogamarra Flora and Fauna Reserve at Cowan is an engraving of a whale-feast, a most important event in the life of the coastal aborigines. The figure of a whale twenty feet long is engraved at the head of a procession of twenty-six human figures, a number of whom are clustered beside the whale. There is a similar composition at Patonga. Not only did the stranding of a whale mean a feast, but also a cure for the sick and ailing, for the aborigines believed that if they sat inside the whale and rubbed the fat upon their bodies they would rid themselves of their ills. There are engravings of whales with human beings depicted inside them, an association which may be fortuitous, but which may, on the other hand, be connected with this belief.

A set in Muogamarra Reserve depicts a fishing party returning, one native holding three fish in his hand. At Manly a bird, probably a shag or duck, is shown catching a fish.

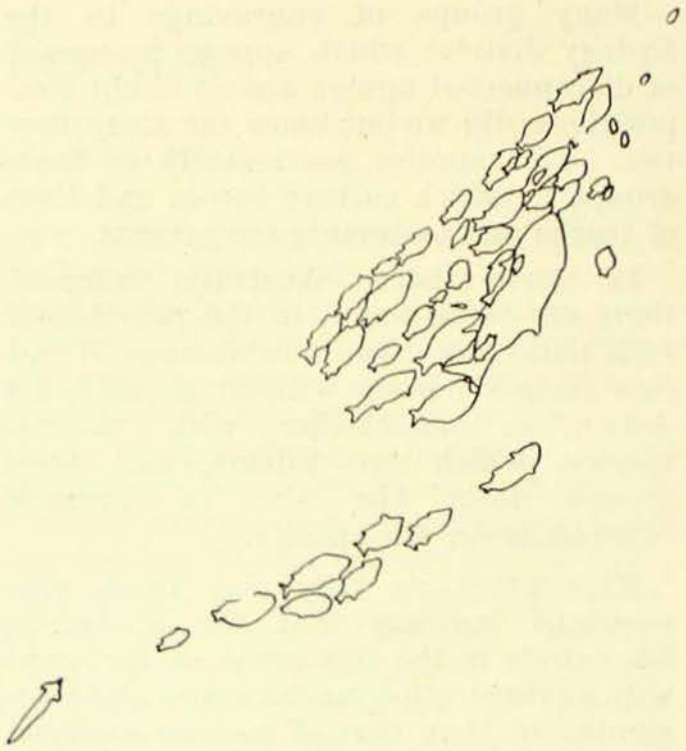
hero, who transforms them into frogs; even the coming of the Europeans on their horses is shown in the invaluable records of these primitive food-gatherers, a mode of life which forms the dominating inspiration in their art.



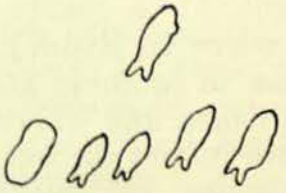
The natives were most skilful in drawing kangaroos, which they often show in line or in small groups as though feeding.

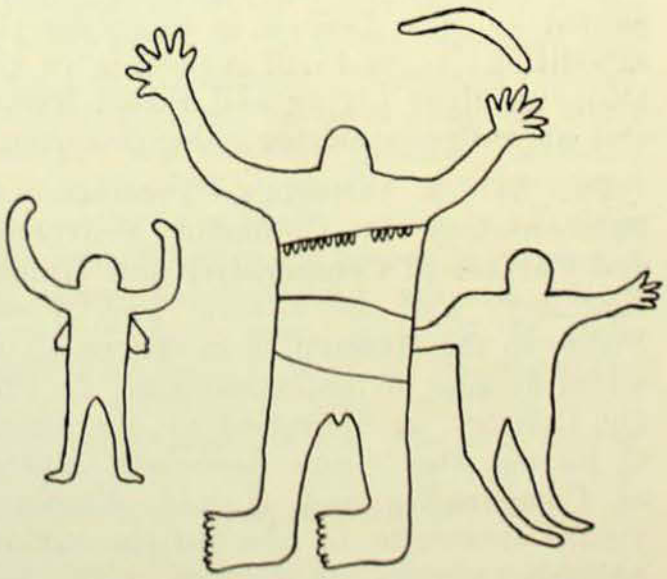
Primitive hunting peoples perform magico-religious rites, in which the paintings and engravings play an important part, by which they seek to attain such a control over the living animals that they will be ensured of the success of their hunting. Thus art becomes an important medium in their secret and ritual life, and their aesthetic impulse finds inspiration in their economic life.

In Australia there is a number of examples of pictorial composition in the extensive series of rock paintings and engravings in many parts of the continent, and a selection of these is shown in the illustrations.

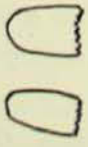


Fish, too, are frequently engraved in a line as they swim along, and one fine set illustrates a school of fish with a shark among them.





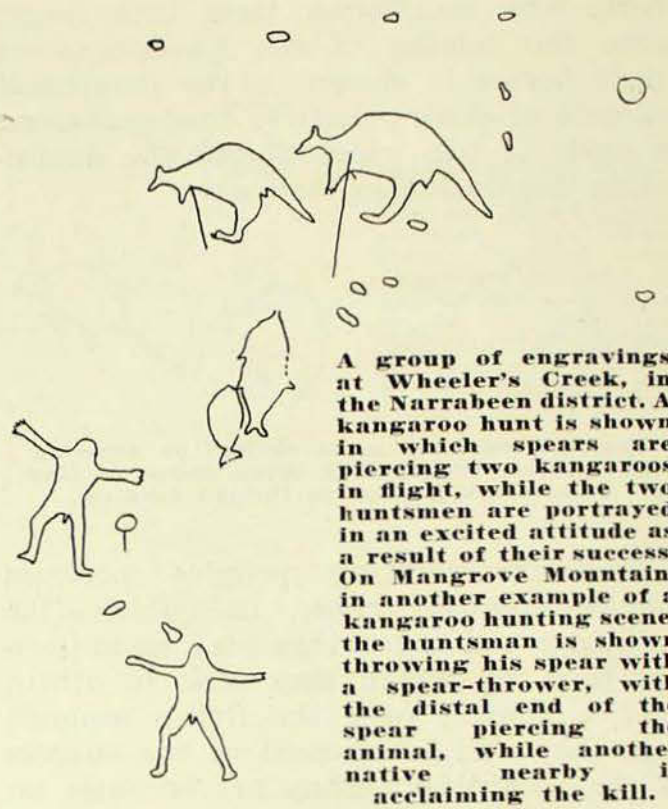
A group of engravings at Mount Kuringai consisting of a culture-hero holding a boomerang, his wife and probably his brother or son, at the end of a long series of human footprints. The set of fish above indicates that this was a site at which totemic increase ceremonies for the species were carried out, as depicted by the Wandjina paintings of the Kimberleys in which the association of culture-hero and totemic species is characteristic.



Many groups of engravings in the Sydney district which appear to consist of disconnected figures are no doubt compositions, did we but know the story they tell. This applies particularly to those groups in which culture heroes and lines of tracks and footprints are present.

In north-western Australia compositions are to be found in the polychrome rock paintings. The now famous *Wandjina* culture heroes, without mouths, are drawn in association with natural species, which are totems, and these groups form the site of increase ceremonies for the species.

Elementary as they are, these compositions indicate that the aborigines are artists in the true sense of the word, with an inspiration much greater and more significant than that of modern children, with whose drawings their art has been compared.



A group of engravings at Wheeler's Creek, in the Narrabeen district. A kangaroo hunt is shown in which spears are piercing two kangaroos in flight, while the two huntsmen are portrayed in an excited attitude as a result of their success. On Mangrove Mountain, in another example of a kangaroo hunting scene, the huntsman is shown throwing his spear with a spear-thrower, with the distal end of the spear piercing the animal, while another native nearby is acclaiming the kill.

On April 17 a party of American visitors arrived in Sydney with the twofold purpose of catching and studying our big game fishes and of obtaining photographs and material for a number of habitat groups in the proposed Australian Hall in the American Museum of Natural History, New York.

Mr. Michael Lerner, who is accompanied by Mrs. Lerner, is financing the expedition; he is Field Associate in the Department of Living and Fossil Fishes and an enthusiastic big game fisherman.

Dr. W. K. Gregory, Professor of Palaeontology in Columbia University and Curator of Comparative and Human Anatomy, and of Living and Fossil Fishes in the Museum, is in charge of the scientific side of the expedition. In 1921 Dr. Gregory, accompanied by Mr. Harry C. Raven, who is now Associate Curator of Comparative and Human Anatomy, visited Australia to procure the various animals required for display in the Australian Hall. Mr. Raven spent about two years here and collected fauna in several States of the Commonwealth. During his present stay in Australia, Mr. Raven will visit his old collecting sites in order to obtain photographs and cinema pictures, as well as trees, shrubs, rocks, soil and other accessories necessary in the construction of realistic displays of the animal life of Australia.

Mr. G. Miles Conrad, Assistant Curator in the Department of Living and Fossil Fishes, will devote himself specially to making scientific studies of big game fishes. Other members of the party are Mr. L. Ferraglio, who will make sketches and colour notes and prepare casts of some of the larger fishes, Captain Bill Hatch, in charge and fishing equipment, and Messrs. Shackelford and Ramsey, who will make motion and still pictures illustrating the activities of the party.

As on his previous visit, Mr. Raven has made the Australian Museum his headquarters while in Sydney.

Living Fossils

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

EVERY day myriads of animals die and "the place thereof shall know them no more". But we do not, therefore, speak of them as extinct, for in most cases there are still plenty of survivors of the same sort. It is only when all representatives of a certain *kind* of animal have disappeared as living forms, when the very pattern, as it were, is lost, that we regard the particular species or group as extinct. Everyone knows that the dodo, the Great Auk, the Passenger Pigeon have vanished, and that other kinds of animals, including our own Native Bear and some other Australian marsupials, are fighting a losing battle to maintain themselves.

In the millions of years since life began and the great battle for self-preservation commenced, many of the contestants have fallen by the wayside. And extinction is not confined to species (the smallest units of classification), for many genera (some containing several species), and the larger groups, such as families and orders, have wholly ceased to be, and the only evidence of their former existence is the often scanty remains of their bones or other hard parts, or perhaps mere footprints or impressions that we find in the rocks of the earth's crust and call fossils. Indeed, if we glance at a comprehensive list in which the various living and extinct animals are classified, we shall be struck by the frequent appearance of the fatal "dagger" which indicates that a particular group has no living representative. Thus there are now but four orders of reptiles, but extinct orders number over a dozen, including such striking and once powerful groups as the land-living dinosaurs, the flying pterosaurs, and the marine ichthyosaurs and plesiosaurs.

SURVIVALS.

Yet there are certain conservative animals that have been able to hold their own through all the vicissitudes of geological time, and remain to astonish us with their ability to adjust themselves triumphantly to ever-changing conditions. Perhaps the most striking instance of a persistent type is provided by the Lamp-shell (brachiopod), *Lingula*, which existed in Ordovician times, perhaps five hundred million years ago,[1] and has left descendants in the warmer seas of today that differ but little from their Ordovician ancestors. Another striking "relict" form is the King-Crab (*Limulus*), the sole living relative of aquatic ancestors which probably gave rise to the spiders and scorpions of today. Yet the King-Crab has become so well adapted to modern conditions that on some parts of the American coast it is so abundant that it is used as a fertilizer. What a sordid fate for one of our most ancient forms of life!

Animals which still survive while all or most of their kindred have disappeared have been aptly termed *living fossils*; and in this article some striking examples are instanced.

SOME AUSTRALIAN LIVING FOSSILS.

Australia has its fair share of archaic forms of life, which linger on here whilst in other parts of the world they have long since become extinct. Australia, indeed, is often referred to as a land of living fossils. We are not justified, however, in speaking of Australia as the oldest continent; as a continent it is no older than others, but it has become a sanctuary for some old-fashioned animals which elsewhere have been replaced by more modern forms. This is to be accounted for by Australia's long isolation from other large land masses; the intervening sea prevented the entry of the higher forms, better equipped for the battle of

[1] See Hodge-Smith: "Radium and the Age of the Earth", AUSTR. MUS. MAG., Vol. v, 1924, p. 136.

life, which would have been serious competitors for the more primitive types which had reached Australia before the connection with other lands was broken.

The Platypus and Spiny Anteater of Australia[2] are today the only surviving members of the primitive mammalian group which had the reptilian habit of laying eggs. Yet these two monotremes, as they are called, are true mammals, for they have the characteristic hairy covering and nourish their young on milk. No monotremes, living or fossil, have yet been found elsewhere than in the Australian region (including New Guinea), and the comparatively recent fossil remains found here throw no light on their evolutionary history, for they indicate that the extinct monotremes differed in no essential character from those now living. These enigmatical creatures, which in certain details of structure and habit show an affinity with reptiles, are undoubtedly descended from very ancient mammal-like reptiles which date from the Triassic period, over one hundred million years ago, or even from the still older Permian.

Marsupials, too, are primitive mammals which may well be called living fossils. They have advanced beyond the egg-laying stage, but, as everyone knows, the young marsupial is born in an immature and helpless condition, a tiny creature which during its first weeks of existence must be sheltered in its mother's pouch and forcibly fed. But marsupials, unlike monotremes, are not confined to Australia, for they are still found in America, and in past geological ages they existed in Europe as well. The living American opossum, which is of very ancient lineage, is regarded as the prototype from which all existing, including Australian, forms have descended, and here again Australia's isolation has not only preserved for us these primitive animals, but allowed them to evolve into the many diverse forms that exist here today.

Another example of survival into comparatively recent times in the Australasian region is the curious horned turtle *Meiolania*.[3] It was first found fossil in the Pleistocene of Queensland, that is, in the geological period immediately preceding our own era; remains of a related species were subsequently described from Lord Howe Island, and fragments of a similar creature have been found in New South Wales and on Walpole Island, near New Caledonia. It would seem, therefore, that this peculiar family of turtles was fairly widely spread in Australia and neighbouring islands, and an interesting fact is that two related forms have been found in Patagonia. But the South American forms are found in Eocene rocks, and are therefore forty or fifty million years old, while the Australasian Meiolanian turtles are no older than a mere million years or so, though none has survived to the present time.

ANCIENT FISHES.

Of the oldest true fishes there were two important groups, the Lung-fishes (Dipnoi) and the Fringe-finned or Lobate-finned Ganoids (Crossopterygii), which lived together in the waters of the Devonian period, approximately two hundred and fifty millions years ago, when fishes were so abundant that the Devonian is often referred to as the Age of Fishes. The Dipnoi and Crossopterygii dwindled throughout the succeeding ages, but, strange to say, both are still represented by living species. Of the dipnoans we have extant *Lepidosiren* of South America, *Protopterus* of Africa and the Queensland Lung-fish, *Neoceratodus*; these are all freshwater forms, and their peculiar distribution indicates the great geological age of the order and its former wide dispersal. The Queensland Lung-fish is now confined to the Mary and Burnett Rivers, but as long ago as the Triassic period it had close relatives in many lands. A hundred years ago the celebrated naturalist Louis Agassiz described some teeth from Triassic rocks in the neighbourhood of Bristol, England. He gave them the name *Ceratodus*, and

[2] Troughton: AUSTR. MUS. MAG., iv, 1932, pp. 327-334.

[3] Anderson: AUSTR. MUS. MAG., ii, 1926, pp. 360-362.

compared them with the teeth of the Port Jackson shark. In 1870 Gerard Krefft, then Curator of the Australian Museum, received two specimens of the so-called Burnett Salmon, and, to his amazement, he found that these had teeth very similar to those described by Agassiz. But he also recognized that the "salmon" was kindred to *Lepidosiren* and *Protopterus*, and therefore a dipnoan, to which he gave the name *Ceratodus forsteri*,[4] in honour of the gentleman who had brought the fish under his notice. It is not, however, known by that name today, for it is considered to differ somewhat from its Triassic ancestors and is now called *Neoceratodus*. It is, nevertheless, a close relative of the Triassic genus, and is to be regarded as the but little modified descendant of a genus of fishes which lived in various parts of the world over one hundred million years ago, and a member of an order that had its heyday in the Devonian.

Quite recently a remarkable discovery of a living fossil has been announced from South Africa; particulars of this discovery have been received by Mr. H. S. Grant, of this Museum, from Mr. W. A. Sargent, of East London. In December of last year a trawling vessel, working off East London, made a haul of fishes in forty fathoms, and among them was a strange looking specimen, five feet in length and of a steel-blue colour. This presented such peculiar features that it was quickly recognized to be of extraordinary interest. It had a cartilaginous skeleton, its head and jaws carried bony plates, and its fins were lobate or paddle-shaped. Its scales were large and covered with an enamel-like substance known as ganoine, characteristic of primitive fishes. Dr. J. L. B. Smith, a well-known South African ichthyologist, pronounces it to be undoubtedly a Crossopterygian fish, and therefore a member of a group which, like the Dipnoi, culminated in Devonian times and decreased in importance in succeeding periods. The Crossopterygian fishes, which, until this recent discovery, were believed to have become extinct in the Cretaceous, fifty million years ago, are extremely interesting to students of evolution, if only because their paired fins contain elements which foreshadow the parts which form the limbs of four-footed animals. It is probable that these paddle-like fins could serve as limbs for occasional slow progress on land. There is evidence, too, that, like their contemporaries, the Dipnoi, these ancient fishes could gulp air, so that we have in this interesting survival a living link with the earliest vertebrates which attempted to invade the land. Readers will be interested to hear that some scales of this remarkable fish are on view in the Australian Museum.

Another archaic fish still abundant in Australian waters is the Port Jackson Shark (*Heterodontus*). This belongs to a family that was once strongly represented in many parts of the world, but is now almost extinct except in Australian seas.

FRESHWATER CRUSTACEANS.

For more than seventy years small shrimp-like creatures of peculiar structure have been known from the Carboniferous and Permian rocks of Europe and America. These have been relegated to a special division, Syncarida, of the Crustacea, distinguished among other things by the absence of a carapace. In 1894, Mr. G. M. Thomson, of Dunedin, New Zealand, described a "shrimp" from Mount Wellington, Tasmania, under the name *Anaspides tasmaniae*, but he did not then realize its great significance. In 1906, Dr. W. T. Calman, of the British Museum, recognized in the "Mountain Shrimp" of Tasmania a surviving member of the Syncarida. Three years later Dr. Calman showed that a minute crustacean called *Bathynella*, which had been known as far back as 1880 from the water of a deep well in Bohemia, is also a Syncarid, and since then other living representatives of this ancient group have been discovered in Europe, the Malay Peninsula, Victoria, and Tasmania. This wide and discontinuous distribution is again proof of great geological age.

[4] Whitley: AUSTR. MUS. MAG., iii, 1927, pp. 50-52; 1929, pp. 363-364.

The late Professor Charles Chilton, of Canterbury College, New Zealand, to whom and to Professor G. E. Nicholls, University of Western Australia, we owe much of our knowledge of the smaller freshwater crustacea of Australia, described a fossil Syncarid from the Triassic beds at Brookvale, near Sydney. To this he gave the tentative name *Anaspides antiquus*.[5] This is, so far as I know, the only specimen which bridges the immense interval of some hundreds of millions of years separating the Carboniferous and Permian Anaspidacea from those living today.

In 1882 Professor Chilton described under the name *Phreatoicus* a blind crustacean found in wells in Canterbury, New Zealand. Since that date several members of the Phreatoicidae, a family belonging to the order Isopoda, a group to which the familiar pill bug or "slater" belongs, have been described from various localities in Australia and New Zealand, and one species was discovered on the top of Table Mountain, South Africa. But the most interesting discovery is that made by the late Dr. R. J. Tillyard, who in 1916 recognized as a phreatoicid several specimens from the Triassic shales of St. Peters, near Sydney. These have been described by Dr. Chilton as *Preatoicus wianamattensis*,[6] and he considered that it differs but slightly from the living form. Here again we have an instance of an apparent gap of over a hundred million years between members of the same family of animals. There must, however, have been a continuous chain of descendants from the Triassic to the present day.

THE STORY OF TRIGONIA.

A pearly bivalve shell called *Trigonia* is commonly met with as a fossil in Mesozoic rocks (Triassic to Cretaceous) in various parts of the world. It was regarded as extinct until, in 1802, Péron, naturalist on the French exploring vessel *Géographe*, found a dead valve on the beach at King Island Bass Strait. Later, Quoy and Gaimard, of the French vessel *Uranie*, discovered living specimens in southern Tasmania. The *Uranie* was wrecked on the Falkland Islands in 1820, and it is related that Quoy risked his life in returning to his cabin to salvage these precious specimens. He declared that he would rather be drowned than return to France without his *Trigonia*.

This living fossil still exists in Port Jackson, where it was first discovered by Samuel Stutchbury, once a Trustee of the Australian Museum. He had dredged up three specimens, which he placed on a seat of the boat. Having allowed his attention to wander, he heard an ominous click, followed by another, and to his chagrin he found that two of the active little creatures had hopped overboard, and presently the third followed suit—and many days elapsed before another was captured.

A NEW ZEALAND EXAMPLE.

New Zealand is still more isolated than Australia, and not even the marsupials were able to make their way into these tight little islands. It is not surprising, therefore, that the Dominion has its living fossils. The most interesting of these and one that is but little inferior in importance to our monotremes, is the tuatara (*Sphenodon*), a lizard-like reptile belonging to an order, the Rhynchocephalia, totally extinct elsewhere since the Eocene. The rhynchocephalians attained their maximum development in the Triassic, and since then the order has dwindled, leaving but one survivor on some small islands off the New Zealand coast, although it formerly inhabited the mainland as well. It is frequently called a lizard and resembles lizards externally, but it is in actual fact not closely related to any living order of reptiles. Its skull has features which recall the crocodiles and even the tortoises, and by some it is considered to come nearest to the primitive reptiles from which all others take their origin.

[5] Chilton: *Journ. Roy. Soc. of N. S. Wales*, lxii, 1928, pp. 366-8.

[6] Chilton: *Journ. Roy. Soc. N. S. Wales*, li, 1917, pp. 365-385.

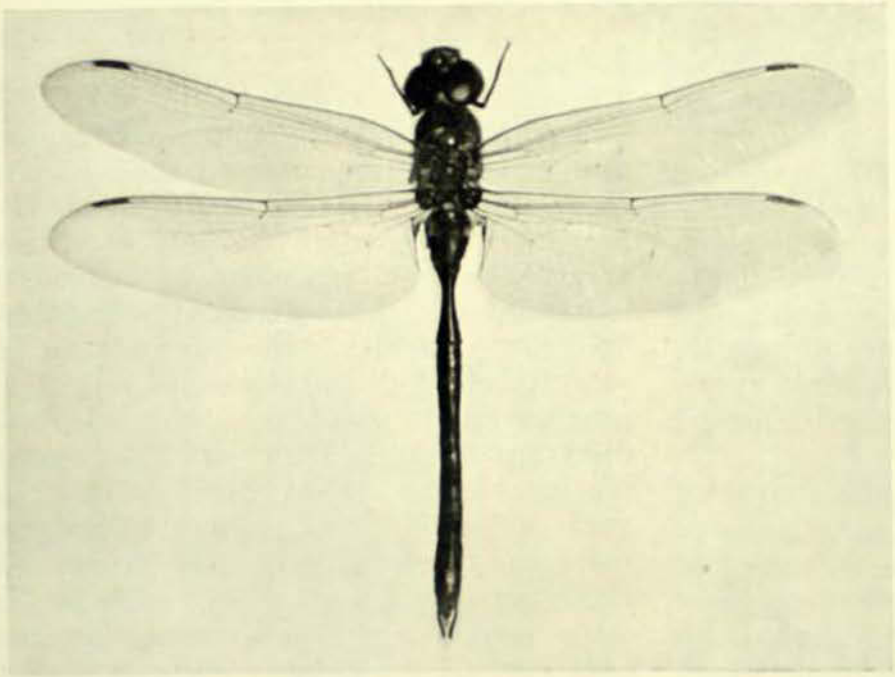
Australian Insects

V. The Dragonflies

By KEITH C. McKEOWN

THAT the dragonflies are an ancient race no scientist would question, but their origins and early history are lost in the dense mists of long past ages. When the curtain first rises on the fossil forms in the Upper Carboniferous rocks, we find the broken remains of a wild riot of insect life of varied kinds. But this is not the beginning, coal-measures were slowly forming, flying here and there in pursuit of their smaller and weaker insect relatives, or clinging to the strange vegetation as they rested and dried their wings. But the mists close down and thicken . . .

Our present-day dragonflies, although they may be lacking in the size of their ancestors, are beings of considerable



A typical Anisopterid Dragonfly.

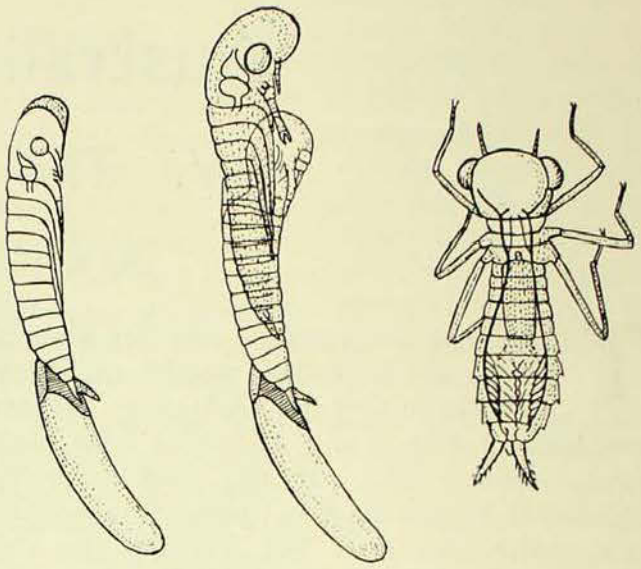
for most of them are very similar to those forms that people the world about us today. The insects have travelled a long way along the hard road of evolution. The majority of the insects of the Upper Carboniferous were remarkable for their large size, and by comparison their modern representatives appear as pygmies. The dragonflies of those far-off days attained a wing-span of twenty-seven inches! It is interesting to conjure up a picture of these huge insects hawking over the swampy lands, where the fascination and beauty of form, perhaps unparalleled in any other groups. The human mind, ever preferring sensationalism to fact, has for some obscure reason endowed these beautiful creatures with a sinister reputation—a reputation wholly unearned. How many of us today know the dragonfly as a "horse-stinger", although it is perfectly harmless both to man and horses? It is attracted to the latter only for the purpose of reducing the numbers of tormenting flies and mosquitoes that hover persistently about

them. But forget prejudice, and see what can be learned of their strange lives.

All the dragonflies in their immature stages are aquatic, living wholly beneath the water, and it is only after the great transformation that changes the mud-dwelling nymph into the perfect insect with its gauzy wings that the watery life is exchanged for a terrestrial, or aerial, one, a life in the air for which they are so perfectly adapted.

For the sake of convenience we may divide the Odonata, or dragonflies, into two groups or sub-orders, the Anisoptera and the Zygoptera. The first includes all the true dragonflies, as we may perhaps call them, stoutly-formed insects with wings ever extended while at rest; the second, the slender-bodied damsel-flies which bring their fragile oar-shaped wings loosely together over the back while resting. Their nymphs, too, differ as markedly as the adults. The Anisopterid nymph is stout, heavy, and rather ungainly, and spends its life crawling about in the mud and slime at the bottom of ponds and streams. It is often popularly known as a "mud-eye". The Zygopterid nymph is slender, frail, and lives mainly among the tangles of aquatic plants. There are other important structural differences, some of which must be mentioned later.

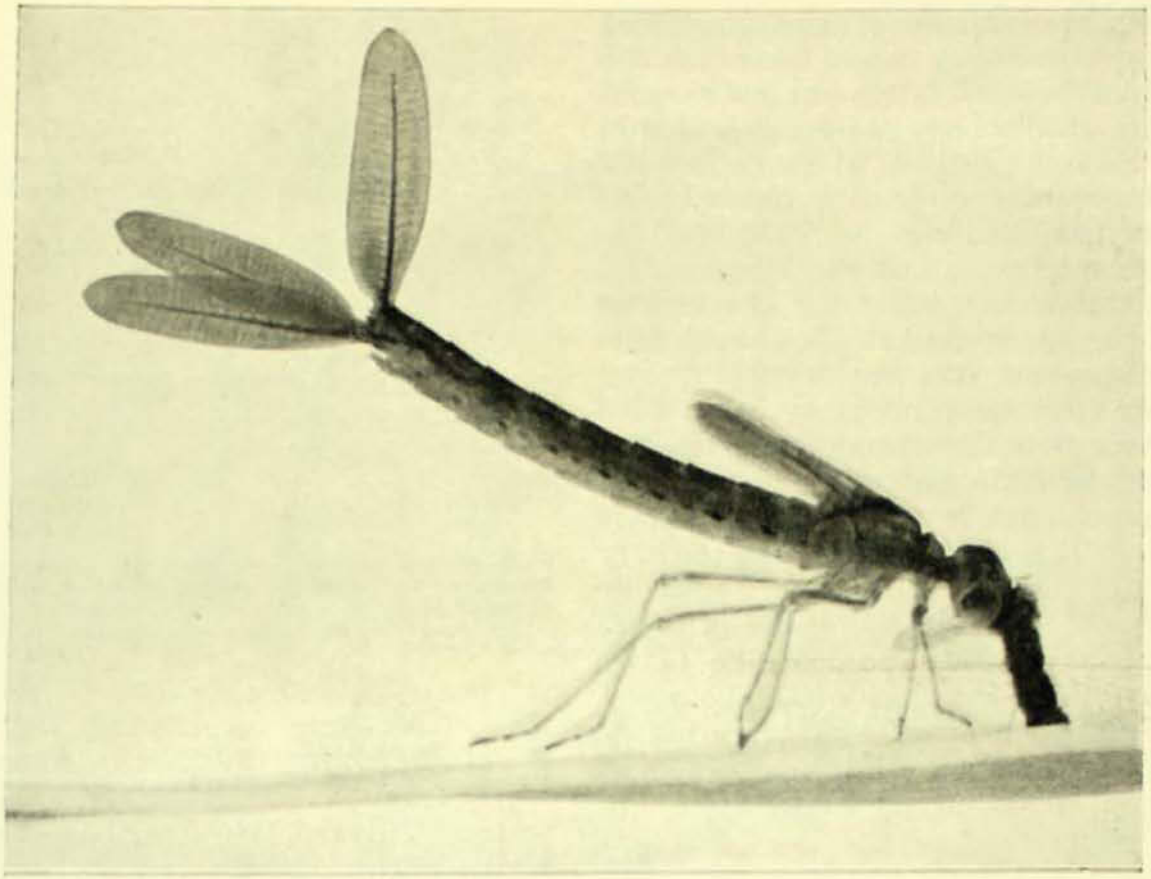
The eggs are deposited in the tissues of aquatic plants, or dropped in a more or less haphazard manner directly into the water. When the egg hatches, the tiny creature that emerges bears little resemblance to the active nymph which we expected to see; it is a sausage-like object wrapped in a tightly-fitting sheath of the finest skin. It is a pro-nymph. This state, however, lasts but a few seconds at most, for a pulsating bladder-like organ appears on the head, swelling and forcing upwards until the enclosing skin bursts, and the tiny, long-legged nymph enters the world, and scurries off to find shelter from a horde of hungry enemies that beset it on every side. At first the little nymph must perforce feed upon minute forms of aquatic life commensurate with its own size and feeble



Emergence of Anax papuensis Burm. from the egg. Left, pronymph emerging from egg-shell; centre, young larva emerging from pro-nymphal sheath; right, the young larva free.
(All figures × 20.)
(R. J. Tillyard, *del.*)

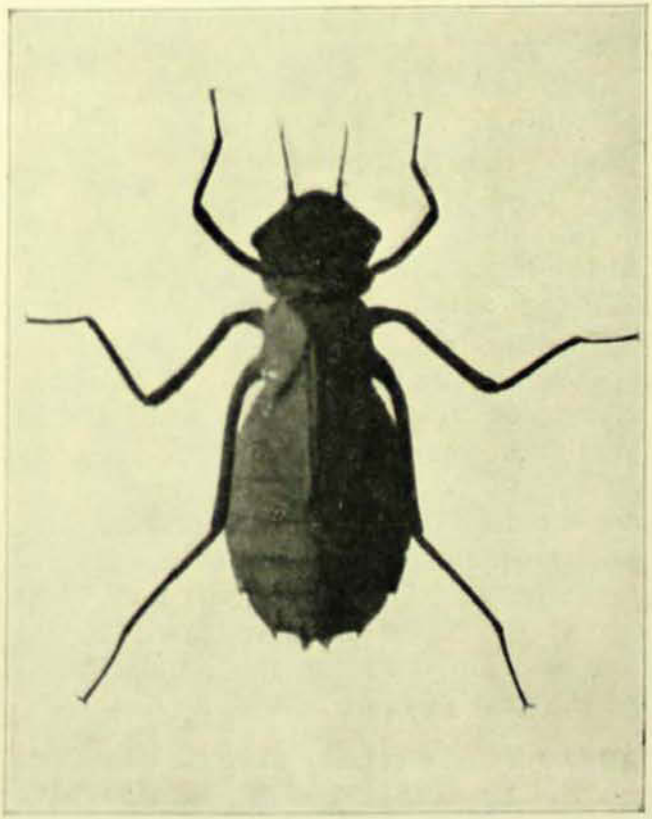
strength. Such a diet would seem to be nourishing, for the nymph grows rapidly, and in consequence has to shed its skin from time to time to accommodate its ever-increasing bulk. The number of these moults does not appear to be fixed as in most insects, but external conditions, drought, warmth, the abundance or scarcity of food, influence not only their number and frequency, but also the duration of the life of the nymph. Maturity may be attained within one year of hatching, or it may be deferred for two, three, or even five years! As the nymph gets bigger, it is able to deal with larger prey, and eventually may even capture quite large tadpoles, fish, or members of its own family of greater bulk than itself.

Many aquatic insects are obviously not completely adapted to life in their watery habitat, and must from time to time rise to the surface to replenish their store of air before descending again for a more or less restricted period of submerged life. The dragonfly nymph is free from such limitations to its activity; it is very adequately equipped with a series of gills which enable it to extract the vital oxygen from the water in which it lives and is bathed. In the Anisopterid nymphs



Larva or nymph of Austrolestes analis Ramb., full-grown, in the act of devouring a Chironomid larva (× 3).

Larva or nymph of Argiolestes icteromelas Sel., full-grown (× 2½).



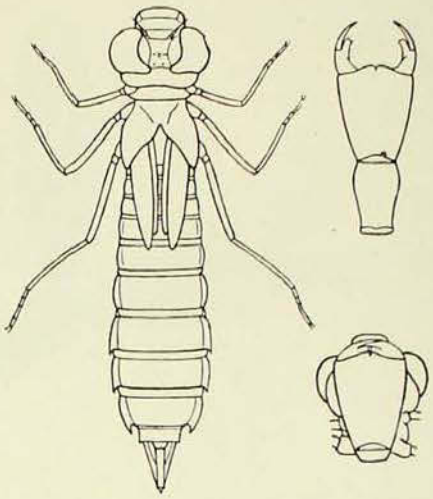
Larva or nymph of Hemicordulia tau Sel., full-grown (× 2).

[Photos.—*Dr. A. J. Nicholson and Miss A. G. Burns.*

these gills are enclosed in an expansion of the lower alimentary canal, known as the "branchial basket". By muscular contractions of the body wall the water is drawn in and expelled, so that the gills in the basket are continually flooded with fresh oxygen-filled water. This very ingenious contrivance has another use, for, in times of stress, when the appearance of an enemy necessitates a hasty exit from the scene, the water is expelled suddenly from the alimentary canal with such force that the nymph is driven forward through the water like an arrow—at a speed much greater than would be possible if it relied upon its legs to carry it out of danger. In the damsel-fly nymphs, on the other hand, the gills are external, and form thin leaf-like plates arranged along the sides of the body, or, more usually, in a series of three plates, varying in shape according to the species concerned, placed at the extremity of the body.

The feeding mechanism of the dragonfly nymph is truly amazing, and without parallel in the insect world. Folded up beneath the head is an appendage known as the "mask", a complex development of what we may, perhaps, term the insect's "lower lip". It is in the form of a jointed arm equipped with a pair of hinged jaws at the extremity. When at rest the mask might well be compared with the human hand resting on the chin, while the arm is pressed close down against the chest. The nymph hunts its prey much in the manner of a cat stalking a mouse, or lies in wait for what living things may pass, but, in either case, as soon as its victim is within reach, the mask shoots out to its fullest extent and seizes the unsuspecting creature with its curved teeth. Once a grip has been secured, the mask is withdrawn to its usual position, and the meal masticated with the true jaws or mandibles.

As the nymph grows, wing-pads appear upon the thorax, increasing in size with each succeeding moult, until the insect is ready to undergo its final transformation into the adult state. Feeling this



Full-grown larva or nymph of Anax papuensis Burm. (× 1½). Upper right, view of labial mask extended (× 2); below, the same, folded into position of rest, ventral view (× 2).
(R. J. Tillyard, *del.*)

irresistible urge for change, the nymph crawls slowly up the stem of some water-loving plant until it is well above the water. Tillyard has described the events which follow, clearly and without undue detail. He says:

When the larva [nymph] has selected its position for transformation, it fixes its tarsal claws so firmly in position that the exuviae [cast skins] remain clinging tightly to their support long after the imago has emerged. The larva then becomes quite motionless, while the internal swelling of the parts increases. This swelling becomes particularly pronounced in the region of the eyes, and on the back of the thorax. The actual splitting of the skin first appears along the mid-dorsal line of the thorax, and quickly extends forward on to the head. It seems to be caused by the insect arching its back strongly, in an attempt to withdraw its head into the thoracic cavity. The thorax bulges out through the crack, so that the withdrawal of the head is quickly accomplished. As soon as head and thorax are free, the legs and wings are gradually withdrawn from their sheaths. By the time this is accomplished, the abdomen is only partly free. The insect next usually hangs for some time with its head downwards, while the action of the sun and air hardens its legs. As soon as these are strong enough, the insect waves them about in an effort to find something to catch hold of. Nothing being usually available, it attempts to jerk itself upwards, and sooner or later succeeds, by a great effort, in seizing the head of the exuviae, or the reed-stem above it. Next, holding firmly on to the stem, the insect withdraws its abdomen from the larval skin, and usually climbs a little way above it, so as to be quite

A typical Zygopterid Dragonfly.

free. . . . The transformation is completed by the elongation of the abdomen and the expansion of the wings.[1]

Many dragonflies emerge just before or after thunderstorms. When the perfect insect has emerged, it rests for a while before flying somewhat weakly away to some sheltered position where the wings may become fully hardened, a process that may take some time. This hardening complete, the insect is ready for its adult life. The cast nymphal skin remains clinging to its support, a mute reminder of what has passed; save for the gaping rent along the back, it is complete in every respect. The slender white threads that project from the thoracic cavity and flutter in the breeze, are the linings of the respiratory tubes, or tracheae, which are discarded with the skin during the transformation.

In the brilliance of their coloration the dragonflies vie with almost any of the other members of the insect world, but, as a rule, these colours are transitory, fading after death, so that a collection of the pinned bodies of these insects in a museum fails to give any true impression of the delicate beauty of the living creatures when flying about in the sunshine.

[1] Tillyard: "Biology of Dragonflies", 1917, p. 97.

Few, if any, insects are so perfectly adapted for flight as the Anisopterid dragonflies, and so far as reliable information is available, they surpass all other insects in speed. Dr. R. J. Tillyard, in one of the few really satisfactory records of the speed of insect flight, timed a dragonfly as it flew up and down, hawking for insects along a straight reach of stream, and he found that it attained an average speed of sixty miles per hour. It is possible that even this would be surpassed in dashes over short distances. The flight of the Zygopterids is weak and fluttering.

The food of adult dragonflies is taken on the wing, small insects being captured in a basket formed by the spiny legs and later transferred to the mouth for consumption. Vast quantities of mosquitoes and other small game are destroyed by these voracious insects as they hawk up and down streams or along sunny bush tracks.

Courtship among the Odonata is usually of the simplest nature, marriage by capture being rather the normal order of things. Tillyard has, however, described much more complex behaviour in the wooing of *Hemiphlebia mirabilis*. "This metallic green Dragonfly", he says, "is almost invisible on green reed-stems, except for its long ribbon-like white appendages. These are displayed as a sign to the female, by raising the abdomen and bending it slightly sideways, while walking up the reed-stem. The female replies by moving the whitened end of her abdomen from side to side in a peculiar manner. Finally the little creatures fly out from the reeds, and engage in a miniature *pas de deux* before pairing." Pairing is effected with the insects in a tandem position, the male flying in front of his mate and gripping her by the crown of the head by means of special claspers at the extremity of his body; the female obediently follows, and bends her body forwards in a loop.

Egg-laying is effected with the insects still in tandem formation. The Zygopterids (and some of the

Anisopterids) deposit their eggs in the tissues of water-plants, in slits cut for the purpose by the ovipositor of the female. The majority of the Anisopterids scatter their eggs directly into the water, the pair flying low over the surface, which is flicked from time to time by the abdomen of the female to wash off the extruding eggs. The operation among the damsel-flies is quite an intriguing performance. The pair alight upon the stem of a reed projecting above the surface of the water. The female backs downwards, drawing her mate, who still grips her head firmly, down after her. As soon as her abdomen is below the water, she sets to work cutting slits in the stem and depositing eggs in each cavity. When a batch of eggs has been safely placed, the little mother retreats a few steps further down, and repeats the progress, until the two insects are completely submerged. The male all this time steadies his mate on the slippery reed. When the female is satisfied that she has exploited the possibilities of that stem to the full, the pair emerge and fly off to prospect other localities.

Since over two hundred different species of dragonflies have been described from Australia, it is obviously quite impossible to discuss the different forms in any detail here, but brief mention must be made of a few. Among the Zygopterids is the remarkable *Hemiphlebia mirabilis* whose courtship has been mentioned. *Xanthagrion erythroneurum,* in which the male has a red thorax and a blue tip to the abdomen, is very widely distributed; the small blue and bronze species, *Austroagrion cyane,* too, is common. *Austrolestes leda* and *analis* are very familiar members of their genus in eastern Australia. *Petalura ingentissima,* from North Queensland, is the largest of the Australian Anisopterids, and is indeed one of the largest dragonflies known, expanding up to six and a half inches; *P. gigantea,* of the Blue Mountains, is another huge species attaining to five inches. *Aeschna brevistyla* has a wide range throughout Australia, and *Anax papuensis* is perhaps the commonest and best known of all. *Austrophlebia costalis* is remarkable for the possession of a brown band along the front margin of the forewings. The genus *Neurothemis* contains tropical species in which the wings of the males are shaded with black or brown.

Mr. H. O. Fletcher, Assistant Palaeontologist, left Sydney on May 21 to join a party led by Dr. C. T. Madigan, University of Adelaide, which will make an attempt to cross the Simpson Desert. This arid and inhospitable region occupies portion of three States of the Commonwealth, and so far has defied all efforts to cross it, though its margins have been traversed, and Dr. Madigan himself has made three flights over it. In 1937 Bryce Russell started from Oodnadatta with the intention of traversing the desert, but no trace of this bold adventurer or his camels has since been discovered.

Dr. Madigan's expedition will investigate the geology and palaeontology, the plant and animal life, and other features of the desert, and will be absent for about two months. Mr. Fletcher, who will have charge of the zoological work, is an experienced and resourceful explorer; he accompanied Sir Douglas Mawson on two Antarctic expeditions, and has already traversed parts of Central Australia on two occasions.

The Nature and Origin of Life

By W. BOARDMAN, B.Sc.,
Australian Institute of Anatomy, Canberra, A.C.T.

IT is a long time since the sun had torn from it a hot swirling nebular mass which by its cooling gave rise to the slowly rotating ball we call Earth. The young globe had no water upon it and no life-giving oxygen above. Living things as we understand them were still in a distant future. Time wrought many changes. Rain fell, lakelets and rivulets appeared on the surface, an atmosphere evolved. Events by their natural course were setting a stage upon which life—plants and animals—could play a part. At some period in the earth's history, life appeared. Just when would be interesting to know, but it is far more important to consider the question how.

What is life? The frogs and plants in a creek are alive. The bubbling water, the stones and sand of its bed have never stirred in response to a life urge. On the one hand a pulsating organic world, on the other the inertness of the inorganic. The differences seem so obvious that time appears wasted in defining them. But we can go no further till these differences are examined in the precise terms of Science, for one of the outstanding results of the accumulation of knowledge has been a steady bridging of the seemingly impassable gap between the two worlds.

Living things possess four attributes not readily observed in the non-living. They can move spontaneously, they take in food and as a consequence are able to grow, reproduction (often a sexual and apparently complicated phenomenon) occurs more or less frequently, and, finally organic substances attain a degree of complexity not met with elsewhere in nature. If these characteristics could be regarded as peculiarities of living matter, we would have an accurate, if somewhat cumbersome, idea of what the term "life" implies. Let us attempt to evaluate them for what they are worth.

The capacity for movement in response to a stimulus is one of the most important reactions in animals. Whether the stimulus comes from within or without, the result is similar. Inadvertently grasp something hot and immediately there is liberated energy which enables the muscles concerned rapidly to move the affected part from the source of irritation. Amoeba, a just-visible formless speck of living jelly that moves by "flowing" over the surface of water weeds and mud in ponds, has the same faculty. It responds readily to variations in the intensity of light and is very sensitive to the presence of solids and gases dissolved in the surrounding water. Recent investigations have gone far to show that there is a close affinity between the movements of an Amoeba and the contraction and expansion of the muscle fibres in a higher animal. Physicists, however, have taken the study a step further by demonstrating that movements of a type similar to those found in Amoeba and by analogy to muscular contractions are reproducible in much simpler non-living substances. Given suitable conditions, oil drops and various organic and inorganic mixtures can be caused to give rise to movements which may justly be described as "amoeboid". These movements are the result of alterations in tension at the surface of the fluids, the alteration being traceable to known chemical and physical causes. The movements of Amoeba, muscle fibre, and a suspended oil drop are alike, since there seems no valid reason for doubting that in each case a common cause is operating. If so, we must rule out the claim of living matter to a monopoly of the phenomenon of irritability.

Growth and reproduction are closely related. When we observe growth, say, in man, only the end-result—increase in size of the body—is manifest. Growth is the cumulative effect of the tendency of the majority of cells to reproduce themselves by dividing into two under favourable conditions. Nourishment is a necessary prelude to growth. Food by its burning releases supplies of energy for the activities of the body; it enables worn out and dead cells to be replaced, and if the food intake is sufficient, the cellular aggregate will, as a result of its divisions, increase in number and thus initiate growth. It is noteworthy that in man and the higher animals there is an upper limit beyond which, as a rule, growth does not proceed, though if a census of the animal kingdom was taken, it is certain that the majority of animals would be found to continue growing throughout life. Reproduction is basically a special form of cell division. Ova are elaborated in the ovary of the female, sperms in the tissues of the male testis. When the comparatively large ovum is penetrated by a sperm it is galvanized into activity and immediately embarks on a course of rapid divisions which mark the first stages in the development of an embryo. Can the inorganic world give us anything comparable to these two phenomena? Again the answer is in the affirmative, this time from experiments carried out with certain colloids. The term colloid, it may be explained, is used to designate a wide range of substances one of whose principal properties is that when in solution diffusion through animal and vegetable membranes is slow or negligible; gums, gelatine and starch are typical. Professor Schäfer writes: "Leduc has shown that the growth and division of artificial colloids of an inorganic nature, when placed in an appropriate medium, present singular resemblance to the phenomena of the growth and division of living organisms. Even so complex a process as the division of a cell-nucleus as a preliminary to the multiplication of the cell by division can be imitated with solutions of a simple inorganic salt containing a suspension of carbon particles."

The last of the supposed differences between the non-living and the "organized" relates to the complexity of substances of organic origin. Previous to the first quarter of the nineteenth century it was contended that organic substances were a group apart, that their like did not occur except as a result of the activity of animal and plant cells, that they were the outcome of the working of a mysterious life force the secret of which could never be unmasked by man. In 1828 Wöhler prepared urea artificially. Urea, the principal dissolved solid in mammalian urine, is one of the important waste products of the animal body. This synthesis ushered in a new era in chemistry, and resulted in the realization that the separation of organic and inorganic divisions was no longer tenable. Also, the great following of believers in the theory that an explanation of the mechanism of life made necessary the postulation of a vital force, found its position undermined. Today the manufacture of complicated organic substances, such as dyes, drugs and perfumes, is a familiar story. Scientists would give much to know all that goes on in a living cell, and though the fringe of this wide and important field has only just been touched, the rapid strides of the last fifty years give hopeful promise for the future.

It would seem, then, that living bodies, while almost unbelievably complicated, present us with no new forces. Nor does the most careful analysis reveal any trace of elements which are not of equally common occurrence in nature. More than 95% of the body of an animal is made up of the well-known elements carbon, hydrogen, oxygen and nitrogen. But even the most painstaking analysis gives no clue to the manner in which a cell works.

Cells are of many kinds, and all excepting those of the central nervous system have the power of dividing and so duplicating their kind to repair waste and promote growth. The cell is the unit structure of the living organism, and the

life stuff of which it is composed is a semi-liquid colourless substance called protoplasm. It must be clearly appreciated that protoplasm is not a single chemical compound, but a highly complex mixture of all those substances which are involved in the life processes at a given moment. There is no more wonderful mixture in the world than this protoplasm. It is indeed "the physical basis of life". So little is known about it that an accurate definition is out of the question. Investigation has demonstrated the presence of protein, fats, carbohydrates, inorganic substances and small but essential proportions of other classes of compounds. Living protoplasm is in a state of continuous flux in composition and within any one cell a number of separate reactions due, for instance, to nutrition, respiration and growth, are able to go on simultaneously without interfering with each other.

The sum total of the varied changes that go on in the cell is known as metabolism. When metabolism or an essential phase of it ceases, the cell dies, and if the cell is necessary for the maintenance of life, then the organism in a shorter or longer period of time, according to the tissue affected, dies also. In brief, the cycle of metabolism is initiated when food and oxygen enter the body, and may be said to be completed when waste products and carbon dioxide are excreted. In animals the food consists of elaborate chemical compounds derived either from plants or the bodies of other animals. In the fabrication of these compounds much energy has been absorbed, so that when they are degraded or broken down by the metabolic activities of the animal cell there is a liberation of energy which can be used to produce heat and motion. Animal food is generally a mixture of carbohydrates, fats and proteins. Carbohydrates (sugar and starch, for example) are essentially fuels, but for the body to use proteins as a source of energy for muscular and other activity is physiologically wasteful, as it cannot utilize them completely. Proteins form the ultimate structural units of the body. It is doubtful if a true picture of even the simplest protein has yet been obtained. The complication of protein structure is bound up with an extreme instability which permits rapid change into proteins of a higher or lower order. When chemists have elucidated the problem of protein metabolism, knowledge of the nature of life will be well advanced, and it may even be possible to test by experiment speculations about the origin of life.

No reasonable objection can be advanced against the expression in physico-chemical terms of the workings of the animal body. There is no reason why the animal body should not be regarded as a super-machine which, in functioning, consumes part of itself, replaces the damage, and possesses an infinite capacity for regulation of the many different and stimultaneous processes going on within it. Loeb's work on the fertilization of animal eggs may be cited as illustrative of the extent to which researches are stripping body processes of a lot of their mystery. In animals generally (there are important exceptions) before the eggs produced by the female can develop it is necessary for each to fuse with a male element or sperm. The single cell so formed by division and differentiation ultimately leads to the production of a new animal, a replica of its parents. It seemed impossible that there could be any substitute for the stimulus supplied by the sperm, the more so since in many animals most elaborate instincts had become evolved to gain this end. Loeb found that the eggs of sea urchins, which are extruded into the surrounding sea water, could be induced to develop even up to the adult condition by treating them with concentrated sea water followed by butyric acid. Later, adult fatherless frogs were obtained simply by piercing the egg membrane with a needle the tip of which had some blood or lymph on it! This extraordinary response of the animal egg has been found to be usual in eggs accessible to investigators. Operative technique is not sufficiently far advanced for experiments to be carried

out on the mammalian ovum, but no reason has been suggested why like methods should not be successful if they could be applied.

Speculation on the origin of life is as old as philosophy. Man has always been curious about the origin and destiny of his kind and the things around him. For many centuries he got along with a peculiar mixture of religious dogma which accounted for himself and the better known animals and the idea of spontaneous generation explaining the existence of the many small things with which the world teems. Was not everybody aware that worms were generated in flasks of vinegar, no matter how tightly corked? The death blow to the concept of spontaneous generation was not delivered till the classical experiments of Pasteur in the nineteenth century, work which would not have been possible had not the microscope as a research instrument attained such an advanced stage of development. There have been other theories to account for life on the earth. One of these held that life had been transported to our planet by meteorites, a suggestion which has not proved helpful and is scarcely in accord with known facts.

To grasp the modern outlook the universality of the principle of evolution crystallized by Darwin for biologists must be appreciated. In the history of life on the earth there has been a constant surging forward, a ceaseless process of adjustment. First, chemical evolution—elements uniting to form compounds of a gradually increasing degree of complexity. Then water, atmosphere, lakes, seas, rivers, mountains, all in logical sequence. The world which gradually assumed preparedness for life was itself the product of a long evolutionary history, just as much as life as we know it today has developed step by step from the first formless specks of living matter. If our ideas about evolution are so well founded, it would seem likely that, as there is no sharp line between the properties of living and non-living matter, so there is no barrier in the continuity between inorganic and organic evolution. Somewhere in that remote past a mixture of chemical substances by their nature and structure became possessed of a new property—life. Primeval living matter must not be compared with an animal like Amoeba, which has an ancestry of millions of years of evolutionary trends and is relatively quite advanced. At some period in the evolution of our planet, circumstances were favourable for the transition of matter to a living state. Temperature, moisture, pressure, atmosphere and other factors were present in the requisite degree or condition. Life may have appeared, and then this favourable set of circumstances changed and for ever prevented any recurrence of the phenomenon. Otherwise (and there are reasons against it) life may be continuously created even today and man, by virtue of the limitations of his vision, is not aware of it. For one thing seems certain, and that is that the earliest life forms were extremely small. A new field of enquiry has been opened up by d'Hérelle's discovery of bacteriophages, literally eaters of bacteria. They are too small to be seen by the microscope. d'Hérelle says they are alive because they reproduce, but his opinion is not shared by all his contemporary workers. Is their discovery a step nearer to the visualization of the form in which life first emerged? Man may never succeed in manufacturing living substance. His intellect may be unable to grapple with the immensity of the problem. But he will try, and who knows . . . .

The Wunderlich Archaeological Library

MR. ERNEST WUNDERLICH, F.R.A.S., a former President and member of the Board of Trustees of this Museum, recently presented the entire archaeological and anthropological section of his private library.

Mr. Wunderlich is well known for his interest in these sciences. This valuable collection of literature, the gatherings of a lifetime, consist of approximately four hundred volumes, many of them extremely difficult to procure and beyond the financial capacity of this Museum to acquire. Flinders Petrie, Maspero, Budge, Perrott, Chipiez, Wreszinski and Pleyte are but a few of the authors, and there is a fine series of the publications of the British School of Archaeology in Egypt.

It was to Mr. Wunderlich that we owe the fine group of Australian aboriginal figures sculptured from life by the late T. Rayner Hoff, and from him the Australian Museum, previously, has been the recipient of many fine and handsome volumes.

Mr. Wunderlich has been an assiduous student of archaeology and anthropology, and has travelled extensively in order to extend his knowledge of these subjects; Egypt, Carthage, Rome, Pompeii, and Herculaneum, to mention but some, have all been visited by him, and he has supported investigations in some of these fields.

Not only are the standard works on civilizations of the past included in this donation, it embraces many others also. There are fine illustrations of temple reliefs, sculpture, and tomb paintings. It is a point of great value to students that this collection will not be disseminated, but will be retained, complete, in one institution.

This acquisition but serves to illustrate the need for greater accommodation. For lack of proper accommodation it will have to be housed in the Board Room.

Mr. Gorrie M. Blair, whose death took place in a private hospital on Sunday, February 26, was a native of Scotland and arrived in Australia in 1891. After a brief stay in Melbourne he came to Sydney, where he joined the staff of the late Mr. John Kirkpatrick, one of the leading architects of the day, as chief draftsman. He later entered the service of the Government, and eventually succeeded the late Mr. George McRae as Government Architect, from which position he retired in 1926. He was recognized in his profession as a brilliant draftsman, with an outstanding knowledge of Classical and Gothic design and construction.

He had been an Elective Trustee of the Board of Trustees of the Australian Museum for a period of fourteen years, and rendered very distinguished services to that institution. His personal qualities no less than his professional knowledge earned him the highest esteem of his colleagues, to whom his death is a severe blow.

At the March meeting of the Board of Trustees, the President Mr. F. S. Mance, made feeling reference to the loss which the Board had sustained, and eulogized the late Trustee's work and service in the interests of the Museum, to which suitable reference was made in the minutes of the Board.

THE MEN AND BIRDS OF PARADISE. By A. J. Marshall, with a preface by Sir William Goodenough. (William Heinemann Ltd., London, 1938.) 8vo, pp. xii + 299, with 17 plates. Price: 11s. 6d.

The greatest appeal of Mr. Marshall's book is to the general reading public who, tied down to mundane occupations, are athirst for tales of travel and adventure, and herein they may drink deep of a zestful draught.

The author's objective in traversing the north-east coast and hinterland of New Guinea was to make a reconnaissance for an expedition to follow in the near future, and so we find that his treatment of the topics chosen is, of necessity, a selective and rapid one, but at the same time an excellent summary of the impressions made upon a more than ordinarily observant onlooker.

Our introduction to the country itself is preceded by a *résumé* of its early history, which is later brought up to date by a survey of the growth of goldmining, the missions and their commercial enterprises, the potential wealth of the territory, and a warning of the encroaching Japanese. One former flourishing industry, trade in the feathers of the "unearthly" Bird of Paradise, that won rich profits, enticed Europeans, but more particularly the Malays, far into the jungle fastnesses, and the latter have left signs of their coming in the language and the physical features of the natives. The varied physical strains apparent in this northern part of the island arouse the speculation of both reader and author.

Many pages are filled with descriptions of native life and custom, their villages and the awesome house tamberan, their gardens, arts and crafts, dress and elaborate personal ornament. Messages are howled across the valleys or beaten out upon great gongs to reverberate thunderously with a fitful wind. Sago-making, food taboos, story-telling and a hundred interesting trifles come in for comment. Attention, too, is given to the mental capacity of the native, his courage and cowardice, the social status of the women, and the belief in the dread powers of the sorcerer. The exchange of stone for steel has altered the lives of many tribesfolk, and the spreading influence of the white man, aided by the recruiting of native labourers from inland districts, has created new standards for old, and spells the doom of the old culture.

The description of the lazy tranquillity of the coastal settlements is enlivened with racy thumbnail sketches of their inhabitants—the recruiter, the government official, the local storekeeper and the infrequent dentist, the odd Indonesian missionary and the few hermits of the coast who find contentment in the solitude of an oasis in the wilderness—all are subjects for a facile pen which deals cunningly but kindly with their idiosyncrasies.

Swiftly as the feet of the explorer in his race against time, the narrative moves to a close, leaving the reader bespelled by the fascination of this primitive land, where physical discomfort and spiritual ecstasy go hand in hand, and life and death are never far apart.

E.B.

To fill the vacancy on the Board of Trustees caused by the death of Mr. G. M. Blair, Dr. Arthur Bache Walkom was made an Elective Trustee at the April meeting.

Dr. Walkom was formerly Lecturer on Geology and Mineralogy at the University of Queensland. He has been Secretary of the Linnean Society of New South Wales since 1919, and Honorary General Secretary of the Australian and New Zealand Association for the Advancement of Science since 1926. He is a leading authority on Australian fossil plants, on which he has written extensively. Dr. Walkom's administrative experience and ability and his wide scientific knowledge will make him a valuable member of the Board.