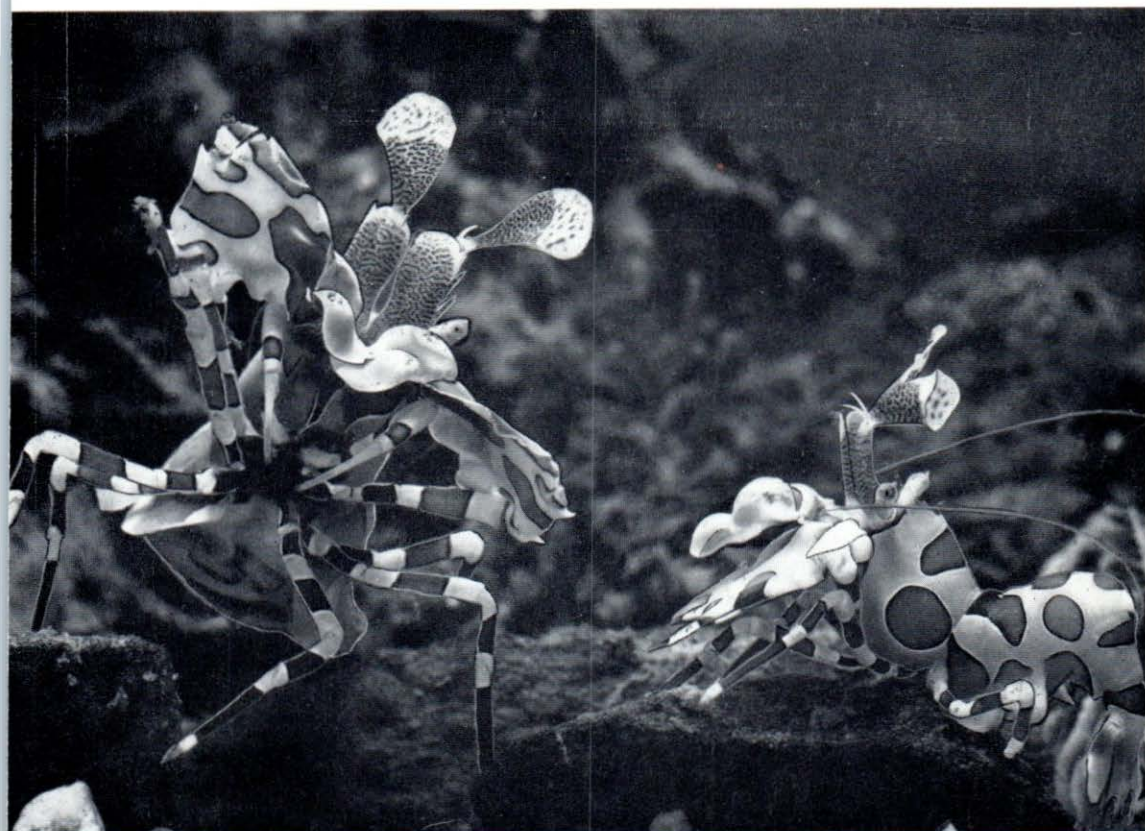


AUSTRALIAN NATURAL HISTORY



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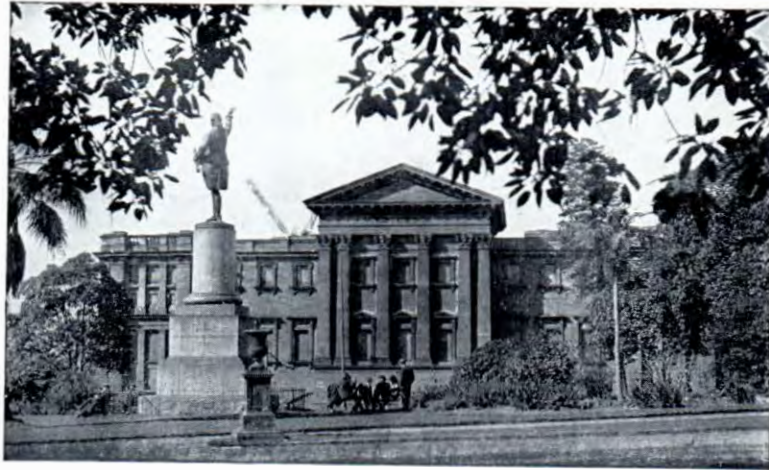
**THE AUSTRALIAN MUSEUM
SYDNEY**

Registered at the General Post Office, Sydney, for transmission by post as a periodical

MARCH 15, 1966

VOL. 15, No. 5

PRICE, 30c (3/-)



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● **FRONT COVER:** A pair of Elegant Coral Shrimps (*Hymenocera elegans*) perform a complex courtship "dance" in the Aquarium of Noumea, New Caledonia. The larger animal, at left, is the female, seen directly from the front; the male, on the right, is in lateral view. The shrimps' bodies are opaque yellowish-white, with irregular rich reddish-brown blotches; the legs are banded. The female is about 1½ inches in length. The photo is by R. Catala, whose article on the aquarium is on page 142.

AUSTRALIAN NATURAL HISTORY



Published Quarterly by the Australian Museum - - - *College Street, Sydney*

Editor: F. H. Talbot, M.Sc., Ph.D.

Annual Subscription, Posted, \$1.40 (14/-)

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The Coelacanth, Living Relic of 50 Million Years Ago

By F. H. TALBOT

ONE of the most fascinating zoological findings of the twentieth century was made a few days before Christmas in 1938 off the east coast of South Africa. Captain Goosen, the skipper of a small fishing trawler, had decided to make one trawl haul on a usually barren bank just before returning to the town of East London. The trawl that came up contained a mixed bag of edible fish and shark, and one large blue fish of a type that had never been seen before by Captain Goosen or his crew. This fish, 5 feet long and weighing 127 pounds, was a living coelacanth, a strange relic of a long-past age.

Fossil coelacanths are well known. They occurred in the rocks of the Cretaceous age in abundance, usually being small, probably freshwater fishes. At that time, some 60 million years ago, dinosaurs dominated life on land, including the greatest of the flesh-eating dinosaurs which grew up to 20 feet high and 40 feet in length. The sea was then inhabited by long, slender marine reptiles, resembling the sea serpents of fables,

and also by flying reptiles with wing-spans of over 20 feet, and a large, swimming, flightless bird that caught fish in its long-toothed jaws. It was thought that the coelacanths had died out at the end of this period, and no further fossils have been found through rocks laid down in the next 50 million years to the present.

Limb-like Fins

Of course, Captain Goosen and his crew did not recognize this fish as a coelacanth, but as it was unknown to them they thought that the local museum might be interested. The East London Museum had then (and still has today) Miss Courtenay-Latimer as its Director. She received a telephone call from Captain Goosen and took a taxi down to the fishing quay. Although primarily an ornithologist, she was immediately struck by the strange body-form of this fish. The fins had thick fleshy bases, almost arm- and leg-like, and there was a small additional tail behind the normal tail.

It was such a strange-looking fish that one of the sailors said that it resembled a marine lizard more than a fish, with its peculiar limb-like fins. Miss Courtenay-Latimer thought immediately of the lung fish. She persuaded the taxi driver, with some difficulty, to put the fish in the trunk of the taxi and took it to the Museum. She then wrote a letter and enclosed a brief sketch to Professor J. L. B. Smith who was the only ichthyologist between her and the South African Museum, some 600 miles away in Cape Town.

Due to the dislocation of mails at that season, Professor Smith, who was recovering from an illness at a small seaside resort some way south of East London, only received the letter on 3rd January—11 days after the fish's capture. Being an astute ichthyologist with a wide knowledge of living fishes from the area, and some knowledge of fossil forms, he was immediately struck by the similarity of Miss Courtenay-Latimer's sketch to the coelacanth group of fossil fishes.

It was so extremely improbable that a living coelacanth fish should have been found 60 million years after the family was thought to have died out that Professor Smith was thrown into a turmoil. It was as if a palaeontologist had suddenly been told that a dinosaur had been caught alive near where he lived, and would he come and have a look at it?

Ichthyologist Sceptical

One's first reaction would be sheer disbelief. Yet Miss Courtenay-Latimer, without knowledge of fossil fishes, had drawn a sketch of a coelacanth. After more letters between Professor Smith and Miss Courtenay-Latimer, Professor Smith wrote a hesitant letter to Dr K. H. Barnard, noted ichthyologist at the South African Museum. Dr Barnard's reply indicated quite clearly that Professor Smith may have thought he had caught a coelacanth, but . . . perhaps he had better think again.

It was not until 14th January that Professor Smith managed to reach East London and see the fish. After one look he was in no further doubt. This improbable

miracle had in fact happened. In March of that year (1939) the *Illustrated London News* published a three-page photograph of the coelacanth, and a brief description of it and of fossil forms, under the title "One of the Most Amazing Events in the Realm of Natural History in the 20th Century". However, the world was moving rapidly towards the Second World War and all ideas of finding further coelacanths were stopped. It was not until 1948 that Professor Smith was able to begin the search for the home of the coelacanths. In this year it was agreed to give a £100 reward for the first two coelacanths to be found. A pamphlet which contained photographs of the coelacanth and information concerning the reward, and the reasons for wanting the fish, in English, Portuguese and French was sent all over East Africa. For four years this bore no fruit. Then in 1952 Professor Smith and his wife were collecting fishes on the island of Zanzibar and gave pamphlets to a sturdy, adventurous trader called Eric Hunt. Captain Hunt traded in a small schooner between the mainland of Africa and the Comore Islands, which lie in the wide channel between Madagascar and the mainland of Africa. He was extremely interested in the possibility of finding a coelacanth, and when he next reached the Comores passed the pamphlets around in the villages and also interested the Governor in the story. He then returned to Zanzibar and met the Smiths again. Mrs Smith gave him more pamphlets and, as he sailed from the wharf, he laughingly said, "If I get a coelacanth I shall cable you".

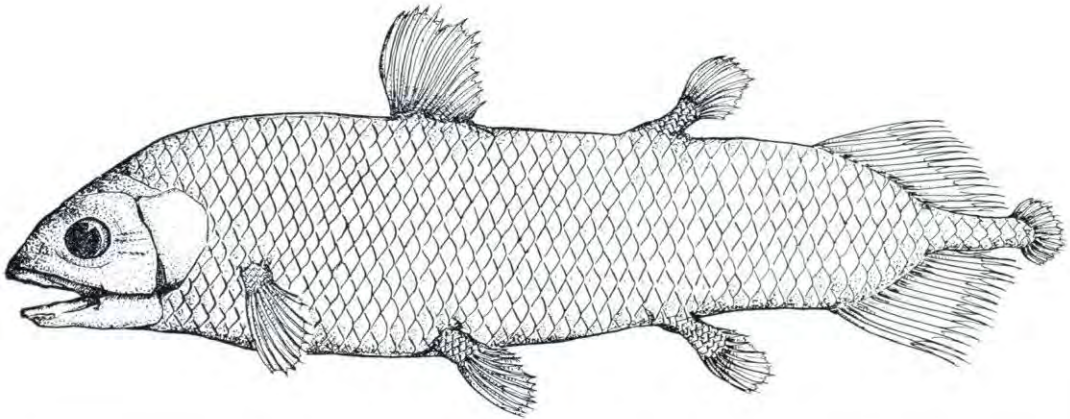
Second Coelacanth Found

Within 10 days the second coelacanth had been found. Professor Smith was so determined to get the second coelacanth that he persuaded the then Prime Minister of South Africa, Dr Malan, to put an Army plane at his disposal, and flew to the Comores to fetch it. This coelacanth is now in Professor's Smith's laboratory in Grahamstown, South Africa. Smith had truly found the home of the coelacanth, for since that time some 20 or so have been caught in these steep-sided volcanic islands. The natives there seem to know the fish and catch it on long hand lines while fishing for other species.



Above: A cast of the first coelacanth, caught by Captain Goosen off East London, South Africa. [Photo: *Transactions of the Royal Society of South Africa.*] Below: The first specimen of a coelacanth to reach Australia. This fine 4-foot-long example of "Old Fourlegs" was caught in the Comore Islands, between Madagascar and Africa, in mid-1965, and bought by the Australian Museum, where it will be put on display. The United States oceanographic research vessel *Atlantis* transported it to Perth, and it was then repacked by the Western Australian Museum and sent by air to Sydney. Holding the coelacanth is Miss Sondra Beresford, assistant to the Australian Museum's Department of Ichthyology. [Photo: Howard Hughes.]





Undina, a fossil coelacanth. about 22 inches in length. [Drawn by Sondra Beresford. after Smith Woodward.]

There is a sad sequel to Eric Hunt's finding of the coelacanth. Later I myself lived on Zanzibar Island and got to know Eric Hunt quite well. One Sunday while fishing with him for small, beautifully coloured tropical fishes, in freshwater lakes on Zanzibar, he told my wife and myself that he had installed in his schooner a deep-freeze unit just big enough to fit a coelacanth, and that he intended to fish on an out-of-the-way reef on his trading among the islands in the hope of catching one himself and selling it to the highest bidder. He left the following day on what was to be his last cruise. His ship was wrecked near some tropical reefs well off his normal course and although some of the crew were saved, Hunt and another crew member, who left the ship in a small dinghy, were drowned. The dinghy was later found drifting upside down. It seems that Hunt was attempting to fish for the coelacanth when this occurred.

Coelacanth's Evolutionary Significance

The coelacanth is interesting to us not only as a living link with the dim past, but also through its distant relationships with ourselves. The coelacanth belongs to the group Crossopterygii, or lobe-finned, fishes. The structure of the crossopterygian fin

differs greatly from that in modern bony fishes. The fin structure is more similar to a limb and has a single stout bone attached to the girdle, and is not a broad-based fin with a number of parallel bony or cartilaginous bars as in most other fishes. From crossopterygians that forsook the water and used their lobed fins to aid in locomotion developed the early amphibian forms and eventually the evolutionary lines leading to man.

Although much work has now been done on the anatomy of the coelacanth, we still know little of this grand old man of the sea. None have been kept alive in aquaria. None have been observed underwater in their natural habitat. The Comores remain a beautiful and sleepy group of islands with no research laboratory or scientists to study this, perhaps the most fascinating of all living fishes. The only evidence on the islands which can be seen by the visitor of the catches which roused the scientific world is a specimen in the simple building at the end of the same dusty air strip on which Professor Smith landed 13 years ago in high excitement (and also with some dread, lest Hunt's fish should prove not to be a coelacanth after all). And this specimen, which lies in an open glass tank, is dried and distorted, and its scales are rifled by every passing souvenir hunter.

Retirement of Dr J. W. Evans

Dr J. W. Evans, M.A., Sc.D., D.Sc., C.M.Z.S., F.I.Biol., who has been Director of the Australian Museum for the past eleven years, retired on 16th January, 1966. His decision to retire at the age of 60 was received by the Trustees and staff of the Museum with sincere regret, as his period of directorship had been a notable one.

Dr Evans' appointment in 1954 took place at a critical stage in the development of the Museum. A new building was urgently required to provide storage for the ever-increasing national collections, for exhibition purposes, and for additional work-rooms and laboratories. Gallery exhibits were at that time outmoded and provided visitors with little information of educational value respecting the Australian fauna. These conditions were associated with a lack of finance resulting from the economic effects of World War II.

In early discussions on proposed developments of the Museum, Dr Evans impressed everyone by his clarity of thought, his energy and his enthusiasm, and also his acceptance, as a challenge, of the difficulties impeding the progress of the Museum. He enjoyed the esteem of the Trustees and his pleasing personality and honesty of purpose soon resulted in the establishment of excellent staff relations.

Soon after his appointment Dr Evans initiated a long-term and flexible plan of gallery re-organization. The success of this plan is apparent, a decade later, in the modernized Aboriginal, fish, bird, invertebrate and mammal galleries. The new exhibits, which include some of the most ambitious and complex ever installed in the Australian Museum, are of the highest world standard.

During Dr Evans' directorship the status of the Museum as a leading scientific institution was considerably increased. This was achieved by the recruitment of well qualified and experienced staff and because the appointment of eleven new Museum assistants helped to relieve curators of part of their routine duties. Dr Evans was also instrumental in obtaining funds to purchase urgently required scientific and other equipment.

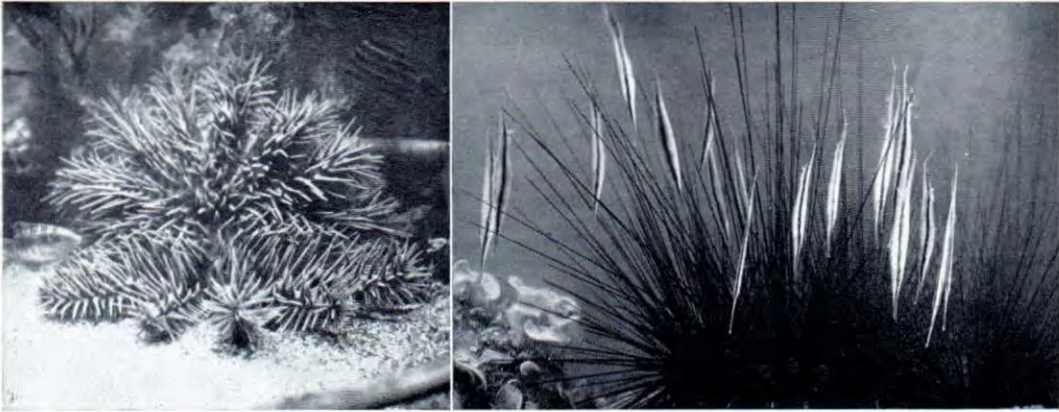
In 1963, nine years after Dr Evans became Director, a new building of six floors and a roof cafeteria was completed and officially opened. This has provided additional storage space, new public galleries, offices and laboratories. A new fossil gallery and an anthropological gallery are nearing completion in this building and recently working plans have been prepared for a new six-storey building to house spirit collections and provide additional working space for the Departments of Preparation and Art and Design. Major alterations in progress at the present time include also the modernization of the Museum's main entrance hall and an adjoining gallery which is to be devoted to the natural history of Papua-New Guinea and Antarctica.



Dr J. W. Evans presenting a prize to Murray Fletcher, 14, of North Sydney Boys' High School, one of five young people who received awards last year for being the first to complete a series of 19 questionnaires in the "Museum Walkabouts". The popular "Walkabouts" were introduced by Dr Evans in 1963. [Photo: Howard Hughes.]

Although Dr Evans has engaged in several aspects of entomological research he is best known for his interest in the order Hemiptera, in which field he is a recognized authority. His enthusiasm for research is exemplified by the many papers he was able to publish during his term as Director in spite of a heavy burden of administrative duties.

The Trustees place on record their appreciation and recognition of Dr Evans' valuable services to the Museum and they extend their congratulations to him on his achievements and their best wishes for many enjoyable and fruitful years of retirement.



By night many echinoderms in the Aquarium of Noumea become active. Left: A Crown of Thorns Starfish (*Acanthaster planci*) shows its spines, which can inflict painful wounds. Right: A group of Razor Fish (*Aeolisicus strigatus*) swim head downwards and find protection among the long spines of the Needle-spined Urchin (*Diadema setosum*).

THE AQUARIUM OF NOUMEA

By R. CATALA

A rather special bond exists between the Aquarium of Noumea in New Caledonia and the Australian Museum in Sydney. It goes well back beyond actual building of the Aquarium, to the time when its founders first sought the help of those curators in the Australian Museum who dealt with marine animals. These ties have been strengthened over the years by gifts of specimens and exchanges of information. It was, therefore, a pleasure to accede to the request of the Director of the Museum, Dr J. W. Evans, for an article on the Aquarium for publication in "Australian Natural History". However, it will not be the first time that the Biological Station at Noumea, with its Aquarium, has been mentioned in this magazine, for it was described briefly by Elizabeth Pope in an account of the natural history of New Caledonia in the March, 1962, issue (Vol XIV, No. 1).

When my wife and I founded the Noumea Aquarium in 1956 we had in mind three main objectives. These were (1) to allow the study of organisms under conditions as nearly as possible identical biologically with those of their natural environments, concentrating on organisms most typical of the

lagoon fauna, in particular on coelenterates such as corals, alcyonarians, gorgonians, etc.; (2) to build up, as far as possible, a comprehensive photographic record of the animals and to make movie films of such species as may be regarded as extremely rare or of exceptional scientific interest; (3) to allow visiting members of the public to learn about living and growing organisms of types generally unfamiliar to them—kinds of organisms which are not available in aquariums in other parts of the world. These goals have now largely been attained.

The marine biological station comprises an aquarium open to the public, a scientific laboratory and the apparatus and pumping installations needed to ensure the continuous renewal of the sea-water in the tanks. The aquarium section, at present, comprises a gallery with twenty-four glass-fronted tanks which are arranged in a rectangle around a service area in the centre. The largest of these tanks has a 10,000 litre capacity. A separate special gallery of ten tanks is devoted entirely to the presentation of organisms from deeper waters that fluoresce under ultraviolet light, such as true corals (Hexacorallia), false or alcyonarian

corals (Octocorallia), anemones, echinoderms, sponges and algae. Now, thanks to a recent grant from the French Government, an extension of the building has begun which should double the size of the station. The grant is expressly for the development of the section of the Aquarium that is open to the public.

Outside the buildings are reserve tanks and aquariums specially designed for the taking of photographs. Adjoining the Aquarium is the laboratory, where biological experiments are carried out continuously along with the perennial investigations into techniques which are of direct interest in the management of the display tanks, for example the culture of plankton (for food), etc.

Sea-water is supplied in open circuit to the tanks at the rate of 400,000 litres per day. It is drawn off, at a distance of 120 metres from the shore, in the open water, beside a small littoral coral reef. The pumping station comprises two entirely independent installations so that if mechanical failure occurs or a break in the pipe line puts one out of action, the other is immediately available to take over and maintain the supply.

Plants, especially in the warmer weather, are abundant in the Aquarium, being represented by those species which are self-introduced into the tanks, per medium of the running sea-water (for example, *Valonia*, *Enteromorpha*, *Ulva*, *Gigartina*, calcareous algae, etc.) rather than by species which are deliberately introduced to serve as food for the animals or to help to maintain a balanced environment.

Inhabitants Of The Aquarium

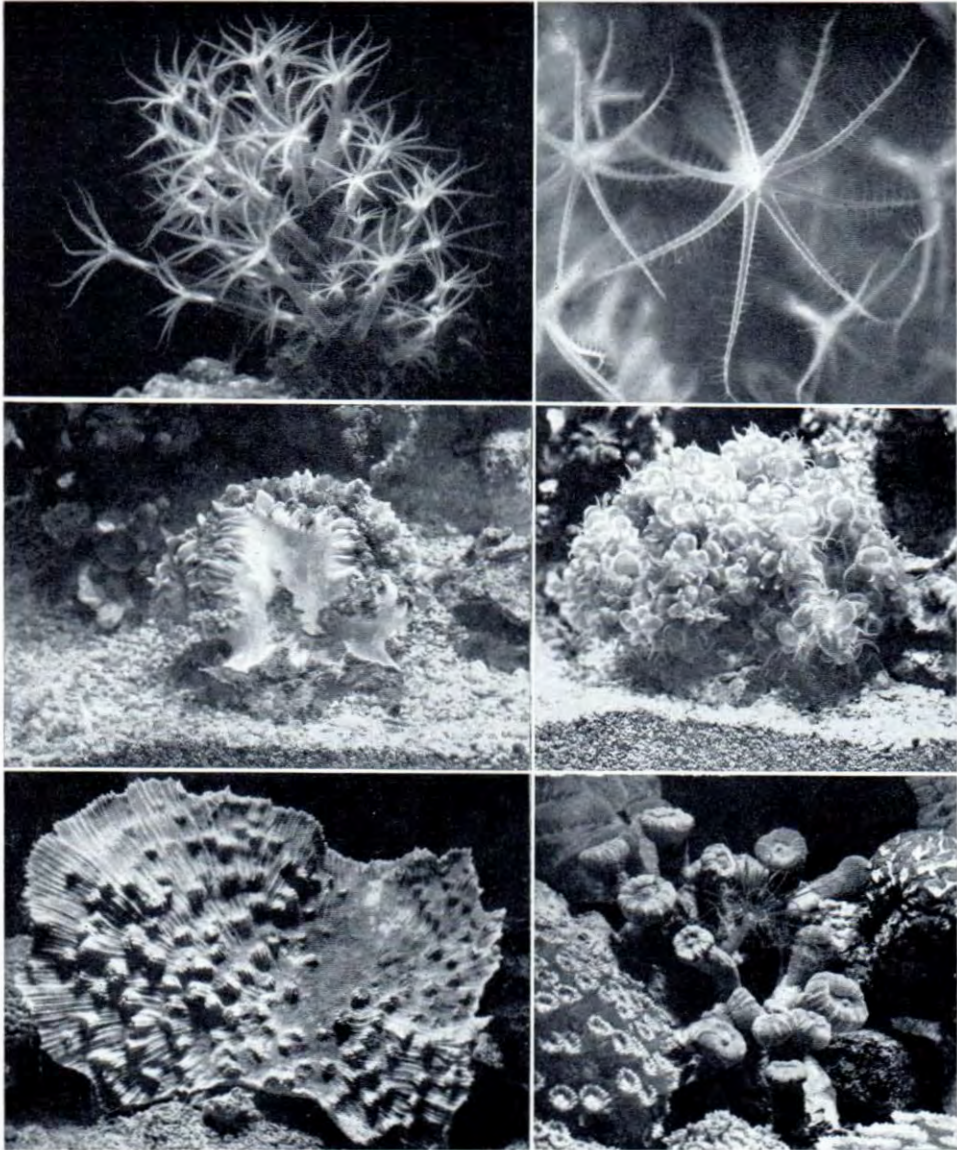
People are always interested to know what can be viewed in the Aquarium, and so the following list sets out, firstly, the permanent inhabitants that are almost always available and, secondly, the rarer species, generally those more difficult to maintain and which therefore can be regarded as occasional or temporary inhabitants only. It is among this latter group, naturally, that some of the most interesting animals are to be found.

Permanent inhabitants of the Aquarium include:—COELENTERATES: hexacorals (stony corals), octacorals (gorgonians, alcyonarians and pennatulids) and anemones. They come from shallower and deeper water habitats. Many coelenterates possess fluorescent pigments. **ECHINODERMS,** such as starfishes like *Oreaster* (the Rhinoceros Star), *Nardoa* and Blue *Linckia*, crinoids of several kinds, e.g., *Comatula* and *Antedon*, many kinds of ophiuroid brittle stars, sea urchins such as the Needle-spined Urchin, *Diadema* and bèches-de-mer or holothurians like the striped Water-bag *Synapta* or sea cucumbers *Stichopus* species and *Holothuria* species. **ANNELID WORMS** are represented by sedentary types like *Spirographis* and the beautiful *Spirobranchus*. **ASCIDIANS** or sea squirts are represented from shallower and deeper waters. **MOLLUSCA** of many types are shown, including chitons, bivalves (like *Pinna*, *Pecten*, *Hippopus*, etc), cephalopods (octopuses) and many gastropods of the prosobranch group. Among **CRUSTACEANS** perennially on show are marine crayfish (langousts), crabs, mantis shrimps, hermit crabs and various shrimps. **VERTEBRATES** are represented by about 450 fishes of 85 different species and constitute a selection of the most typical and spectacular species from the coral lagoon or from the edge of New Caledonia's Great Reef; reptiles are also regularly represented by turtles and sea-snakes such as *Aipysurus* species.

Temporary inhabitants include: rare deep-water SPONGES, COELENTERATES like the Portuguese Man-of-war (*Physalia*), large rhizostome jelly-fish with their attendant commensal fishes; deep-water BRYOZOA (lace corals, etc.); MOLLUSCA such as the interesting nudibranchs, cuttlefish and Pearly *Nautilus*. **PROTOCHORDATE ASCIDIANS** are represented sometimes by the deeper water species *Polycarpa aurita*. Among the rare VERTEBRATES which are kept are sharks and rays (of the cartilaginous fish group) and members of the following families of bony fish: Plotosidae, Exocoetidae (Flying Fishes), Clupeidae, Hemiramphidae, Syngnathidae, Aulostomidae, Pegasidae, Silaginidae, Priacanthidae, Carangidae, Mullidae, Acanthuridae, Mugilidae, Sphyraenidae, Muraenidae (eels) and Antennariidae. Occasionally even mammals may be represented. Recently a dugong, 1.80 metres long, weighing 60 kg, lived for four months in the Aquarium.

Fluorescent Organisms

The phenomenon of fluorescence in corals from depths of from 30 to 40 metres was discovered in January, 1957. The two first specimens which responded to ultraviolet radiation by fluorescing were the corals *Euphyllia picteti* and *Cynarina lacrymalis*. Ever since this time methodical prospecting for this phenomenon has been carried out both in the lagoon and outside the Great Reef. At the present time corals representing thirty or so genera are displayed in the



Some corals and alcyonarians from deeper waters. *Top* (left) the rare alcyonarian *Alcyonium catalai*, fully expanded, and (right) a close-up enlarged view of its polyps, showing the eight feathery tentacles, with batteries of nettle cells barely visible as white dots. *Centre*: Two views of the deep-water coral *Pterogyra sinuosa*, the left one showing flesh and tentacles retracted, by day, the other showing the polyp expanded, by night. Note the swollen bases to the tentacles. *Bottom*: *Left*, a remarkable fluorescent coral, *Mycedium elephantosis*. Its all-over colour is fleshy-pink in daylight, but, under ultraviolet radiation, the most delicate tones of blue are seen on the striated general surface while the rounded raised corallites are pinkish-mauve. *Right*, corals from the aquarium's display of fluorescent organisms. Daisy-like polyps of *Goniopora lobata* (bottom left-hand corner) glow with a greenish hue. Surrounding the central spidery-tentacled anemone is a group of stalked *Caulastrea furcata* corals which glow bright-green under ultraviolet, and towards the top-right a part of the brain coral *Platygyra lamellina* is seen. In the top left-hand corner is a simple coral, *Cynarino lacrymalis* (the first species discovered to fluoresce), which varies from peacock-blues and green to orange.

Hall of Fluorescent Organisms. Some are colonial corals (*Alveopora*, *Goniopora*, etc.), others are solitary forms (*Cynarina*, *Trachyphyllia*, etc.).

Other coelenterates also exhibit very beautiful fluorescence, in particular some of the alcyonarians and anemones. Amongst the feather stars, some species of the genera *Comatula* and *Comanthus* have remarkable powers of fluorescence. Finally, deep-water sponges of the genus *Euspongia* must also be added to the list.

Preliminary research on fluorescent madreporal corals has revealed that three kinds of pigments are involved in the fluorescing processes—flavines, urobilines and pterines. No doubt subsequent work will disclose others. Several theories have been advanced as to the role these pigments play in the living organism. It was thought, for instance, that an acceleration of photosynthesis might take place to the evident advantage of the microscopic algae (Zooxanthellae), which co-exist, in the flesh of the coral, with the pigment granules. Another theory put forward is that these deep-water corals might be able to utilize other radiations and be able to utilize the energy of the ultraviolet rays, in their metabolic processes. But in either of these two theories one must ask oneself why a considerable number of other corals species from similar depths and from biologically similar habitats do not manifest any fluorescent reactions under ultraviolet light. Various other theories have been advanced about fluorescence but the scope of this article will not allow me to set them all out in detail. Whatever its function may be, this ability to fluoresce which occurs in certain marine organisms opens up exciting prospects of many lines of investigation into diverse fields concerned with its biochemistry, its physics and its biology. It also offers a new technique for use in the field of taxonomy in a group like the corals which, up till now, has taken into account only the characters of the calcareous skeletons, when trying to determine the relationships and classification of species within the group. Studies on the living tissues show, in fact, that different patterns of fluorescence separate certain corals which up till the present have been considered as belonging to one and the same species.

While awaiting the complete solutions to the problems raised by the phenomenon of fluorescence, we may note that the list of organisms possessing this remarkable ability is still far from being complete and meanwhile we can enjoy to the full the spectacle of extraordinary beauty which they present.

The Aquarium is open to workers of other countries who wish to engage in scientific research or to make observations on its inhabitants. Already specialists from many countries, including Australia, England, America, Japan and France, have used its facilities. Here they have been able to study the deeper water fauna which would have been very difficult or even impossible in the natural habitats.

The Work Of The Aquarium

Through the offices of the Aquarium, already much of the New Caledonian reef and lagoon fauna has been collected and named or has been sent to specialists abroad for identification and documentation. Some of these specialists were attached to the Australian Museum, and others, notably Professor J. W. Wells, of Cornell University, Ithaca, N.Y., U.S.A., who identified the madreporal corals, in particular the fluorescent ones, or Madam Tixier, of the Paris Museum, who named the numerous alcyonarian corals, came from much farther afield.

Another project has been the collecting and documentation of the local marine algae by Madame Catala, and this marine flora has been identified by Valerie May, of Sydney, New South Wales.

The photographic recording of the fauna has gone on ceaselessly and a very large library of colour photographs has already been compiled. Invertebrates, particularly coelenterates, have received special attention and much has been accumulated on living stony corals and alcyonarians, both in daylight and under ultraviolet light.

Many molluscs, especially nudibranchs, have been recorded and one recalls with pride that the first colour transparencies of living Nautilus were taken at the Aquarium. Very fine records have been obtained of rare echinoderms such as the crinoids and



A beautiful pink and white alcyonarian, *Spongoes merleti*, which comes from a depth of 40 metres, can expand until it is two feet or so in height or retract below the surface of the sand.

the Basket Star (*Gorgonocephalus*) and, in the Crustacea, of the rare shrimps *Hymenocera* and *Hippolysmata*. Finally, many photographs of marine polychaetes have been obtained, in particular of serpulids which are abundant in the lagoon of New Caledonia.

Important records in colour have been made showing live fish in natural attitudes. They cover the lagoon fauna or extremely rare species or even records of species new to science. The most remarkable changes in coloration during the course of growth and development have been observed and recorded for certain species of *Coris*, *Novaculichthys* and *Cetoscarus*.

Cinematographic documentation has enabled us to produce a 70-minute-long, 16-mm colour film which includes several notable "firsts" in its records of the animals, and when this film was projected recently in Australia, at the Australian Museum and the University of New South Wales, such interest was aroused at university level that the authorities and zoologists there have strongly urged us to write and add an English commentary to it, as it should have very wide appeal. It is hoped

this project will be completed before the end of 1966. In this film "Carnival Under the Sea", the most remarkable of the Aquarium's animals are featured.

It was under this same title that a book which documents all the scientific findings of consequence made at the Aquarium appeared in October, 1964, published by R. Sicard, Paris. It comprises 144 pages of text, many black and white illustrations, and 28 colour plates. It is available either in a French or English edition.

Some of the illustrations reproduced on stamps may almost be regarded as scientific records of the marine organisms from the Aquarium. Some stamps of this type will continue to appear each year. Those genera which have already appeared on stamps are *Brachyurus*, *Lienardella*, *Glaucus*, *Spirographis*, and fluorescent corals; also the *Nautilus*, ascidians, *Hymenocera*, *Phyllobranchus* and *Paracanthurus* have been featured. A set of three stamps showing the typical colour patterns of the same fish in the juvenile, the sub-adult and adult stages and the new alcyonarian species from deeper water, *Alcyonium catalai*, appeared late in 1965.

This survey of the Aquarium of Noumea and its work must perforce be restricted to mere essentials and must omit any account of the many fascinating ancillary activities associated with the proper maintenance and continuous display of so many diverse animals and the keeping of them in perfect condition—the frequent deep-diving projects, the excursions to fulfil feeding requirements, and so on. We can also mention only briefly the worth of the Aquarium to Noumea as a tourist attraction. However, no account would be complete without acknowledging the financial aid which has been given on several occasions from Metropolitan France and help, in the form of grants-in-aid, made each year by the Territory and the Tourist Department and the Municipality of Noumea.

Finally, it must be said how much the freely-given help received through the collaboration of foreign scientific institutes (in particular from the Australian Museum) has helped and proved a powerful driving force to the founders of this Station.

[Photos in this article are by the author.]



An artist's reconstruction of *Rhaetosaurus*, a herbivorous dinosaur found in Jurassic sediments near Roma. [Oil painting by Douglas Annand.]

Fossil Footprints in Queensland

By ALAN BARTHOLOMAI
Queensland Museum

IN several Queensland localities we have been fortunate enough to follow literally in the steps of time. Footprints left behind by various kinds of extinct animals of the Mesozoic Era are periodically encountered, preserved in sedimentary rocks, mainly in the coal measures of the south-eastern portion of the State. These range in age from the middle part of the Triassic period to the lower part of the Cretaceous period of geological time, from about 220 to 120 million years ago.

The Mesozoic Era, comprising the Triassic, Jurassic, and Cretaceous periods in descending order of age, is often referred to as the Age of Reptiles, owing to the remarkable radiation in the numbers and types of reptiles which inhabited the earth at that time. They were, in fact, the dominant form of vertebrate life, and it is not surprising that the majority of the fossil footprints in rocks of this era relate to land-living reptiles. Of these, by far the most impressive were the dinosaurs, some of which reached gigantic proportions and represented the acme in size development in the terrestrial verte-

brates. Generally speaking, the largest dinosaurs were quadrupedal animals maintaining a herbivorous way of life, but not all herbivorous dinosaurs were quadrupeds. Some had reduced forelimbs, associated with a bipedal stance, thus resembling, to a degree, the upright stance of the carnivorous dinosaurs which preyed upon them.

The dinosaur footprints so far located in Queensland all appear to belong to carnivorous dinosaurs of the group known as the Theropoda, particularly interesting as the carnivorous dinosaurs are poorly represented by skeletal remains throughout Australia. The prints vary considerably in size, even within the same geological horizon, but all present a three-toed appearance, with the individual toes tapering towards their tips. It is to be expected that the prints of such dinosaurs would show evidence of the possession of large terminal claws, but those examined to date have apparently been exposed to some degree of obliteration before preservation and the impressions of the claws have been almost entirely erased or completely lost.

Rhondda Dinosaur

For several years, dinosaur trackways have been known to occur in abundance at several localities in the Walloon Coal Measures of Middle Jurassic age, but early in 1964 a series of older, three-toed prints was located in the roof of a coal seam in the uppermost part of the Ipswich Coal Measures of late Middle Triassic or early Upper Triassic age. They represent the earliest evidence of dinosaurs in Australia, and, with the possible exception of one South American form, may even be the oldest in the world. The trackway, consisting of three prints across the roof of a tunnel, was located by miners about 700 feet below the surface in the Rhondda Colliery near Dinmore, a small coal-mining community about 16 miles south-west of Brisbane. It was obviously made by one animal.

The best-preserved print, which was cast in plaster for study and display, measured about 18 inches in length and the stride was just over 6 feet, indicating that the Rhondda dinosaur was of moderate size, and may have approached 20 feet in total length. In form, the footprints are very similar to those identified as *Eubrontes* from slightly younger sediments of Upper Triassic age in the Connecticut Valley, U.S.A., an area famous for the multitude of track-

ways which occur there. Although these footprints at Dinmore are considerably smaller than most located in the Walloon Coal Measures, they do represent considerable evolutionary development beyond the condition ancestral to the dinosaurs observed in the Lower and Middle Triassic thecodont reptiles.

Footprint Two Feet Long

Also on display in the Queensland Museum is a representative print removed from the roof of the coal workings in the Jurassic sediments at the Balgowan Colliery on the Darling Downs about 120 miles north-west of Brisbane. It measures over 2 feet in length and indicates the size ultimately achieved in the carnivorous theropod dinosaurs of that period.

Many of the prints uncovered by coal-mining operations are found projecting downwards into the workings from the mine roofs, perplexing many of the visitors, as well as some of the miners, viewing the trackways. Such phenomena are readily explained by building up a logical series of events relating to their history of preservation and discovery. During their life, many of the dinosaurs frequented lushly vegetated swamps, the herbivores seeking their plant food there, and the carnivores seeking their

Triassic dinosaur footprint from the Rhondda Colliery. This cast represents the footprint as it appeared in the mine roof. [Photo: The Queensland Museum.]



prey. As the decaying vegetable detritus accumulated, deposits of peat were formed, and it was in such peaty deposits that many of the footprints were made. In time, silt was introduced to the area by running water, filling and covering the impressions, thereby preserving them. Over millions of years, considerable thicknesses of sedimentary rocks were deposited under the continuing freshwater conditions, and the peat in which the prints were made was ultimately converted into coal. Much later, when this was removed from its sandwiched position between rock layers, the natural casts of the footprints project from the mine roof.

Because of their position, removal of the actual prints is often impracticable, due regard having to be paid to mine safety regulations. Even where the footprints can be safely removed by careful excavation, collection is often hindered by cramped working conditions. For example, the seam from which an actual print was removed at Balgowan was only 3 feet 9 inches in thickness. Furthermore, the rock in which the prints are preserved often shatters during excavation and it is usually necessary to wedge a cushioning box against the print



Dinosaur footprints of Jurassic age in the roof of coal workings in the Westvale Colliery. [Photo: The Queensland Museum.]

to hold any broken sections in close juxtaposition. Application of a plaster of paris backing gives rigidity to the specimen after its removal, and prevents further fracturing. However, one print in the Queensland Museum from the Westvale Colliery was calmly removed in one piece by a miner with a single well-judged blow of his pick.

Where removal of the prints is impossible at the present time, an adequate record of the occurrence can be made in the form of a plaster mould. Even this is not without its difficulties, as the plaster has a tendency to fall from the roof if too much weight is added.

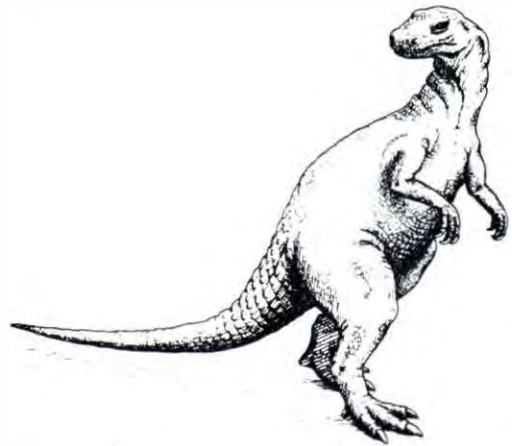
Not all of the fossil footprints in southeastern Queensland, however, are located in coal mines, and after the important dinosaur discovery at the Rhondda Colliery, an investigation was made of a previously-known site in a shale deposit, also of Triassic age, in the floor of Petrie's Quarry at Albion, a suburb of Brisbane. Attesting to the relative abundance of prints at this locality, no less than thirty were uncovered in a single day with the assistance of the University Student Geology Club. Many were present in distinct trackways, and these related to at least two different types of tetrapods. None of the footprints, however, appears to relate to the dinosaurs, although some may be reptilian, being three-toed, but with the individual toes elongated and slender.

By far the greatest number of prints were made by moderate-sized labyrinthodont amphibians, contemporaries of the Middle Triassic reptiles. These were short-legged, broad-shouldered vertebrates, very different in appearance and locomotion from the frogs which are the only representatives of the Amphibia we know in Australia today. Their trackways show them to have a broad straddle and short stride, with a quadrupedal stance. Skeletal remains of various labyrinthodonts are known from Triassic deposits elsewhere in Australia, including *Bothriceps* and *Paracyclotossaurus* from the freshwater sediments of New South Wales. The best preserved trackway at Albion contained nineteen prints, each of which measures about 6 inches in length and 5 inches in breadth, with indications of three and sometimes four short, broad toes.

A fossil bone deposit has been recently located at Mt Morgan, within a half a mile of an occurrence of dinosaur footprints. Both occurrences are in freshwater sediments of apparent Lower Cretaceous age, but the bones appear to be slightly older than the footprints. The trackways are interesting in that they illustrate not only the large three-toed prints of the hind foot, but also much smaller five-toed prints presumably made by the forefeet of the dinosaur as it ambled forward.

Unfortunately, however, it is generally the case that where footprints are common, preservation of actual skeletal elements is rare. This is certainly true of the coal measures in the south-east of Queensland, and it is not until one examines the Cretaceous marine sediments of the Great Artesian Basin that reptilian bone fossils are commonly encountered. One exception to this is the occurrence of a large, quadrupedal, herbivorous dinosaur, *Rhaetosaurus brownei*, known from a single incomplete skeleton from Durham Downs, in Jurassic sediments to the north of Roma in the south-east of the State. It is easy to imagine that such animals were preyed upon by flesh-eating dinosaurs like those which left their prints in the coal measures.

Apart from the occurrence at Mt Morgan, trackways are unknown in sediments of the early part of the Cretaceous period, about 120 million years ago, as much of inland Queensland, where most rocks of this age occur, was covered by a shallow epicontinental sea. Various types of marine reptiles thrived there, including the dolphin-like ichthyosaurs such as *Myopterygius*, long-necked plesiosaurs like *Woolungasaurus*, and short-necked pliosaurus like the gigantic, 40-foot *Kronosaurus*. These are known from their skeletal fossil remains. They were reptiles which returned to an aquatic existence, similar to the reversion of the whales and dolphins among the mammals. Quite surprisingly, skeletal remains of terrestrial plant-eating dinosaurs are sometimes found interred in these obviously marine sediments. This was because the largest herbivorous dinosaurs probably enjoyed a semi-aquatic environment, where their buoyancy in water assisted to support their great bulk, and where, at the same



An artist's reconstruction of the type of dinosaur which left its tracks in the coal measures of south-east Queensland. [Drawing by Queensland Museum staff.]

time, there was abundant plant food. Their bodies could then quite conceivably be washed out to sea after death. None of the remains collected to date is complete, probably due to predation or to scavenging after death. *Austrosaurus*, represented by several vertebrae, and collected from Clutha Station, near Maxwellton in central northern Queensland, was the largest of these Cretaceous dinosaurs. It may have attained a length of about 50 feet, and was probably larger than the earlier *Rhaetosaurus*. In addition, parts of a bipedal herbivorous dinosaur, somewhat similar to the well-known European dinosaur *Iguanodon*, and estimated to have been about 35 feet in length, were collected from near Muttaborra in central Queensland early in 1963. Also, remains of what appears to be an armoured dinosaur have been recovered from near Winton, in central Queensland, from freshwater Cretaceous sediments.

Although remains of dinosaurs are all too few in the Cretaceous rocks in Queensland, we know considerably more about these animals from the fragmentary skeletons preserved than we know about the reptiles and amphibians which left their footprints in the coal measures in the south-east of the State. We can only hope that, ultimately, fossil bone deposits will also be located there, to supplement the evidence accumulating from the study of the tracks these animals left behind them.

PARASITISM AND THE PARASITIC HELMINTHS

By E. S. ROBINSON

Zoology Department, School of Biological Sciences, University of New South Wales

PARASITISM is widespread in the animal kingdom. Apart from the Echinodermata and Brachiopoda, every major phylum includes species which are parasitic. Although everyone has some idea of what is involved in a parasitic relationship, parasitologists have difficulty in framing a comprehensive definition of a parasite. All would agree that a parasite is dependent on another living organism (the host) for food. Yet different groups of parasites show different degrees of dependence at various stages of their development.

A generally acceptable definition of a parasite is: "An organism which derives at least part of its nutritional requirements from another larger living organism." The reader may still be able to think of animals that fit this definition but are obviously not parasites! A blood-feeding mosquito, for example, is consistent with such a definition but is not thought of as a parasite. To get around this problem some parasitologists use the term "micropredator" to describe blood-feeding insects.

Parasites have evolved from free-living ancestors. Some must have arisen from their ancestral stock far back in geological time and are now highly modified in their structure and physiology. In metazoan parasites, these structural and functional adaptations usually involve the reduction of sense organs, the development of strong attachment organs and an increase in reproductive capacity. Many of the problems confronting a parasite are obviously different from those of its free-living relatives, and amongst the animal parasites we see many intriguing adaptations to parasitism. Successful or well-adapted parasites do not drastically harm their hosts and do not elicit antagonistic responses in their hosts. The widespread occurrence of host-parasite relationships which seem to have little effect on either member is sometimes overlooked because the parasites most frequently

studied and discussed are those which cause disease.

Parasitic Worms

The reaction of most people to parasitic worms is one of revulsion. The basis of this response is twofold. Firstly, living parasitic worms are not attractive in external appearance with their smooth, soft, whitish, worm-like bodies and slow rhythmic contractions. Secondly, their mode of life is regarded by many as more loathsome and insidious than the predator's habit of quickly overpowering its prey.

Such an attitude no doubt stems from anthropomorphic considerations. Humans tend to be impressed by their fellows who realize ambitions through power and strength. On the other hand, people tend to regard with suspicion and distaste those who achieve success by less spectacular, indirect and more cunning methods.

However, in a discussion of parasitic worms from the strictly biological point of view we do not consider emotional or ethical attitudes. Our interest lies in the structural, functional and life-cycle adaptations of parasitic worms and the nature of the complex relationships which exist between the parasite and its host.

Parasitic worms or helminths (from the Greek word meaning "worm") are not grouped into any one taxonomic category. The majority of species belong to two phyla—the Platyhelminthes and the Aschelminthes. The remainder are included in certain lesser-known phyla, such as the Acanthocephala.

The platyhelminths or flatworms are, in most cases, dorso-ventrally flattened worms lacking a body cavity. They usually have both male and female reproductive systems present in the same individual. There are two very important groups of parasitic flatworms, namely, the trematodes or flukes and the cestodes or tapeworms.

cause loss of condition, scouring and even death. Larval reproduction, which may take 40 to 50 days, occurs in a particular species of freshwater snail, *Lymnaea tomentosa*. This snail, up to half an inch long, can be readily distinguished from other snails found in the same swampy or wet pasture habitats because it is "right-handed", that is, if the aperture of the shell is directed downwards and the spire directed towards the observer, the spiral is "right-handed". The disease is found in south-eastern Queensland, eastern New South Wales, throughout much of Victoria and in north-eastern Tasmania.

In estuaries and salt-water lagoons of N.S.W., a schistosome fluke, *Austrobilharzia terrigalensis*, which occurs in the adult stage in the blood of certain marine birds, may penetrate the skin of man causing an unpleasant dermatitis known as "swimmer's itch". The intermediate host of this trematode is the estuarine snail *Velacumantus australis*.

Cestodes

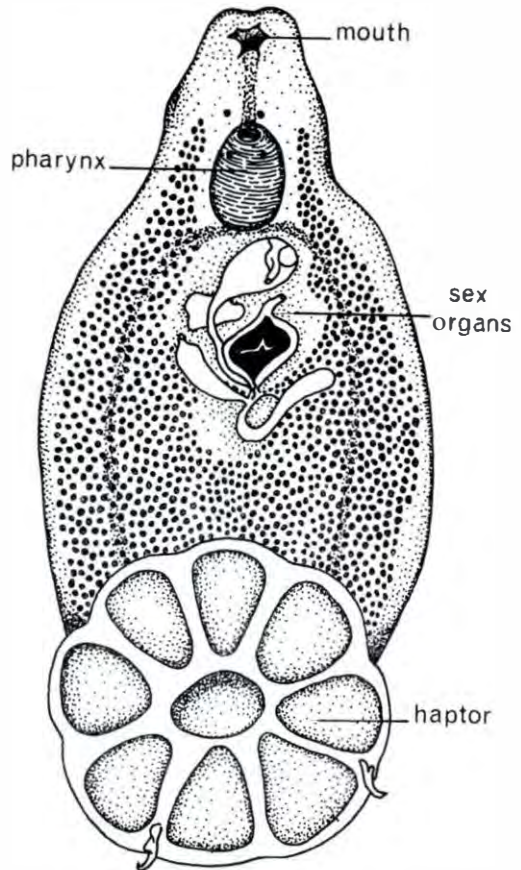
The cestodes or tapeworms are parasitic flatworms which lack a digestive system at any life-cycle stage. As adults they are found only in the gut of vertebrates. The tapeworm body is usually divided into segments called proglottids, which arise by a process of budding near the head and consist largely of male and female reproductive organs. The head or scolex of a tapeworm is provided with attachment organs which differ widely throughout the cestodes and include suckers, grooves, hooks, and armed proboscids.

In cestode life-cycles, larval stages develop in the intermediate hosts. The size, shape and structure of larval stages vary from the small spherical cysticerci of *Taenia pisiformis*, found in the body cavity of infected rabbits, to the long, thread-like plerocercoids of *Dasyrhynchus pacificus* in the muscles of the Jewfish and the large bladder-like hydatid cysts of *Echinococcus granulosus* in various mammals.

Echinococcus granulosus is a tiny tapeworm which may occur in large numbers in the small intestine of dogs. Eggs are deposited on the ground with the faeces of

the dog and if ingested by mammals such as man, sheep, pig, cattle and, in Australia, wallabies and kangaroos, hydatid cysts may develop in the brain or viscera.

In Australia, hydatids is certainly the most serious human disease caused by a parasitic worm. During 1961 there were twenty recorded deaths attributed to hydatid disease, of which four were in N.S.W. and twelve in Victoria. These limited data are of little help in indicating the total number of Australians harbouring hydatid cysts. A recent survey of farm and station dogs in N.S.W. showed that more than 25 per cent harboured the adult parasite. Domestic dogs and the dingo appear to be the only definitive hosts of *Echinococcus granulosus* in Australia.



Heterocotyle robusta, a monogenetic trematode found on a New South Wales marine fish, *Urolophus testaceus*. Note the conspicuous posterior haptor. [Diagram by the author.]

Nematodes

The phylum Aschelminthes is an extremely heterogeneous collection of groups which show little relation to each other. Nematodes or roundworms form by far the largest of these groups, with more than 10,000 described species. It is thought that the known species make up no more than a small proportion of the total number of living species.

Nematodes are tubular worms, pointed at each end and usually less than half an inch long. The well-known nematode *Ascaris*, which may reach a length of 10 to 12 inches, is therefore atypical in size. The sexes are usually separate in nematodes and the larval stages, although small in size, are similar to the adults in general appearance.

Roundworms are ubiquitous. It is often overlooked that half the known species are free-living in soils, swamps, lakes, rivers and oceans. Parasitic nematodes are commonly found on plants and in both invertebrates and vertebrates. There is, however, remarkably little morphological difference between free-living and parasitic nematodes. It would seem that free-living nematodes are pre-adapted for a parasitic existence.

The life-cycles of nematodes are extremely variable. Some are direct, such as *Ascaris* and the common threadworm of children, *Enterobius vermicularis*, while many are indirect, for example, filarial

worms which utilize arthropod intermediate hosts.

It is hard to over-estimate the economic and medical importance of parasitic nematodes. In Australia, there are many nematodes of sheep, cattle and pigs which lead to considerable economic losses annually. In sheep, for instance, gut nematodes include *Haemonchus contortus* (the Barber's Pole Worm), *Oesophagostomum columbianum* (the nodule worm), *Chabertia ovina* (the large-mouthed bowel worm) and species of *Ostertagia* and *Trichostrongylus*. All these species are capable of affecting the condition of sheep.

Australia is free from widespread incidence of any nematodes dangerous to man. Hookworms (*Ancylostoma* and *Necator*) are found in man in coastal regions of north-eastern Australia. Although massive infections may induce acute symptoms of pain and exhaustion, hookworm disease is essentially a chronic infection. The potentially dangerous filarial worm *Wuchereria bancrofti*, which is transmitted by mosquitoes, is found in roughly the same region.

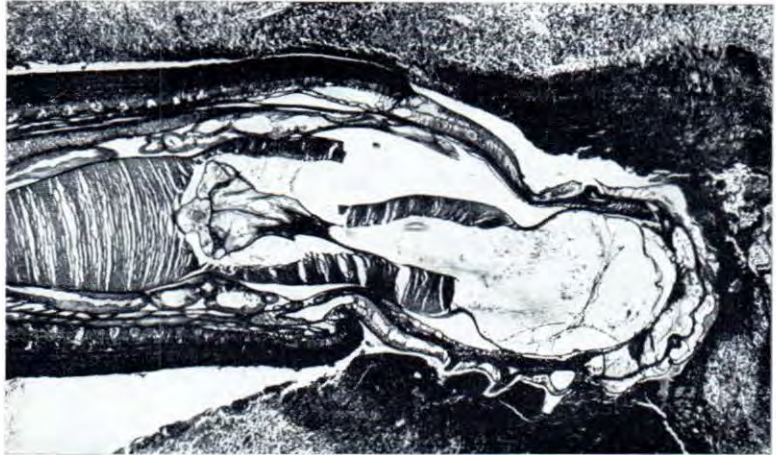
Minor Groups

Gordian worms (nematomorphans) are aschelminths which, as long, highly-coiled larvae, inhabit the haemocoel of insects and spiders. They are reasonably common in the local American Cockroach (*Periplaneta*

Part of the gut of an oceanic sun-fish, *Mola mola*, cut open to show a heavy infection by the tapeworm *Anchistrocephalus microcephalus*.
[Photo: M. King.]



A photomicrograph of a section through the anterior end of the Thorny-headed Worm (*Macracanthorhynchus hirudinaceus*), showing the hooked proboscis deeply embedded in the intestinal wall of a pig. [Photomicrograph by the author.]



americana). Acanthocephalans, the thorny-headed worms, are gut parasites of vertebrates. They possess several characteristics in common with cestodes but constitute an isolated and distinct phylum. An acanthocephalan, *Macracanthorhynchus hirudinaceus*, is common in pigs in parts of N.S.W., causing ulcerations of the gut wall around the region of attachment of the armed proboscis.

Control

The control of parasitic worm infections in man and domestic animals is an important applied biological problem. Chemotherapy, i.e., the treatment of parasitic infections with parasitocidal chemicals, is now widely practised. Extremely effective drugs are available for many gut parasites at a price which makes extensive treatment feasible. Although chemotherapeutic procedures may cure, they do not prevent, infection. Prevention of infection is most likely to be attained by interrupting the parasitic life-cycle at its most vulnerable phase. Such control measures require initially an exhaustive study of the ecological, behavioural and physiological aspects of the host-parasite relationship. It is only after the biology of the parasite and host is understood that worthwhile efforts can be made to destroy the delicate balance between the associated organisms.

NOTES AND NEWS

VISITORS TO MUSEUM

Dr A. W. B. Powell, of the Auckland Institute and Museum, recently spent three weeks at the Australian Museum working on literature and specimens of the family Turridae. He also had a field trip to the south coast of New South Wales with the Curator of Lower Invertebrates at the Chicago Natural History Museum, Dr Solem, and the Curator of Molluscs at the Australian Museum, Dr D. F. McMichael. Dr Solem, who specializes in the study of small land snails, later left for New Zealand and Fiji for further collecting.

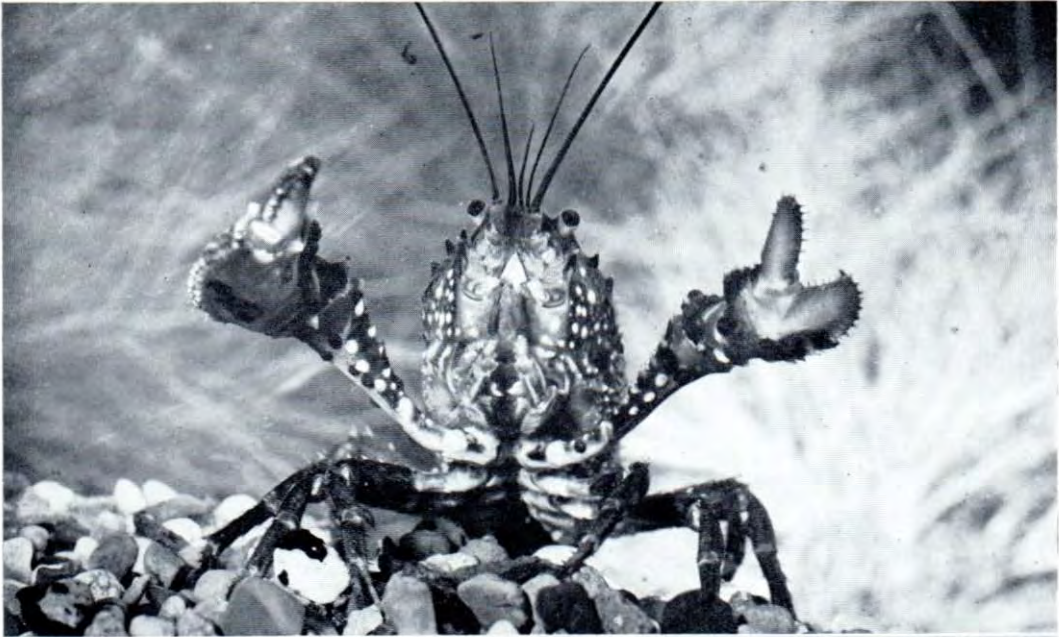
DOLPHIN EXHIBIT

Two dolphin casts were recently added to the Australian Museum's exhibits. They are reproductions of a single specimen of the Common Dolphin (*Delphinus delphis*) which was collected at La Perouse and presented to the Museum by the University of Sydney. One of the casts is cantilevered to give a free-swimming effect.

CUCKOO SPECIMENS

The Shining Bronze Cuckoo (*Chalcites lucidus lucidus*) winters in the Solomon Islands and migrates to New Zealand to nest in November and December. The exact route it takes is not known, as there is almost continuous ocean between New Zealand and the Solomon Islands. Last October two specimens, which had injured themselves by flying against windows near Sydney, were received by the Australian Museum. During the past few years a few specimens have been received in a similar manner in both spring and autumn, so the Australian east coast may be a regular route or the specimens obtained may have been blown off-course. The Museum's Curator of Birds, Mr H. J. Disney, is making a study of Bronze Cuckoos and would be pleased to receive any which are found dead or injured.

Sydney Freshwater Crayfish



Euastacus spinifer (sometimes referred to as *E. serratus*), the common freshwater crayfish of the Sydney district, N.S.W., photographed head-on in a threat attitude (above) and side-on in a resting position (below) with the last segments of the tail and tail-flaps (abdomen and telson) turned under the body. The prominent stalked eyes can be seen clearly in both photos. *E. spinifer* grows to a body length of about 9 inches (excluding the nippers or chelae) and is generally brownish-green with a variable amount of red, especially on the spines. There are at least 71 described species of freshwater and closely related land crayfish in Australia. [Photos: Howard Hughes.]



A mound of the Spinifex Termite (*Nasutitermes triodiae*), of the Northern Territory. This species makes the largest mounds of all Australian termites, measuring up to 20 feet high. [Photo: B. J. Marlow.]

INSECTS OF THE DESERT

By DAVID K. McALPINE

INSECTS, undoubtedly the most widespread of animals, are present on almost all the land surfaces of the earth. In Australia there is certainly no area where they are absent, even the driest parts supporting a host of different kinds.

Nevertheless, the insects living in the dry central and western parts of the Australian continent have special adaptations in their physiology, life-cycle or behaviour patterns which enable them to withstand the rigours of the climate. Most of the species living there are different from those of wetter coastal districts. When conditions fall below the minimum requirements for any species in a locality, extinction or at least decimation of the population takes place. Recolonization can take place when more favourable conditions are restored, if the

species has the ability to migrate or to multiply rapidly from a very low population level. In either case recolonization depends on the fact that our deserts are not uniform but during the long periods of drought some patches of country, however small, retain sufficient moisture, vegetation or shelter from extreme conditions for the survival of some individuals.

Dryness The Main Hardship

The most notable hardship to be withstood or avoided by desert insects is dryness. All insects, like other animals, need water for survival and there is a fascinating variety of ways in which insects can solve the water-shortage problem. Firstly, insects of dry country have the ability to lose water from their bodies at a slower rate than those of humid areas. Moisture

does not penetrate so readily through the cuticle of the body surface and they can commonly lose a larger percentage of body water without ill effects. They tend to avoid the extremes of heat which would cause excessive evaporation. Avoiding heat is very much the same as avoiding moisture loss in the desert. Some insects burrow in the ground or into living or dead plant material, or shelter under stones, so that they are really avoiding desert conditions by living in places where some dampness is retained, even through prolonged drought. Certain grasshoppers remain in the shade during the heat of the day, or, in the absence of shelter, they may turn end-on to the sun so that their bodies receive a minimum of its rays. Ants and some wasps, flies, and grasshoppers move very quickly over bare, hot ground thus presumably absorbing as little heat as possible before reaching the shade or flying into the somewhat cooler air well above the ground.

Many insects of arid or semi-arid areas develop and multiply very rapidly during and after rain, only to enter an inactive drought-resistant stage as drought conditions return. The drought-resistant stage of the life history may be either the egg or pupa, or even the adult insect.

Endurance Of Cold

Although deserts are noted for their cold nights, endurance of the cold is perhaps a more particular problem of high altitude and high latitude than of deserts, at least in this part of the world. A large proportion of insects remain in an inactive or non-flying stage of the life cycle during winter. In those grasshoppers passing the winter as adults, active movement is limited on cold mornings until the body temperature rises sufficiently, often as a result of basking in the sun.

It is to be regretted that there has been so little study of insects in the interior of Australia. Insects have, logically, been most studied near the main centres of population, and perhaps the less varied insect fauna of the Centre has discouraged much work on the very peculiar and specialized forms now known to exist there.

Because of their economic importance, the short-horned grasshoppers and locusts

have received more attention than most insects. Many of the species live only within special kinds of environments to which they are adapted, for example some are restricted to certain kinds of soil or vegetation. When we consider that the eggs are buried in the soil and the food of grasshoppers consists of living vegetable matter the importance of these factors becomes apparent. Quite often grasshoppers closely resemble objects in their environment. *Phanerocerus testudo* from South Australia looks like a rough, reddish pebble and is usually found among pebbles of this description (see *Australian Natural History*, September, 1962). Species of *Cratilopus* may resemble,



A Piedish Beetle (*Helaeus* species), often seen on sandhills in central Australia. Hindwings are absent and the elytra (modified forewings) are fused together on the insect's back. Length 1¼ inches. [Photo: Howard Hughes.]

from their colouring and ornamentation, stones covered with grey-green lichen. There are grasshoppers resembling sticks, grass, or leaves, and these are therefore very difficult to see in their normal surroundings.

Another characteristic of a number of desert grasshoppers is the tendency towards

reduction of wings. Ability to fly to new feeding grounds may seem an obvious advantage, but for an insect able to survive only in a narrowly defined habitat this could be fatal. A desert insect could well become "lost" and so perish.

Flies

In all parts of Australia flies are plentiful. The Bush Fly (*Musca sorbens*) is as plentiful and annoying to man and stock in arid Australia as it is on the east coast. The larvae of Bush Flies live in excrement or other moist material of animal origin, but in the dry interior entomologists have been unable to find sufficient of these materials to account for the numbers of flies present. This has long been one of the mysteries of Australian entomology—where do Bush Flies breed? Of course there are many other kinds of flies of whose breeding habits we know even less, but none so conspicuous as this.

By contrast a fly of the interior which is practically never noticed, except as a larva, is the Kangaroo Bot-fly (*Tracheomyia macropi*). The larva is a parasite within the windpipe of the Red Kangaroo (*Megaleia rufa*), and was described as early as 1913, though the adult fly was only made known in 1953.

Termites

There are many species of termites (com-

monly but incorrectly called "white ants"?) in Australia's semi-desert areas. Often their presence is made obvious by the conspicuous mounds constructed of clay and often also of plant material. Other species build only subterranean nests, or nests within tree trunks. One tends to associate termites always with trees or wooden buildings, but certain species can live in treeless plains where their giant nests may form the most conspicuous feature of the landscape. This is possible because some termites can live entirely on grasses, including spinifex (*Triodia*) and other small herbaceous plants. They are ideally suited to survival in the desert because of their ability to make the fullest use of available food. Digestion of cellulose, so important a component of all plant matter, is possible because of the presence of microscopic single-celled animals in the termites' gut. These ingest the otherwise indigestible particles and render them available as food to the insect.

Termites are insects of concealed habits and never venture forth in the daytime. The hot sun and dry air of the inland would rapidly destroy their delicate bodies by dessication. Even at night they do not move about in the open but work from their burrows or covered runways, which are constructed for access to objects in the open. Thus it is that an insect physically incapable of withstanding exposure to dry air for even an hour or two, can develop



A cricket-like insect, *Cylindracheta*, which burrows in dry sandy places. The insects of this genus are confined to Australia and the drier parts of Chile. Length about 1½ inches.
[Photo: Author.]

its own "cities" in the desert, through its complex instinctive behaviour patterns and physiology.

Ants

True ants abound in semi-desert regions and, though they never build mounds of the dimensions of some termite mounds, some build nests of characteristic appearance. The Meat or Mound Ant (*Iridomyrmex detectus*) builds its broad, low mounds in central Australia, as on the east coast. The large black Mulga Ant (*Polyrhachis macropus*) makes a conspicuous mound of mulga leaves with a central crater containing the entrance to its nest. The Honey-pot Ant (*Camponotus inflatus*) is found throughout the dry interior. Certain of the worker-ants serve as food stores for each colony. In these individuals the abdomen becomes distended with a honey-like fluid till it reaches the size of a small grape.

The other workers are fed on this fluid by regurgitation. The Aborigines esteem the sweet fluid, and dig the ants from their nests.

This leads to consideration of an even more widely known article of Aboriginal diet—the Witchety Grub. This term has been used for a variety of different edible moth and beetle larvae. Originally it referred to the larva of one or more species of Goat-moths (family *Cossidae*), particularly to a desert species, *Xyleutes leucomochla*, according to Tindale. The larvae are found burrowing at the foot of *Acacia* shrubs and it is claimed that availability of Witchety Grubs is an important factor in the rearing of healthy children in the Western Desert of Western Australia. Larvae of Ghost-moths (family *Hepialidae*) are also eaten. These live in the ground at the foot of trees or in holes excavated in trunks. The pupae and adult moths are often eaten in addition to the larvae.

NOTES AND NEWS

FIELD WORK

Three members of the Australian Museum's staff did about a month's field work in Queensland late last year. They were Dr F. H. Talbot, Curator of Fishes, now Director of the Museum; Dr D. F. McMichael, Curator of Molluscs; and Mr M. Cameron, a preparator. The trip included work at a number of planned locations along the Barrier Reef between the Capricorn Group and Cairns. They worked at the Heron Island G.B.R.C. Research Station, which now offers first-class facilities for scientific work, and camped on One Tree Island, Holbourne Island (off Bowen) and Michaelmas Cay (off Cairns). Day visits to a number of reefs were also made. At Michaelmas Cay they were accompanied by the Museum's former Curator of Fishes, Mr G. P. Whitley, who had previously visited the island in 1926 with the G.B.R. Boring Expedition led by Mr C. Hedley. Although the trip was not primarily a collecting one, but was planned to permit more time for general biological observations of selected groups, fair collections were made of shells and fishes.

SURVEY OF REPTILES

The Australian Museum's Curator of Reptiles and Amphibians, Mr H. G. Cogger, spent six weeks in New Guinea late last year carrying out a survey of the reptiles and frogs of Karkar Island, about 50 miles from Madang. Karkar Island is a dormant volcano about 15 miles in diameter and rising to a height of more than

6,000 feet. It has a native population of more than 15,000 but there are no villages or gardens above 1,200 feet. Mr Cogger spent about two weeks collecting in forest camps between 3,000 and 4,000 feet, while the remainder of the time was spent in collecting in coastal plantations and gardens. About 1,000 specimens of more than 30 species were collected.

EXCAVATION OF ROCK SHELTER

As a result of a previous archaeological survey near the junction of the Hunter and Goulburn Rivers, New South Wales, an Australian Museum party consisting of the Curator of Anthropology, Mr D. R. Moore, the Curator of Crustacea and Coelenterates, Dr J. C. Yaldwyn, and the officer in charge of the Exhibitions Department, Mr F. J. Beeman, carried out a week's field work in the Sandy Hollow area in November. Excavation of a rock shelter, previously located, proved very productive of artifacts and other Aboriginal remains. The bottom of the deposit was not reached when digging had to stop at a depth of 2 feet 6 inches. The object of this work is to establish a basic archaeological sequence for the Upper Hunter. It is also hoped that there may be some record of the known contact between the inland and coastal tribes. Later the survey will be extended downstream to the Singleton district. Other promising areas were surveyed and a painted cave in the Widdin Valley was recorded and photographed.



Galaxias coxii (top), Shoalhaven River, New South Wales, and *Galaxias truttaceus*, Flinders Island, Bass Strait. Scale line equals 1 centimetre. [Photo: Author.]

FISHES OF THE FAMILY GALAXIIDAE

By **ROGER FRANKENBERG**
Department of Zoology, University of Melbourne

FISHES of the family Galaxiidae form a considerable part of the southern Australian freshwater fish fauna. The smaller members of the family are generally known to fishermen as minnows, larger species as native or mountain trout. The term "minnow" especially is to be deprecated, as this name was originally applied to a European fish of a different order and more closely related to the carp. For the genus *Galaxias*, the generic name itself provides a suitable and euphonious common name. For the family as a whole, the family common name, "galaxiid", can be used.

In both habits and general appearance the galaxiids are not unlike the trout of the Northern Hemisphere, but with one exception are scaleless, and do not possess the small adipose fin typical of the salmon

family. Like trout, they will readily rise to a fly, and if it were not for their generally smaller size, the introduction of trout for sporting purposes would have been unnecessary.

In 1773, Forster, a naturalist with Captain Cook's expedition, noted small trout-like fish in an inland lake near Dusky Bay, New Zealand. Forster's description suggests that this fish was *Galaxias argentus*, and it is hence the first authentic record of the family. Nearly thirty years later, in 1802, Lesueur, a member of Baudin's expedition, secured a few small "truites" in south-eastern Tasmania with a "coup de fusil". Whereas his fishing technique is not encouraged today, his catch is believed to have been *G. truttaceus*, which is therefore the first Australian record.



Galaxias truttaceus (top), a large specimen of "whitebait", Pieman River, Tasmania, and *Galaxias attenuatus*, Calder River, Victoria. Scale line equals 1 centimetre. [Photo: Author.]

When first described, these Tasmanian fish were given the name of *Esox truttaceus*. *Esox* is the generic name of the pikes of the Northern Hemisphere, and there are indeed some points of resemblance. Both are rather elongate fish with a single dorsal fin set back far on the body. By comparison, trout have a more centrally situated dorsal fin, and, further back, a smaller fleshy adipose fin. The Grayling (*Prototroctes*), of the Southern Hemisphere family Aplochitonidae, also possesses a trout-like adipose fin, but on other characters is held to be closer to the Galaxiidae. While it is generally accepted that the Galaxiidae and Aplochitonidae are closely related, they have together been associated at different times with both the esocoids and the salmonoids of the Northern Hemisphere. Most recent opinion favours the salmonoid relationship; the resemblance to the pikes is therefore interpreted as being due to convergent evolution.

General Features Of The Family

The family as a whole has achieved considerable diversity. The largest member is the first-named species, *Galaxias argenteus*, of New Zealand, which has been recorded up to 23 inches in length and 6 pounds in

weight. *G. coxii* and *G. auratus* are probably the largest Australian species, but rarely reach 9 inches. Most species are included in the genus *Galaxias*, but six other genera are recognized, among which are the smallest and most diverse members of the family. Two of these genera, *Brachygalaxias* and *Lepidogalaxias*, barely exceed 1 inch in length. The colourful *Brachygalaxias pusillus*, which is characterized by a brilliant orange lateral stripe, was originally described from Victoria in 1936, and has since been found in Western Australia and Tasmania. The only other species of the genus is *B. bullocki*, of South America. *Lepidogalaxias salamandroides* from the south-west of Western Australia was not described until 1961, and is unique among the galaxiids in possessing a distinct lateral band of scales. The type specimens were taken from the muddy bed of a stream only a few inches in depth, near Shannon River. Their small size and cryptic habit undoubtedly enabled them to escape notice for a considerable time, and it is quite possible that other new and interesting species may yet be discovered. The genus *Paragalaxias* was created for a small species, *P. shannonensis*, only known from the Shannon Lagoon in Tasmania. *Nesogalaxias neocaledonicus* is also restricted in distribution,

only occurring in the Lac en Huit in New Caledonia.

The remaining two genera comprise the "Mudfishes" (*Saxilaga* and *Neochanna*), which burrow in mud or damp earth, and are well adapted to life in small streams which may dry up during hot summer months. Most galaxiids will survive for long periods out of water, but the original description of *Saxilaga cleaveri* provides the most striking example. The first specimen was taken at Ulverstone on the north-west coast of Tasmania in 1932, and was found in a cavity in the root of a tree stump which had been blown out of the ground by explosives. It was kept alive for some time in a tin of water sunk into the ground, but on one occasion jumped out and "was later found happily wandering about, some distance away among the tomato plants". When the fish was secured for the museum it was kept for over 65 hours in a dry container. By this time it was considerably shrivelled up and showed no signs of life. On being placed in formalin, however, "it revived, and demonstrated its vitality by a few vigorous plunges, only to be overcome in a few moments by the preservative" (E. O. G. Scott, *Papers and Proceedings of the Royal Society of Tasmania*, 1933, 41-47). The New Zealand Mudfish (*Neochanna*) is very similar to *Saxilaga* in habits and appearance, but is more "degenerate" in the sense that it has lost the ventral fins.

Most of the galaxiids live permanently in fresh water, but one species, *G. attenuatus*, has a marine stage as a normal part of its life cycle. The adults migrate downstream to spawn and the eggs are deposited in tidal estuaries at high-water mark of spring tide. The eggs normally hatch 14 days later on the next spring tide, and the young fish spend the first part of their life in the sea. Later they return to fresh water and ascend the streams where, in New Zealand, they are often netted in large shoals as "white-bait". Juveniles of the South American species *G. maculatus* are also known to enter the sea, and some other species are suspected of doing so. *G. truttaceus*, of Australia, and *G. fasciatus*, of New Zealand, have high salinity tolerances, and the young of these species are often taken in "white-bait" shoals in the lower parts of rivers.

On the basis of the downstream spawning migration of species such as *G. attenuatus*, the galaxiids have been interpreted as being in the process of invading fresh water from the sea, with *G. attenuatus* retaining the supposedly primitive spawning habit of the family. If the life cycle of *G. attenuatus* is examined more closely, however, it is seen that, as far as possible, the eggs are kept out of sea-water while they are developing. This is a highly specialized spawning habit which has been achieved independently by an atherine fish, *Leuresthes tenuis*, of North America. It could therefore alternatively be interpreted as an adaptation by a freshwater fish to saline conditions. Recently Mr David Pollard, of Monash University, Victoria, established that, for a landlocked population of *G. attenuatus* in Victoria, the direction of the spawning migration has become reversed. At spawning time the adults ascend the small streams flowing into the lake and deposit eggs on the grassy banks, often leaping entirely out of the water to do so, after the habit of their estuarine-breeding forebears.

World Distribution

As well as occurring in Australia, members of the Family Galaxiidae are also found in the southern regions and outlying islands of New Zealand, South America and South Africa. The explanation of this distribution has long been conjectural, but appears to involve three main hypotheses: (1) common marine ancestry; (2) continental drift, or land bridges between the southern continents; (3) migration through the sea of salt-tolerant forms.

The first hypothesis is considered unlikely, as there is no existing evidence of a common marine ancestor; present diversity and adaptations of the family suggest that some members at least have been long resident in fresh water.

As to the second, while there is increasing evidence for continental drift, it is doubtful whether such movements could have occurred recently enough to account for the close resemblances between some South American and Australian species. At the same time, it must be admitted that some fish have existed relatively unchanged

for long periods of time. Unfortunately, the palaeontological record is of little assistance in understanding the history of the Galaxiidae. The only fossils definitely assignable to the family are of *Galaxias* itself, from the Pliocene of New Zealand.

The most reasonable explanation of their distribution appears to be the third hypothesis, migration through the sea. *G. attenuatus*, on the basis of its present distribution, provides the strongest evidence that marine migration has taken place. It has a known marine stage in its life history and the same species occurs in Australia, New Zealand, and reputedly South America. *G. gracillimus*, of Chile and the Falkland Islands, is very similar to *G. attenuatus* and may prove to be conspecific. Several other South American species show closer resemblances to species in Australia or New Zealand than to other South American species. A similar situation exists between south-eastern Australia and New Zealand. If these apparent relationships are confirmed by more detailed investigations, then a strong case for marine migration should be established.

Effect Of Introduced Species

Since the introduction and establishment of many species of exotic fish in Australia, there has been a general decline in native species. At the same time, industry and agriculture have increased pollution and erosion, water conservation practices have changed the physical nature of many streams, and angling pressure has increased. Hence it is not always possible to lay the blame directly on introduced fish. Nevertheless, there is strong circumstantial evidence to suggest that introduced trout have been largely responsible for eliminating galaxiids from certain sections of Victorian rivers.

In the headwaters of the Kiewa River on the Bogong High Plains, Brown Trout (*Salmo trutta*) occupy the main body of the stream, while galaxiids are only found in situations inaccessible to trout, such as above waterfalls or in small tarns adjacent to the main stream. Assuming that the galaxiids were once continuously distributed, trout appear to have fragmented their range into a number of small isolated populations

The two have only been taken together in sluggish lowland streams with abundant weed growth, providing a more complex environment and less favourable conditions for trout.

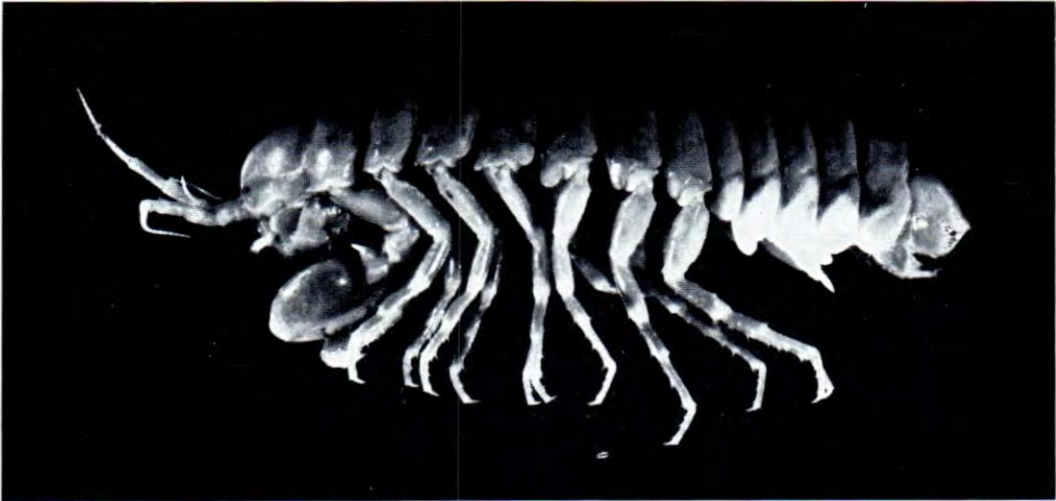
Lake Tarli Karng, a small high-altitude lake in Gippsland, once contained an abundant population of *G. coxii*. A recent expedition, however, only recorded Brown Trout, from both the lake and a small in-flowing stream. However, *G. coxii* still appears to have a widespread, if somewhat fragmented, distribution in south-eastern Australia. The threat of extinction appears to be greater for species with more restricted distributions.

The Tasmanian species, *Paragalaxias shannonensis*, *Galaxias auratus*, and *G. johnstoni*, are extremely limited in their known ranges, and exist with, or in close proximity to, trout. *Paragalaxias*, in particular, is of considerable zoogeographic interest, as it has been associated with the South African galaxiids. From the scientific viewpoint alone, such species should be preserved, but unless measures are taken to ensure their survival, one can only hold a pessimistic outlook for their future. For *Paragalaxias* it may already be too late; a recent visit to the type (and only known) locality failed to reveal any specimens.

BOOK REVIEW

"TROPICAL AQUARIUM FISH", by A. Van Den Nieuwenhuizen; Constable and Co., Ltd., London. English translation by A. Leutscher, 1964; 200 pages, many coloured and monochrome illustrations; price, \$12.60 (£6/6/-).

The habits and breeding behaviour of a selection of tropical freshwater fishes are described in this book. Written in a popular style, the information is authentic, with proper respect for the history and scientific names of each species. The photographic illustrations are outstanding, showing the living fishes in their courting and mating rituals and the care some of them evince for their young. No Australian species are included and it will probably be a very long time before ours are as beautifully portrayed and painstakingly dealt with as those selected for "Tropical Aquarium Fish"—G. P. Whitley.



A phreatoicid collected from the Otway Ranges, Victoria. [Photo: T. Gordon.]

THE PHREATOICIDS

By W. D. WILLIAMS

Department of Zoology and Comparative Physiology, Monash University, Victoria

WHEN Australians talk of their country's unique fauna, most people think of such animals as koalas, emus, kangaroos and platypuses. It is natural that they should, for these vertebrate animals are the most visible evidence of Australia's great zoological interest. Yet some of Australia's invertebrates are just as interesting or even more so. A number of these interesting invertebrate groups occur in inland waters, and in this article we shall wave the flag, so to speak, for one such group—the Phreatoicidea (usually pronounced free-a-toe-i-sid-e-a) or Phreatoicoidea. Vernacularly they are referred to as phreatoicids.

General Appearance

Some of the principal features may be seen in the accompanying photo and drawing of a typical phreatoicid. The body is elongate, and the three body regions are well defined. Of the seven pairs of walking legs the first is clawed or prehensile, and the uropoda are lateral and biramous. Although they can't be seen in the illustrations,

overlapping plates are found beneath the thorax of breeding females. These plates, or oostegites, form the brood-pouch or marsupium, and are derived from lateral ingrowths at the bases of the anterior walking legs.

With the exception of some subterranean forms, phreatoicids are remarkably homogeneous in structure. The late Professor G. E. Nicholls, whose work provides the major portion of the Australian literature on the group, described it this way: "The general external likeness throughout the whole group (excepting some subterranean forms) is very marked indeed, and it is only a close scrutiny that reveals the range of structural difference."

The adults are usually about an inch long, many less, but some species are larger. *Phreatoicopsis terricola* usually grows to almost 2 inches in length.

The phreatoicids may be found over most of the Australian continent and Tasmania. They occur in the tropical northern region

and in the arid centre as well as in the temperate south-eastern and south-western regions. Until recently the Phreatoicoidea were thought to be confined to the Southern Hemisphere: they were known to live in New Zealand, South Africa and, of course, in Australia. Lately they have been found in India too. The majority of species, however, are found only in Australia.

Their habitat is in freshwater bodies. They are found typically in natural water bodies such as lakes, swamps, springs and creeks, both slowly and swiftly flowing. Occasionally they take up residence in artificial places, such as dams. They have also been collected from the outflow of a warm and slightly salty artesian bore, from wells, from beneath logs and in shallow burrows in damp forest areas.

They live from sea-level up to several thousand feet; species have been found in creeks only a few yards from the sea, and also in sub-alpine conditions. Sometimes they live among the vegetation, but at other times they can be seen in areas with few visible plants.

In spite of their water habitat, they usually cannot swim, but move by walking along the bottom of pools, or by burrowing in the mud of lake and creek beds, and under stones and logs.

Ecology

Even though certain species are abundant in Australia, not a great deal is known of the ecology or "scientific natural history"

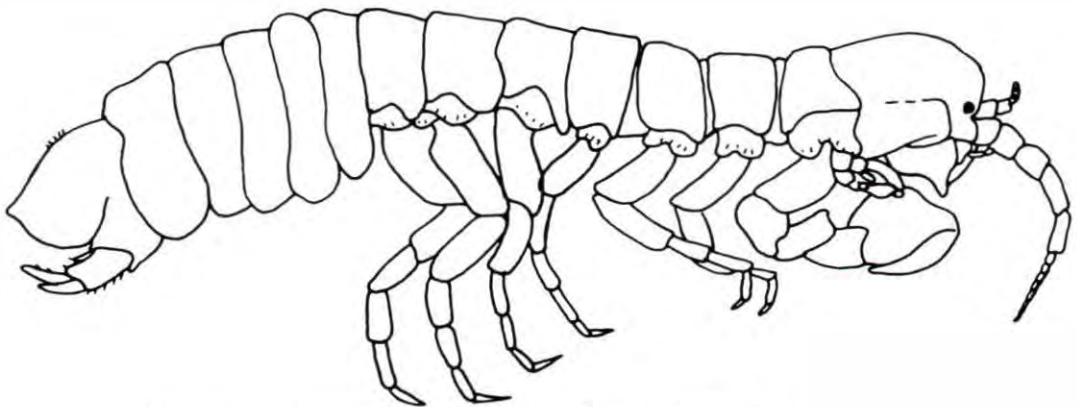
of the Phreatoicoidea. What is known is based on a number of casual observations.

Here, then, lies a whole field of investigation, both for the professional and amateur zoologist. It is worth remembering that amateurs in the past have made significant contributions to our knowledge of Australian crustaceans.

Knowing that the Phreatoicoidea belong to the Peracarida (see below), we can be sure that they have no special stages in their life-cycle which would make them particularly resistant to a temporarily unfavourable environment.

Not that some adult forms are entirely without defence against adverse conditions. Although most can stand no desiccation at all, some can survive the drying-up of their habitat by burrowing into the moist deeper layers of the bottom mud. Some species of the genus *Mesamphisopus* are known to behave in this fashion, while *Paramphisopus* also may occasionally pass through a dormant stage.

At all events, the eggs, unlike those of certain other crustaceans (e.g., the tadpole shrimps mentioned in a recent article in this magazine by Dr J. C. Yaldwyn), are not resistant to drying, and development only takes place within the brood-pouch of the female. No larval stages occur: the progeny leave the pouch more or less as miniature adults in form. Up to about 100 embryos may be incubated at any one time, the number depending upon the species, the size of the female and other factors. The length of the developmental period is



Phreatoicopsis terricola, the largest living phreatoicid. [Diagram by the author.]

variable too; no doubt there are some differences between species in this respect, and certainly the temperature of the water is important.

Little is known of what phreatoicids eat, but the structure of their mouthparts and behaviour indicate that many are omnivorous and detritus-feeders, feeding upon the organic matter contained in bottom muds and on small animal and plant particulate matter.

A small number of regular samples from an artificial lake in central Tasmania indicate that some species at least undergo regular seasonal vertical migrations. At certain times of the year they are present just below the water's edge, yet at other times migrate to deeper water.

Classification

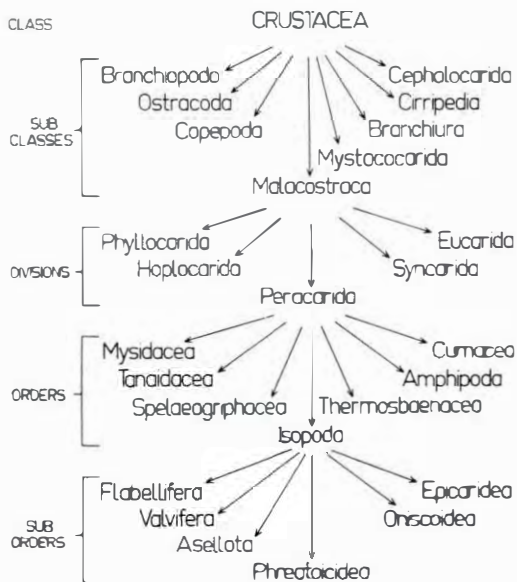
Phreatoicids belong to the phylum Arthropoda, which includes such animals as insects, spiders, ticks and centipedes. Within the Arthropoda they fall within the class Crustacea, along with crabs, shrimps, prawns, barnacles and so on. You can see from the diagram how they fit into this class, and how they are closely related to the slaters or wood-lice (Oniscoidea) and sea-

centipedes (Valvifera). It should be mentioned that, although the Phreatoicidea are regarded here as forming their own sub-order, some writers prefer to regard them merely as a tribe within the sub-order Quatuordecapoda.

Before a discussion of the manner in which phreatoicids themselves are split up it is appropriate to consider briefly the principal diagnostic characters of the Malacostraca, Peracarida and Isopoda, in addition to those of the Phreatoicidea. It is assumed that readers are familiar with the salient features of the Crustacea.

The Malacostraca are crustaceans with bodies clearly divisible into a head, a thorax and an abdomen. They usually have twenty segments, six of which are fused to form the head. Each segment except the first (and sometimes the last) has a pair of appendages. The most important feature of the Peracarida is that the female during the breeding season bears a small brood-pouch or marsupium beneath her thorax (the order Thermosbaenacea is exceptional in this respect). Some peracaridans have a small carapace or dorsal "shield" but this is absent in the Isopoda, which are also characterized by their modifications of the abdominal appendages or pleopods for respiratory purposes. Mostly the Isopoda are dorso-ventrally flattened in body form, but this is not the case in the phreatoicid isopods which are either laterally flattened or more or less cylindrical in cross-section. Other features of the Phreatoicidea include their compressed abdomens and the presence of pleopods typically adapted for both breathing and swimming and of uropods (the last pair of appendages) which aid in walking. There are naturally many additional features which serve to distinguish the phreatoicids from other isopods, but they are less important than those mentioned and need not be included in an article of this nature.

Three families make up the sub-order Phreatoicidea. They are the Amphisopidae, Phreatoicidae and Nichollsidae, and are distinguished mainly by differences in shape and morphology of mouthparts, pleopods and uropods. The first two families contain several genera and species; the Nichollsidae has a single genus (*Nichollsia*) and is found only in India.



Classification of the class Crustacea with particular reference to the sub-order Phreatoicidea. [Diagram by Drusilla Wade.]

The Amphisopidae, to which also belong the South African species, is the most widespread in Australia. The Phreatoicidae occur in Australia only in the south-eastern quarter—Victoria, Tasmania and the more temperate parts of New South Wales. The New Zealand forms belong to this family. The majority of its species may be found only in Tasmania; two subfamilies are almost exclusively confined to the island. For some reason, there has been a great proliferation of phreatoicid species in Tasmania; some lakes, particularly the Great Lake, contain several closely related species. This phenomenon parallels the similar proliferation of Amphipoda (another order of the Peracarida) in Lake Baikal, Russia. Whilst Lake Baikal and the Great Lake are strikingly different in the nature of their

basins—Baikal is much larger and is extremely deep (over 5,000 feet)—a feature both lakes have in common is great antiquity. Contrary to earlier opinion, the Great Lake was apparently not glaciated during the Pleistocene.

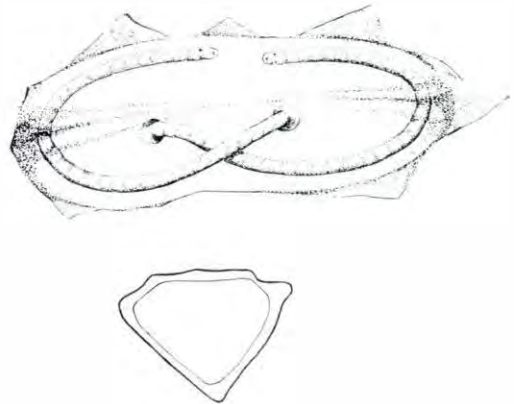
Although isopods other than the Phreatoicida occur in Australia in habitats typical of the phreatoicids, such forms are much less common; they certainly do not display the proliferations of species that the Phreatoicida do. Thus, there is no exact Australian equivalent of the common freshwater isopod (*Asellus*) of Europe. We may, however, generally regard our phreatoicids in part as the ecological equivalent of *Asellus* in at least certain parts of Australia.

LEECH EGG CAPSULES

Following publication of an article on leeches in the March, 1965, issue of *Australian Natural History*, an inquirer, Miss M. Voorwinde, brought in an egg capsule for identification. It had been found attached to pond weed obtained near Hawkesbury River, N.S.W., and introduced into a home aquarium. The capsule was of a light, transparent, horny colour, elongated and somewhat oval in outline, with one end a little more pointed than the other. Its cross-section was almost triangular, as shown in the lower drawing. In length it reached 10 to 11 mm and its breadth was approximately 4 mm. Under 100x magnification its surface was found to be granular and to have thickened longitudinal lines (? strengthening struts) one at each peak of the triangle of the cross-section, running right along the length of the capsule.

Inside, two developing "worms" were observed, each with a comparatively large rounded sucker at one end, as seen in the upper drawing. They writhed continually and Miss Voorwinde noticed that their activity increased when strong light was directed on them. The segmentation of their bodies was most obvious. After seven days in the aquarium, the developing leeches had grown to about $1\frac{1}{2}$ times the length of the capsule in which they were enclosed and their bodies had thinned, so that each looked like an earthworm with a large sucker posteriorly. They have been tentatively identified as belonging to the Erpobdellid genus, *Dineta*.

Eye-like sensory organs could be seen at the end opposite to the large sucker. The young leeches eventually hatched, emerging from the



slightly blunter end of the capsule, and at this stage measured 13 mm long, when fully extended, and only about half this when contracted. There was also a less obvious sucker anteriorly, for they progressed by a series of typically leech-looping movements, but, because of their thinner bodies, looked more like looper caterpillars than conventional leeches. During their incarceration in the egg capsule, the twins were generally arranged much as is shown in the accompanying drawing in spite of their constant motion. (Drawings by Helen Ashton, from sketches by Miss Voorwinde.)
—Elizabeth C. Pope.

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To teachers and pupils of schools and other educational organizations special facilities for study will be afforded if the Director is previously advised of intended visits. A trained teacher is available for advice and assistance.

Gifts of even the commonest specimens of natural history (if in good condition) and specimens of minerals, fossils and native handiwork are always welcome.

The office is open from 9.30 a.m. to 1 p.m. and 2 to 4.30 p.m. (Monday to Friday), and visitors applying for information there will receive every attention from Museum officials.

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