The AUSTRALIAN MUSEUM MAGAZINE

VOL. XII, No. 9 Price—TWO SHILLINGS

Despite an intruder this MALLEE FOWL persists in attempts to restore soil cover to eggs in the nesting mound. Heat to hatch the chicks comes from the sun and from decaying vegetable matter; the hen bird does not brood her eggs. **(Article Page 289.)**

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THE AUSTRALIAN MUSEUM

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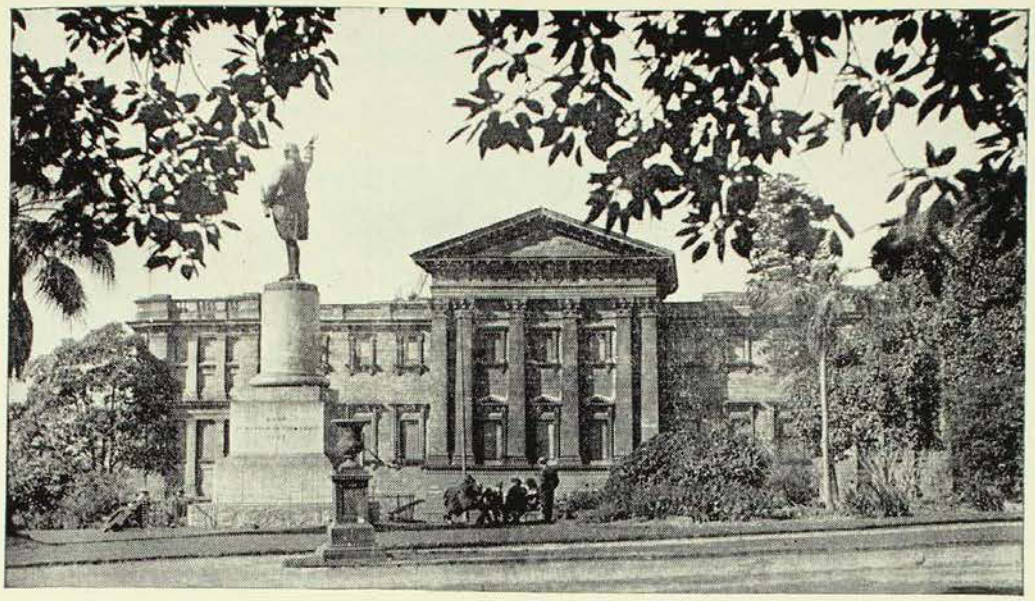

THE AUSTRALIAN MUSEUM MAGAZINE

● OUR FRONT COVER provides an interesting addition to the illustrations in H. J. Frith's article on the unique mallee fowl (page 289). In one way or another the male bird attends to the nesting mound throughout the year. When first mated the birds may occupy a different mound each year but as they become older they are more likely to use the same mound year after year.

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The Ghost Pipefish

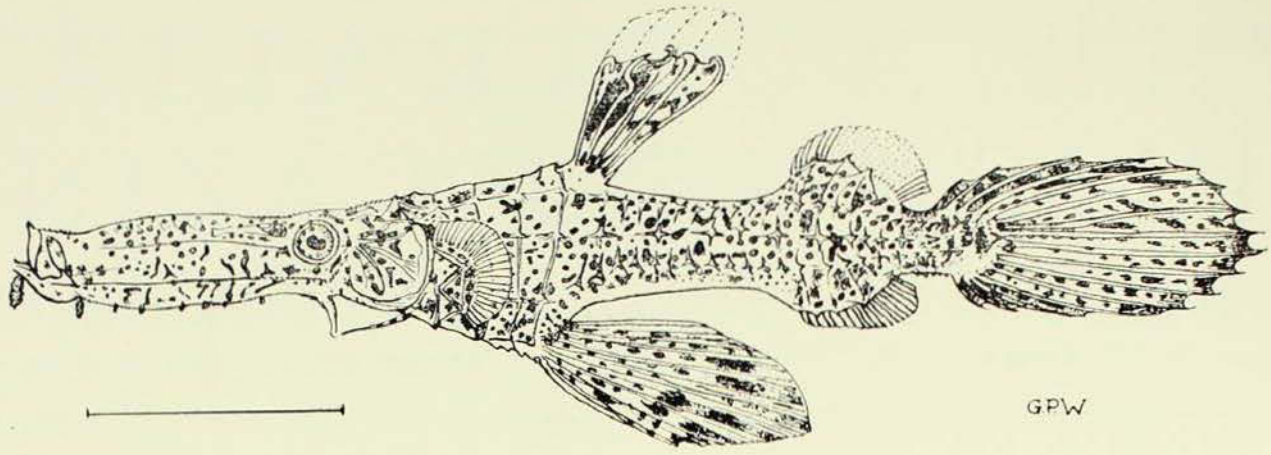
By G. P. WHITLEY

> Certainly many questions of great interest regarding the biology and development of these curious fishes are to be solved, and it is to be hoped that some day one of the zoologists having the opportunity of observing the living animals in their natural surroundings will take up the task.
>
> Jungersen, *Ichthyotomical Contributions*, 1910.

FAMILIAR, common fishes like the Snapper or Bream we choose to call "typical" fishes: they have fins, scales and proportions which to us are normal. But there are bizarre species, so altered in shape that they seem almost freaks or deformities, yet each is marvellously suited to its chosen mode of life and to its surroundings. The sea-horses and pipefishes are well known examples of piscine oddity; both have tubelike snouts with a little mouth at the end, and armoured, stiff-jointed bodies. The pipefishes are long and narrow but the sea-horses are like a knight in chess with their arched necks and horse-like heads.

In both these groups of fishes the female lays her eggs under the body or tail of the male and he "mothers" them in a special area of skin, often protected by folds or a pouch, until they hatch, when he gives them birth. Now the sea-horses and pipefishes have a cousin which does not conform with their extraordinary rules. For lack of a common name, I call this relative the Ghost Pipefish, because of its weird appearance. It belongs to the genus *Solenichthys* (often called *Solenostomus* in natural history books) and the family Solenichthyidae. It has two dorsal fins and a large tail-fin, whereas the sea-horses and pipefishes have only one dorsal fin apiece and the tail-fin is either absent or small. There are no ventral fins in sea-horses and pipefishes, the males carrying the eggs below the body or tail. But in the Ghost Pipefish, the female does not transfer her maternal duties but carries her eggs and young in a pouch between her large ventral fins. There are nine nominal species in the genus *Solenichthys*.

The Ghost Pipefish is said to swim upright, but I imagine it spends much of its time, when young, floating at the mercy of ocean currents (whence it has been taken in plankton nets), and, when older, hiding amongst masses of seaweed. It has none of the marks of a swift or strong swimmer.



A strikingly marked Ghost Pipefish (*Solenichthys raceki*) found amongst seaweeds off Broken Bay, New South Wales. The line alongside represents one inch. The dorsal fins have been restored where dotted.

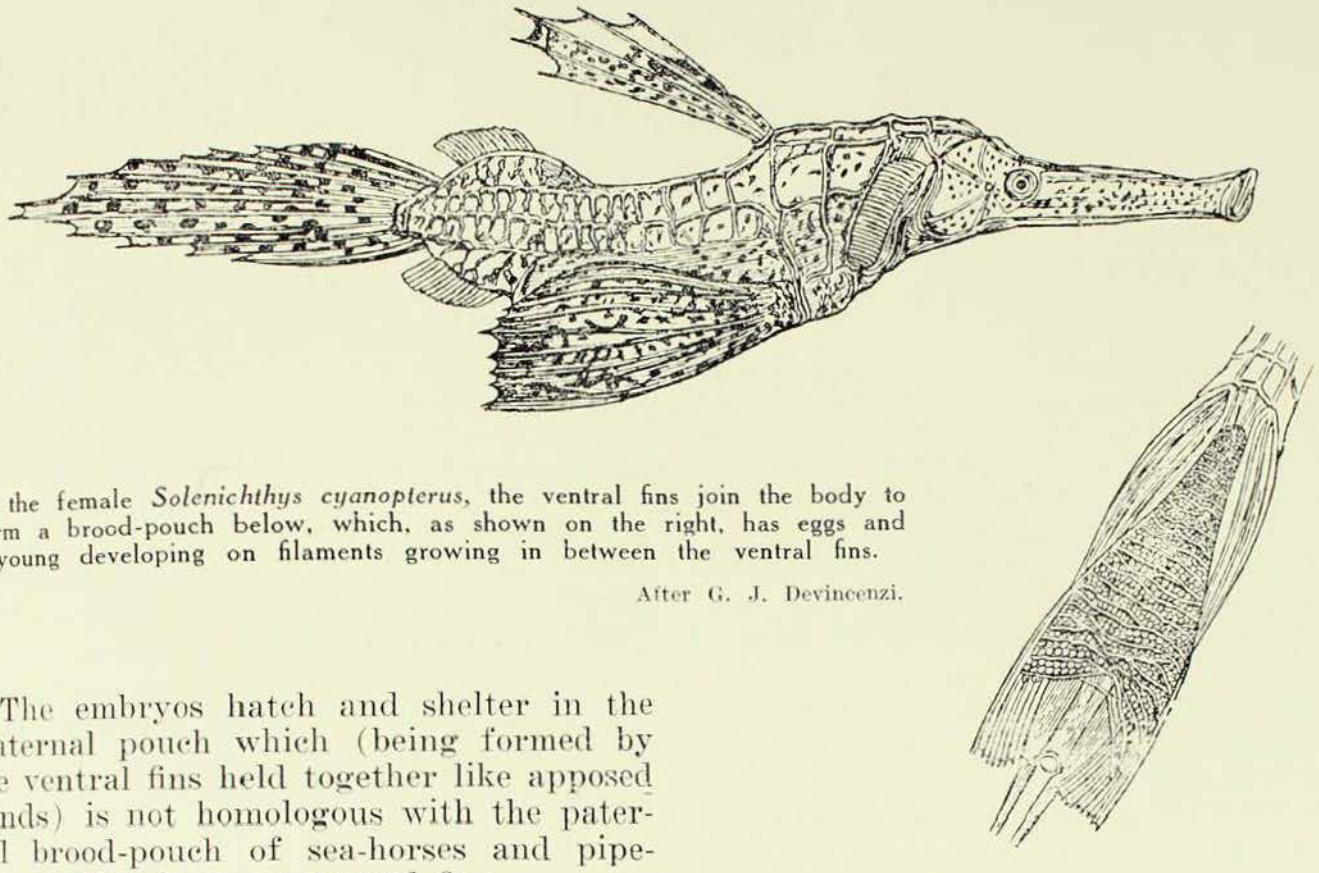
The large eyes indicate good sight for hunting its prey—crustacea and other tiny animals, which are evidently sucked through the toothless jaws and down the tubelike snout by the fish puffing out the cheek, the principle being similar to that of the old-style fountain-pen filler with the glass tube and rubber bulb.

One of these extraordinary fishes was brought up in a mass of seaweed from 5 to 7 fathoms off Broken Bay, New South Wales, in January, 1955, by Dr. A. A. Racek of the State Fisheries Branch, Sydney. If the fish had not wriggled in his hand, its presence might not have been betrayed, so closely did it resemble the weed. In life, it was green in colour, marked with numerous dark spots and blotches on head, body and most of its fins. These markings remind one of tea-leaves in a cup in which all sorts of designs may be imagined: spots on dominoes, tiny boomerangs, dumb-bells and so on. The blotches formed much larger marks on the dorsal and tail-fins, which might have been unfurled as signals to other fishes of the same species, or as " eye-spots " to scare enemies. After death, the colour changed, in preservative, to yellow, with the aforesaid dark blotches still conspicuous. Some of the fins were edged with a pinkish hue, the eye was reddish, and there were little pink tassels dangling below the snout and the butt of the tail. I named this species *Solenichthys raceki*.

Another very frilly Ghost Pipefish was reported from off the coast of Ceylon in 1909 by A. Willey who called it *Solenostoma laciniatum* from the Latin word *lacinia*, a lappet or flap of a garment. Papillae and skinny flaps adorned its head, body and fins and could evidently be shed and regrown. The Ceylon fish was a female, giving Willey the opportunity of figuring the eggs and fry in various stages of development, these having been found in her brood-pouch attached to skinny stalks. Willey wrote [1]:

> When alive the predominating colour was brilliant scarlet with orange marbling. The pectoral, second dorsal and anal fins are absolutely hyaline—a condition which conspires with the general scheme of coloration and laciniation to produce harmonious relations with the environment. This fact is not brought out in published figures. It renders the essential organs of locomotion chromatically non-existent. . . . . The vivid colours of *Solenostoma*, which contrasted strongly with the brown seaweed amidst which the specimen was living, belong to the category of warning colours and combine with its other characters to make the animal look like anything except a fish. Kaup pronounced it to be 'one of the strangest forms to be found in the whole class of fishes'. Perhaps it resembles a brightly-coloured sponge when at rest in its natural surroundings.

(1) Willey, *Spolia Zeylanica* 6 (23): 102-107, pl. i, figs. 1-2.



In the female *Solenichthys cyanopterus*, the ventral fins join the body to form a brood-pouch below, which, as shown on the right, has eggs and young developing on filaments growing in between the ventral fins.

After G. J. Devincenzi.

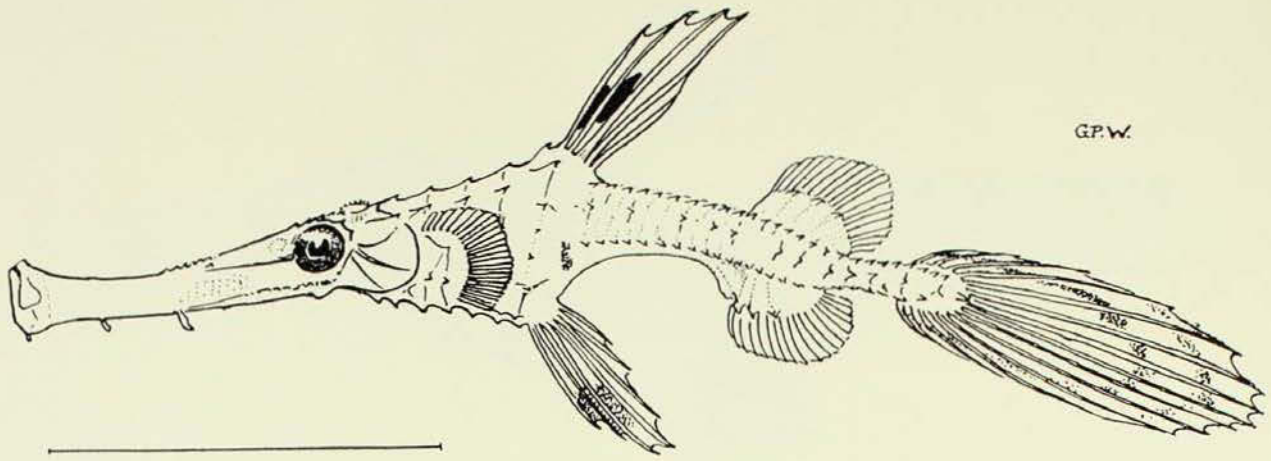
The embryos hatch and shelter in the maternal pouch which (being formed by the ventral fins held together like apposed hands) is not homologous with the paternal brood-pouch of sea-horses and pipefishes which have no ventral fins.

Gunther in 1870 wrote: "There is a peculiar provision for the retention of the eggs in the sac and probably for the retention of the embryo. The inner walls of the sac are lined with long filaments arranged in series along the ventral rays, and more numerous and longer at the base of the rays than in the middle of their length, behind which they disappear entirely . . . . .". This is shown in Devincenzi's figure, reproduced here.

For a long time, only female Ghost Pipefishes were known and the earlier naturalists thought that they "sufficed for themselves" but later the males were found —skinny little fishes with the ventral fins free from the body and another curious difference: remarkable radiating lamellae in their nostrils which were much larger than those of the females. Probably then the males find their mates by smell. Perhaps they fight for their favours as the fins are sometimes mutilated as if bitten or torn in combat.

Through the courtesy of the Royal Society of South Australia, Adelaide, I have been lent a copy of the volume of a scarce Danish scientific publication in which appears a very detailed account of the "Solenostomidae", by Hector F. E. Jungersen (*D. Kgl.Danske Vidensk. Selsk. Skrifter*, 7 Raekke, nat.-math., viii, 5, 1910, pp. 269-364, pls. i-vii and text-fig. 1). The main species dealt with was called *Solenostomus cyanopterus*, although the figures show it to be the deep-snouted species later named *paegnius* by the Americans, Jordan and Thompson.

The anatomy is beautifully worked out and illustrated in Jungersen's paper, and he gives particulars of distribution, classification and relationships for the genus. Most of his specimens came from Japan and, as in all other published work on these queer-looking fishes, we find only a few crumbs of information which may concern the life-habits. Thus, the food of one fish consisted of Palaemonid crustaceans: the musculature of the fish's head permits of some vertical movement but the thorax because of its armament is immovable: males have elaborately developed nostrils but the nasal openings of females could not be found.



The first Ghost Pipefish caught in Australia. A young *Solenichthys leptosomus* found floating in the sea off Newcastle, New South Wales.

Jungersen's account of the attachment of the eggs is similar to that of Willey, published a year earlier and not referred to by him.

For little fishes which probably spend all their lives in a single clump or area of sea-weed, the geographical distribution of the Ghost Pipefishes is extremely wide. Possibly their remote ancestors were stronger swimmers (the large fins are their legacy) and colonised the seas in pre-Eocene times before they developed the habit of hiding and settling amongst weeds. Jungersen notes that more than one species may be found together in some localities, and stated: " The geographical range embraces the Indian Ocean and the western part of the Pacific, from Zanzibar to New Guinea and to the eastern coasts of Japan. Inside this wide area the localities where specimens actually have been found are rather few and scattered: no captures at the coasts of the continents or the great islands have hitherto been mentioned . . . . . ".

We now know that the range can be further extended. During " Operations Crossroads " the Americans obtained one small Ghost Pipefish off Bikini Atoll. Others have come to light in the Philippines and between the Red Sea and East London in east Africa. The *Siboga* trawled two from 95 metres in the Arafura Sea. The genus has been found twice in recent years impinging on the Australian coastline in New South Wales, although not yet discovered in any other Australian State. The first one (*S. leptosomus*) was found off Newcastle in 1952 and the second was Dr. Racek's specimen, already noted. These were $3\frac{1}{4}$ and $4\frac{3}{4}$ inches long respectively but Japanese Ghost Pipefishes up to $6\frac{1}{2}$ inches have been recorded.

The Moonfish or Opah in New South Wales

In an illustrated article in this MAGAZINE (X, (3), Sept., 1950, p. 76) all the Australasian occurrences of the beautiful Moonfish or Opah (*Lampris regius*) were reviewed. Since then McCann (*Rec.Domin.Mus.* ii, 1953, p. 3, fig. 3) has added a small female from Palliser Bay, New Zealand, and now I am able to record the species from New South Wales for the first time in a scientific publication.

Mr. G. L. Williams, Fisheries Inspector at Nambucca Heads, presented to the Australian Museum one of these fishes which had been taken alive by Mr. A. J. Hamilton from shallow water at Scott's Head, south of Macksville, New South Wales, on 18th November, 1957. Its weight (gutted) was 104 lb. The total length was 46 inches; depth of body 26 inches; length of head 13 inches; diameter of eye 2 7/8 inches. The dorsal and anal fins were not depressible. It had 48 dorsal and 39 anal rays, 13 gill-rakers on the first arch, and about 77 pores along the lateral line. On each side of the thorax were five or six faint scars (like those attributed to the attacks of lampreys by authors dealing with an Alaskan moonfish).

This is only the sixth record of a moonfish from Australia.

—G. P. Whitley.

String Figures of Australia

By FREDERICK D. McCARTHY

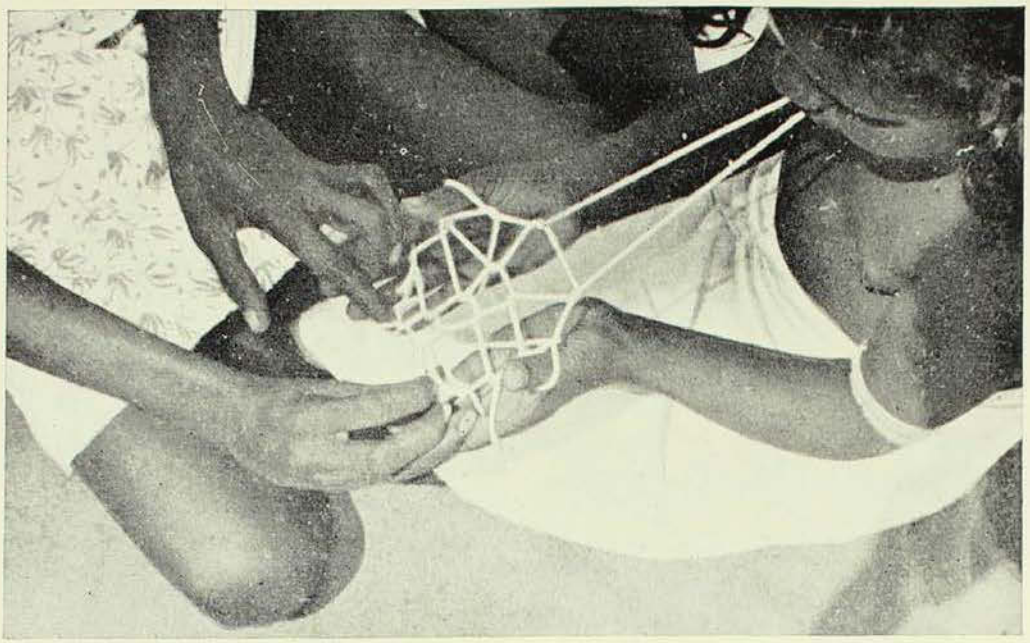
MOST individuals make a few cat's cradles in their childhood days, and now and then a craze for this fascinating pastime sweeps through our schools. Australia was the first continent, and vies with New Zealand in being the first locality, from which string figures were reported.

An important distinction must be made between cat's cradles and string figures. The former are essentially simple designs, begun with a distinctive opening manipulation, and executed by two players who take a figure from each other's hands alternately and develop it into the next one in a series. They are best known in Europe and Asia, and rarely where string figures proper are practised.

String figures, on the other hand, are produced chiefly by the manipulations of the string by co-ordinated movements of the fingers of both hands, assisted by the teeth, neck, elbows, knees and toes when necessary. Some figures are made by two persons, others by three or four. Most of the figures are single, static designs displayed as finished examples of skill, or for a ritual, magical or social purpose. A minority belongs to a series of from two to five or more distinct designs, which may become more complex as the series progresses between two operators. The designs may be changed by repetition or variation of string manipulations. The basic opening movements employed, the greater variety of string manipulations and extensions of the figure at various stages of its development, and the function of string figures in primitive societies, all serve to distinguish them as a more serious and more difficult pastime than cat's cradles. In Professor D. S. Davidson's words:

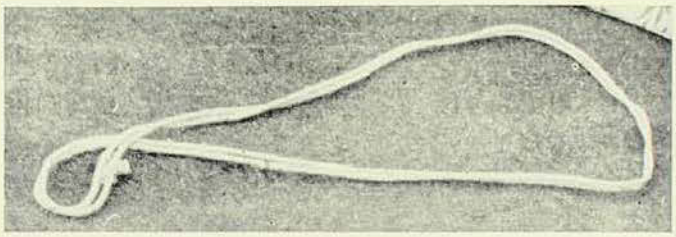
> The steps in construction in some figures are so complex that a correctly attained final result can be considered an accomplishment of no mean order. Hence, in areas where string figures are well established there usually is a sufficient variety to attract some interest from all intelligence levels of the population. For the dolts there is the simple type of figure; for the brilliant, a potentially unlimited source for mental exercise and amusement; for the experimentalist, a fruitful field for development with the discovery of new and intricate patterns as a reward; for the artist, an opportunity for keen personal satisfaction in the meticulous execution of difficult figures; for the skilled entertainer, an extensive repertoire with which to delight an audience.

An interesting string figure which portrays a possum in a hole in a tree. Note the graceful manner in which Na:rau's long fingers are integrated with the design.



Left: String figure of a long-necked freshwater tortoise, made by two aboriginal women.

Below: This simple figure of a seagull represents one of thirty-six folded ones made by Na:rau and not known elsewhere.



String figures are found chiefly in Africa, North and South America, Melanesia, Polynesia, Micronesia and Australia. Our knowledge of them is only a century old. They were first recorded among the Maoris by Ernest Dieffenbach in 1843, although Thomas Petrie had noted them among the Brisbane tribes of Queensland between 1837 and 1850. They were reported among the Eskimos in 1864, and in Polynesia in 1876. Edward Tylor, the great British anthropologist, first drew attention to their cultural interest in 1879, and in 1880 Franz Boaz, a renowned American scientist, became the first to describe the sequences of manipulations by which string figures are made. Another important step was taken in 1902 by Professors W. H. R. Rivers and A. C. Haddon, of Cambridge, who published a standard method of recording string figures, and finally the first world-survey of the subject was compiled by Mrs. C. F. Jayne in 1906.

In Australia, Dr. W. E. Roth in 1902 recorded the first important series from Queensland, but like many other subsequent series the techniques of string manipulation for each figure were not noted. However in 1941, Professor D. S. Davidson made a complete record of designs and techniques in Western Australia and the Northern Territory and published a survey of those known in Australia.[1]

In 1948 I had the opportunity to record string figures at Yirrkalla, Arnhem Land.[2] Here I found the men to be poor exponents of this comparatively difficult pastime, because they made the figures only during certain rituals about female ancestresses named the Wauwalak sisters, who are credited in the local mythology with having introduced string figures. It is a women's craft of which many aboriginal women are skilful devotees.

The Yirrkalla women use a loop of string from 2 to over 3 ft. long, but the men use a slightly longer loop. The women wear their loops as necklaces and produce them whenever opportunity offers for a gossip, just as our women do with knitting. The loop must not be left about the camp because of its potential social and magical dangers; if it were given to a man it is thought that the husband's jealousy would be aroused and he would seek to punish his

[1] *Proceedings American Philosophical Society* 84, 1941, pp. 763-901.

[2] A full description of this series was completed in 1954 and is awaiting publication in Vol. 2 of *Records of the American-Australian Arnhem Land Expedition.*

rival. A loop must not be picked up, touched or burnt by a man or serious illness in himself or its owner would ensue.

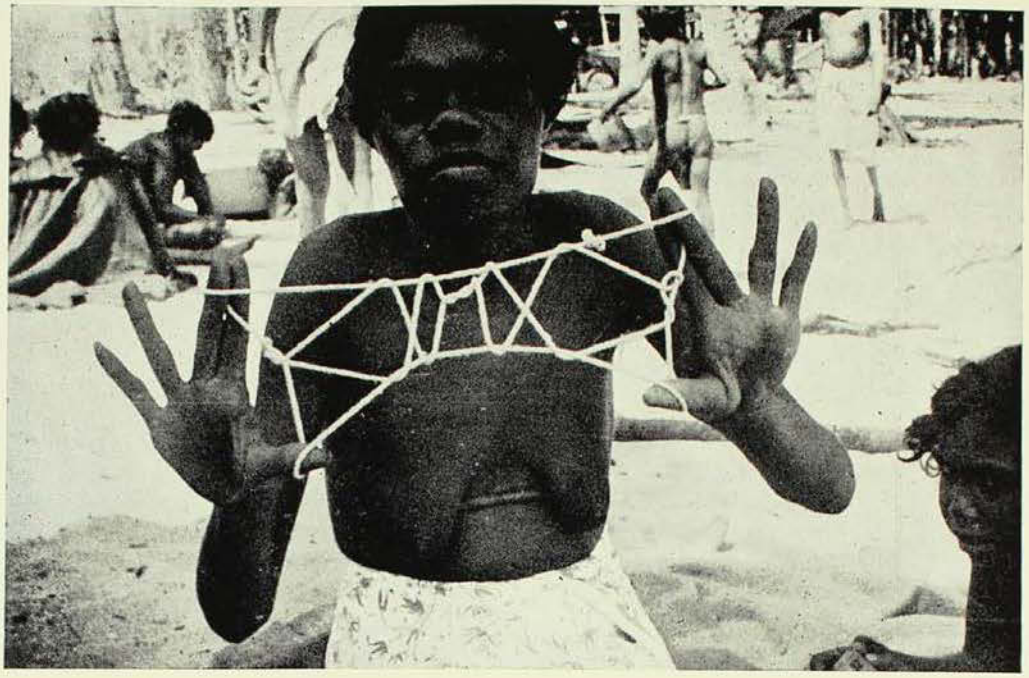
Professor Davidson had stressed the fact that the Queensland tribes were the most skilful and imaginative string manipulators in Australia, and nobody suspected the rich haul awaiting discovery in Arnhem Land. After testing a number of men and women in the Yirrkalla camp, I concentrated my investigation on a young married woman named Na:rau, who proved to be a golden goose, to coin a term; a genius with a loop of string. She set a world's record which may never be broken. Of the 212 designs that I collected at Yirrkalla Na:rau made all but 10, and fashioned all but 6 of the 187 techniques (or series of manipulations secured). Whether she made the figures slowly for recording purposes or rapidly for photography, her errors were remarkable low. Her long slim fingers moved gracefully and accurately over the strings, like a pianist's over the keys of her piano. Her astoundingly wide knowledge of the designs, sequences of manipulations and subjects is, from the technical and quantitative points of view, proof of a mastery of her craft and of the possession of highly intelligent powers of mental and manual co-ordination. With Na:rau string-figure-making is an art.

The simplest string figures at Yirrkalla involve only one or two manipulations from a loop on the fingers. They are then placed on the lap or on the ground and arranged to represent animals, plants and fruits, weapons, implements and cicatrices, a coffin, and such activities as a man throwing a spear or a girl pounding bulbs. Additional small loops are made for fruit on trees. This folded type does not appear to have been recorded anywhere else in the world. Thirty-six of them were made by Na:rau.

The largest group of string figures proper involves from 5 to 10 manipulations, the second from 11 to 19, and the third from 20 to 34, with one or two sequences as high as 54. Most of them are of the static mesh type, in which diamonds and ovals often represent numbers of animals, people and yams. The majority, too, are symmetrical in design. In fact, throughout the world very few figures are known in which the fingers of each hand are used for different manipulations to produce an asymmetrical design. A feature of the display of the completed figure is the manner in which the fingers and hands become an integral part of the composition of string and the same figure may be shown at different angles for this purpose. There is a small number of sequences of two static figures, and the longest series collected consist of five designs which depict the story of catching parrot fish. Action figures are rare, and the few moving designs made include ibis flying into a tree, sawing wood and others.

The subjects are wide in range. They include weapons, implements, utensils, ornaments, huts, features of the landscape and sky, ritual things, animals and plants (many of which are totems). Added to the purely aboriginal subjects are the proa boat, sarong, flag, cannon and others derived from the Indonesians who visited Arnhem Land for several centuries seeking

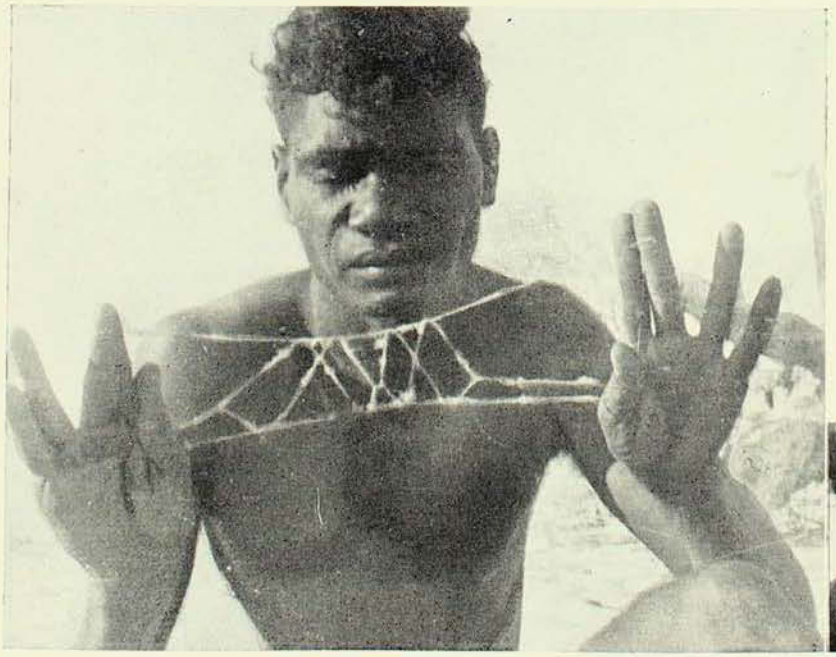
Teeth and neck as well as fingers were used in producing this string figure the subject of which is unknown.



This complicated figure, representing a scorpion, illustrates one of the multiple twists (in the middle) which are a feature of string figure designs in Arnhem Land.

beche-de-mer and pearl shell. Motifs like bottles, pannikins, scissors, a knife and so on, have been added since contact with the white man. Subjects such as the banana, coconut, cassava, "piggy-piggy", and tomahawk also came from one of these two sources. The habits of animals are recorded in such figures as adult with young, bird with egg, sea-eagle catching mullet, ducks diving in water, leeches in a swamp, possum or crab in a hole, and others of a similar nature. The most important sources of motifs are the local environment, human and animal life, food and the material culture of the Yirrkalla people. Most of the subjects, too, are from the women's sphere of life, it being a women's pastime, but a few designs depict men hunting and fishing.

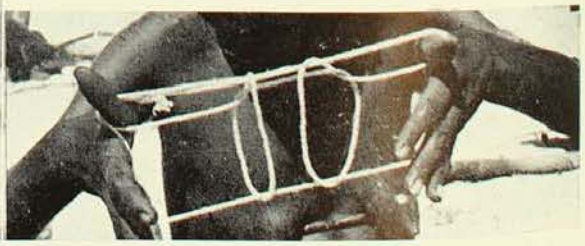
The resemblance of the designs to the subjects varies considerably. Many of the mesh and most of the folded figures are



The men make string figures during certain ceremonies. Here Wadjuk has completed one of a crocodile.

A realistic figure of two armbands.

All photos by Author.



realistic representations, but many in the former group are also totally unlike their motifs. The degree to which they are realistic is illustrated by the fact that the parts of each figure are all named; one end of a design represents head and fore-limbs, the other tail and legs with the body, breast, back, wings, stomach and intestines also denoted.

Yirrkalla is undoubtedly the richest locality in Australia yet investigated for string figures, but many other localities in Arnhem Land are probably just as rich. Comparatively large series have been recorded in north Queensland (125) and central Australia (between 70 and 100) but the number of designs decreases markedly in Western Australia (6 to 8) and there are none known in the south-west of this State; South Australia (11) and Victoria (2). The only State in which none is recorded is New South Wales, where it should still be possible to find a knowledge of some string figures among the aboriginal women. Professor Davidson was able to ascertain that the making of string figures had spread eastwards in Western Australia, having reached many native camps between 1880 and early in the present century. From this fact, and the few figures known in Victoria, he thought the pastime had been introduced into Australia by Torres Strait Papuans who visited the Cape York coastal Aborigines, and had spread thence over the continent, developing to a greater degree in north Queensland than elsewhere. The Yirrkalla material indicates that Arnhem Land forms a second point of diffusion (particularly into the Northern Territory and central Australia, in this instance) as with so many other traits in aboriginal culture.

Just over 400 figures are now recorded in Australia, about one-third of those known in the world. The closest comparative totals are 156 from the Eskimos, and 115 in Hawaii. The 69 of the Copper Eskimos is the nearest approach to Yirrkalla's record total from one camp or locality. No other individual in the world has approached Na:rau's remarkable record. An interesting point is that although this craft has a similar technical foundation everywhere, individual figures made in the same way are rare in different localities, and where figures from various places do resemble one another the techniques usually differ. Sixteen Yirrkalla designs occur in Melanesia, 15 in Polynesia, and 12 in Micronesia. Only 24 of them are made in Queensland. Although more similarities are to be expected in both designs and techniques, it is true that the main source of motif is in local subjects, and that local techniques are usually developed by a people from the common basic foundation. It is strange that the size of the loop used throughout the string-figure-making region of the world is approximately the same, and the opportunities to exploit more intricate figures by the use of a bigger loop has been availed of only by the Nauruans. A local feature of Arnhem Land figures is the use of an excessive number of twisted strings in the completed designs.

It is obvious that the enriched tempo of social and ritual life, of art and music in Arnhem Land as compared with other parts of aboriginal Australia, has produced a creative attitude in all aspects of life of which the remarkable ability of Na:rau in the string figure craft is an outstanding example.

Gifts from Skin Divers

Some interesting specimens of Zoanthids, Alcyonarians, colonial ascidians and *Phoronis* worms have been given to the Museum's Invertebrate Departments by Dr. P. W. Groves and his colleagues of the Underwater Research Group.

Of special interest is a clump of bluish Zoanthids, taken near Balmoral, Sydney, at a depth of 25 ft. These are coelenterates which show structural affinities with corals but lack limy skeletons and have the outward appearance of an anemone. Their occurrence was recorded as long ago as 1889 by Thomas Whitelegge, of the Australian Museum, but few if any specimens have been taken in Sydney Harbour in recent years. Proof of their continued existence in these waters is therefore welcome. The *Phoronis* are the first specimens of their kind in the Museum's collections.

The Honey Mouse

By L. GLAUERT

THE Honey Mouse, or Noolbenger as it is called in its native Western Australia where one of its native names has been adopted, is confined in range to the south-western corner of the continent. The little animal is about the size of a common House Mouse, the head and body measuring about 3 in. and the tail 4 in., in an adult animal. It can be distinguished from all other small Australian marsupials by its extremely long snout, which is about two-thirds of the length of the head, and by its coloration. The head is pale brown and the body greyish-brown with three dark stripes along the back. The central stripe, which is almost black, extends from the head on to the basal part of the tail, whilst the two outer ones are fainter and do not reach the tail. The under parts are pale yellowish or even white, the limbs pale rufous and the feet white. At times the whole animal is more greyish but the stripes remain persistent.

Structurally, the animal is most interesting as it has diverged considerably from the other small members of the possum family. All the digits except the united second and third of the hind foot, which are fitted with curved functional claws used for combing the fur, are expanded at the tip and bear a short, useless nail impressed on their upper surface. This feature is reminiscent of the Tarsier of the East Indies and is the reason for the scientific name of *Tarsipes* being given to the Honey Mouse.

The most astonishing specialisation, however, is the skull where, in adults, the snout occupies approximately two-thirds of the total length. The tongue is long and bristled at the tip like that of Honey Eater birds. There are on the palate ridges which scrape honey and pollen off the tongue when it is withdrawn through a funnel formed by flanges on the upper and lower lips, assisted by the long, slender, lower incisors which are placed parallel to the axis of the lower jaw. As the food taken is soft, the teeth are degenerate both in shape and number. The upper canines and lower incisors are the only ones which are well developed; the rest, in a total of 22 as a maximum, are rudimentary or degenerate.

Like the Numbat or Banded Ant-eater, *Myrmecobius fasciatus*, the Noolbenger displays "relative growth" since the young in the pouch lack the long snout which develops with age.

This animal has an interesting scientific history. At a meeting of the Zoological Society of London held on January 11, 1842, Monsieur P. Gervais, on behalf of himself and M. Jules Verreaux, exhibited drawings representing the details of a small marsupial from Swan River for which the name *Tarsipes rostratus* was proposed. The publication of the *Proceedings* of this meeting was delayed and for reasons of scientific rivalry Dr. J. E. Gray, having received material from Captain George Grey, the Government Resident at King George's Sound, published a description of the animal in the Annals and Magazine of Natural History (1: 40), and named it *Tarsipes spenserae*. In this way he became credited with the authorship of a generic name originally proposed by others.

The specimens sent to Dr. Gray were accompanied by notes on the habits of the animal, based on the descriptions of Mrs. Eliza Lucy Grey, the charming youngest daughter of Sir Richard Spencer, Captain Grey's predecessor in office at King George's Sound. It was in her honour that the Noolbenger received the scientific name *Tarsipes spenserae*, although, incidentally, the family name was misspelt.

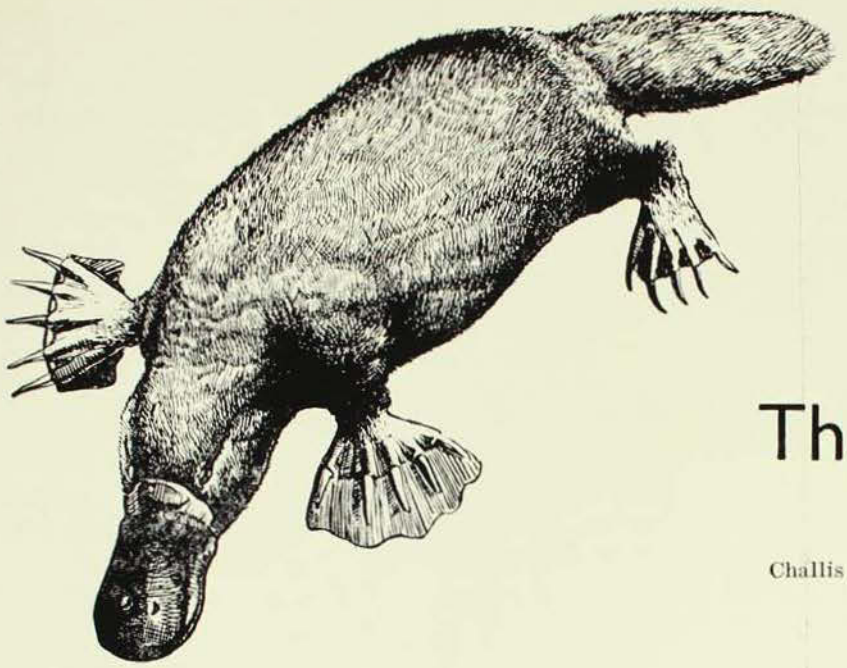
The first living specimens brought to Mrs. Grey by the natives were offered fruits and nuts as food but they did not feed and soon died. After Scott Nind had dissected several specimens and found the stomachs contained a clear, honey-like fluid, other food was proffered. Mrs. Grey found they liked flies and moths and John Gilbert tried sopped bread sweetened with sugar. The animals inserted their long bristled tongues into this until the mass became completely honeycombed.

Several attempts to keep a Noolbenger in captivity have been made at the Museum in Perth and one of these was fairly successful. This animal was received from Mr. W. Gibb, of Balgowie on the King River, near Albany. It was kept in a roomy cage in which was placed a bird's nest for sleeping quarters. In spite of the shelter nest the Noolbenger was usually chilled when examined first thing in the morning, so I used to place it in one of my waist coat pockets to warm it. In due course it would come out and climb on to my hand where I had accustomed it to finding sugar at the tips of my fingers. It would first climb on to my palm and then ascend each finger in turn, licking the sugar off the tips. In addition to sugar, watered honey, sopped bread, an occasional fly and sprays of wild flowers were placed in the cage. A Banksia would keep the little creature busy exploring every floret, or so it seemed. Hakeas and Dryandras were also favourite flowers but in the various wattles offered the animal showed no interest. Observers in the far south of the State have reported that the bottle-brush is a favourite source of nectar during the proper season. But irrespective of the time of year and the flower, a thorough search was always made if the flower was recognised as acceptable.

The flowers favoured doubtless contain some essential food because my pet, having been treated as described, appeared to be in the best of health even after spending three months or more in captivity. When I had to leave town for a week and entrust the feeding to other hands the instructions given concerning flowers were not observed. On my return I found the cage crammed with wattle blossom and a day or two later the animal died.

The spread of settlement and the development of agriculture are bound to have depleted the numbers of this small marsupial but it is still common along the area close to the south coast, east and west of Albany, and round the Leeuwin and Naturaliste as far as the country near Busselton. Several specimens have been collected recently near Perth; it is known as far north as Dandaragan and has made an unexpected appearance at Irwin River not far from Dongara on the west coast. Odd specimens have also been captured at Kukerin, Nyabing and Pingrup, west and south of Lake Grace, suggesting that at one time it was more or less abundant in the mallee country of the southern wheat belt of Western Australia.

Like some other animals which live in the south-west the Noolbenger again makes its appearance near Esperance where it has been collected even as far inland as Salmon Gums, 65 miles to the north.



The Monotremes

By P. D. F. MURRAY

Challis Professor of Zoology, University of Sydney

THE Platypus and the Echidna or Spiny Ant-eater, collectively known as Monotremes, rank high among the world's most interesting animals because of the light they throw upon, and the questions they raise about, the origin of the "highest" of major animal groups, the Class Mammalia.

Anybody, whether zoologist or not, knows a mammal when he sees one, unless indeed it happens to be a whale when he may mistake it for a fish. There is a clear and obvious difference between mammals and other animals: mammals are hairy, or have at least some hairs (even if only few, again like whales), are warm-blooded, and they give birth to "living" young, not to eggs. No mammal could be mistaken for a reptile or bird, not even the scaly pangolin or a bat. Now, once zoologists had accepted the theory of evolution, they became intensely interested in the relationships of animal groups to one another, and there was a great surge of studies in comparative anatomy and embryology having as its aim the unravelling of such relationships. Among the many problems studied was that of mammalian origins; and the structure and many features in the embryonic development of mammals seemed to indicate that they must be descended from some sort of reptiles. If that were so there must exist, or have existed in the past, forms intermediate between reptiles and mammals.

Then the platypus turned up, and was received at first with the comment of the countryman gazing at the giraffe: "There ain't no sich animal!". It was thought to be a fake, made by the sticking together of bits of two different animals, like the "mermaids" which used to be made by combining the front half of a monkey with the back half of a fish. However, Truth is great, and at last the platypus was recognized as a real animal, and as a mammal; but a very odd one. There is no doubt of the mammalian nature of both the echidna and platypus; they have hair, they produce from structures like mammary glands a secretion by which the young are nourished, they have typically mammalian diaphragms separating the thorax from the abdomen; they have a four-chambered heart and a single aortic arch, which is the left one as in other mammals. Their skeletons are in many respects typical mammalian skeletons. In particular, the lower jaw has on each side only one bone, and not several, as reptiles have, and in their ears, like mammals, they have three little bones, the "auditory ossicles", which transmit sound vibrations from the ear-drum to the true organ of hearing, and not only one, as in reptiles.

The monotremes have mammalian brains in that the "pallial" region is the most strongly developed portion of the cerebral hemispheres, and not the "striatal" portion as in reptiles and birds; but a great bridge of nervous material, called the corpus callosum, which connects the two hemispheres in higher mammals, is absent, as it is in reptiles and marsupials.

But when looked at more closely, monotremes are discovered to have a number of features which other mammals lack, but which are usual among reptiles. There are several such features, of relatively minor importance, in the skull. One is the presence, in the platypus, of a pair of little bones called "prevomers", and another the presence further back in the palate of a pair of "pterygoid" bones; reptiles have both these, and mammals lack both. The pectoral girdle, or shoulder girdle, is especially reptilian. One of the important differences between reptiles and mammals is in the attitude of the limbs. In reptiles they are held outward from the body and the trunk is slung between them, at rest usually lying on the ground; in terrestrial mammals, as in a dog or a horse, the limbs extend vertically below the trunk, holding it well clear of the ground. The reptilian stance requires that the bony support embedded in the trunk, against which the limb bones abut, shall be supported by pressure-resistant struts running to the mid-ventral line. Thus in reptiles an elaborate set of bony structures connects the socket for the bone of the upper arm to the sternum, or breast bone, and the breast-bone itself is strengthened by a special bone called the "interclavicle". In both reptiles and mammals the part of the shoulder girdle above the socket is strongly developed as the scapula or shoulder-blade and affords attachment to various muscles which work the limb and stabilise the scapula against the body. But in mammals the ventral part of the girdle, the struts joining the socket to the breast-bone, is markedly simplified by comparison with reptiles and is often absent. If it is present it is represented by the "clavicle", the bone which in a living man can be seen as a ridge running from the shoulder to the breast-bone, in front of the "salt-cellars". It is in general present only in forms which, having considerable freedom of movement of the arms, require a ventrally-directed strut. Thus, it is present in Man and bats, but not in horses. Now, in the monotremes, whose stance is rather reptilian than typically mammalian, the shoulder girdle is that of a reptile, with a strong and typically reptilian system of struts running down to the sternum, which too is reptilian in having an interclavicle. There are also a number of other features in the monotreme's skeleton which recall those of reptiles.

Other and more impressive reptilian features appear when attention is given to the reproductive and excretory systems. In both sexes of both monotremes, as in all reptiles, the posterior end of the intestine, the effluents of the excretory system and the genital ducts, all open into a common chamber, the "cloaca", so that for all these systems there is only one external aperture. In higher, or "eutherian" mammals, of course, the apertures of the urinogenital systems and of the alimentary canal are separate; marsupials are roughly intermediate between the reptilian and monotreme condition on the one hand, and the eutherian on the other.

In female monotremes the oviducts, the two tubes which conduct the ova from the ovary towards the exterior, and on the way provide them with albumen and shell, are quite separate, and open independently of one another into the cloaca. This again is a reptilian feature, very rarely found in other mammals, in which there is nearly always some degree of fusion of the two oviducts to form a single vagina, or this and a joint uterus as well. It is however, in the egg itself that the monotremes most clearly announce their reptilian derivation. It is a large-yolked egg, with a shell, such as is produced by most reptiles. The ovum itself, corresponding with the "yolk" of a hen's or lizard's egg, is packed with yolk, as it is in reptilian and in no other mammalian egg, the living protoplasm being limited to a tiny spot at one point on the surface. Its diameter is about 3mm in the platypus; that of eutherian ova is about 0.2 mm. After fertilisation, which is of course internal, it is covered with a thin

layer of "white", or albumen, and by a shell which consists of inter-laced keratin fibres much as does the shell of a reptile or bird. A very remarkable feature of platypus development is the growth of the egg after the first formation of the shell and before laying: it enlarges to a diameter of 16 to 18 mm by 14 to 15 mm, apparently taking in something, presumably of nutritive value, from the maternal oviduct. Whether this occurs in the echidna, too, I do not know.

The female echidna, having laid her large-yolked, shelled egg, as any reptile might have done, broods the egg in a special but temporary pouch reminiscent of that of a marsupial. The platypus has no pouch, but only a depression on her belly; the egg is laid in a nest at the end of a burrow, and is there brooded. Both monotremes have mammary glands, but there is no teat such as exists in marsupials and higher mammals, and the baby monotremes take the milk from the wet hair.

Little is known of the physiology of either reptiles or monotremes, but some work has been done in both on the control of body temperature. The higher mammals, of course, maintain a high and constant body temperature, while in reptiles the body temperature varies with that of the surroundings and is never far from it. Monotremes, it is found, are fairly called "warm-blooded" like other mammals, but their average temperatures are rather low: 32.2°C in the platypus and 31.1°C in the echidna; in various eutherian mammals it ranges from about 36°C upwards for a few degrees. In both monotremes the temperature is held constant when the external temperature is between 27.6°C and 32.6°C, but tends to break down outside these limits and, in the echidna, when it is hibernating. In respect of temperature control, it would seem that they are much more mammalian than reptilian.

It is clear that while the monotremes are mammals, they are also closer to the reptiles than any other exisiting mammals. They go some of the way, but not all the way, towards satisfying the evolutionary zoologist's demand for a form intermediate between reptiles and mammals. They powerfully reinforce the theory that the mammals are, in fact, descended from reptiles, leaving no reasonable doubt that this was so.

Nevertheless, the platypus and echidna are not the ancestors of the marsupials and higher mammals. For one thing, they live now, which it too late by something like 150 million years; the earliest known fossil remains of mammals come from the Jurassic. For another, however primitive they may be in some aspects of their organisation, each is a form highly specialized to a particular and very special mode of life; in the platypus, an aquatic life and a diet of freshwater animals, especially molluscs and insects; in the echidna, a diet of ants and the labour of tearing up their nests. Presumably in association with their peculiar diets, both species are toothless as adults, and the echidna throughout its life. The platypus has twelve teeth when young and for a time they are used, but when the animal is about a foot long the horny false teeth of the adult develop beneath them, and they are cast off. The toothless condition tells us nothing of the mammalian or reptilian relationships of the animals, but the condition in the platypus is interesting, causing one to wonder why, if they are useless to the adult, they should be retained by the young. Perhaps in part by virtue of their life in an isolated continent protected from the fierce competition of freshwater eutheria, perhaps protected from competition even with marsupials by their special and peculiar modes of life, the monotremes have managed to survive, and surviving, to tell us something of the ancient history of the class of animals to which we ourselves belong. Unhappily, we have no fossil remains of monotremes older than the Pleistocene period of a million years ago.

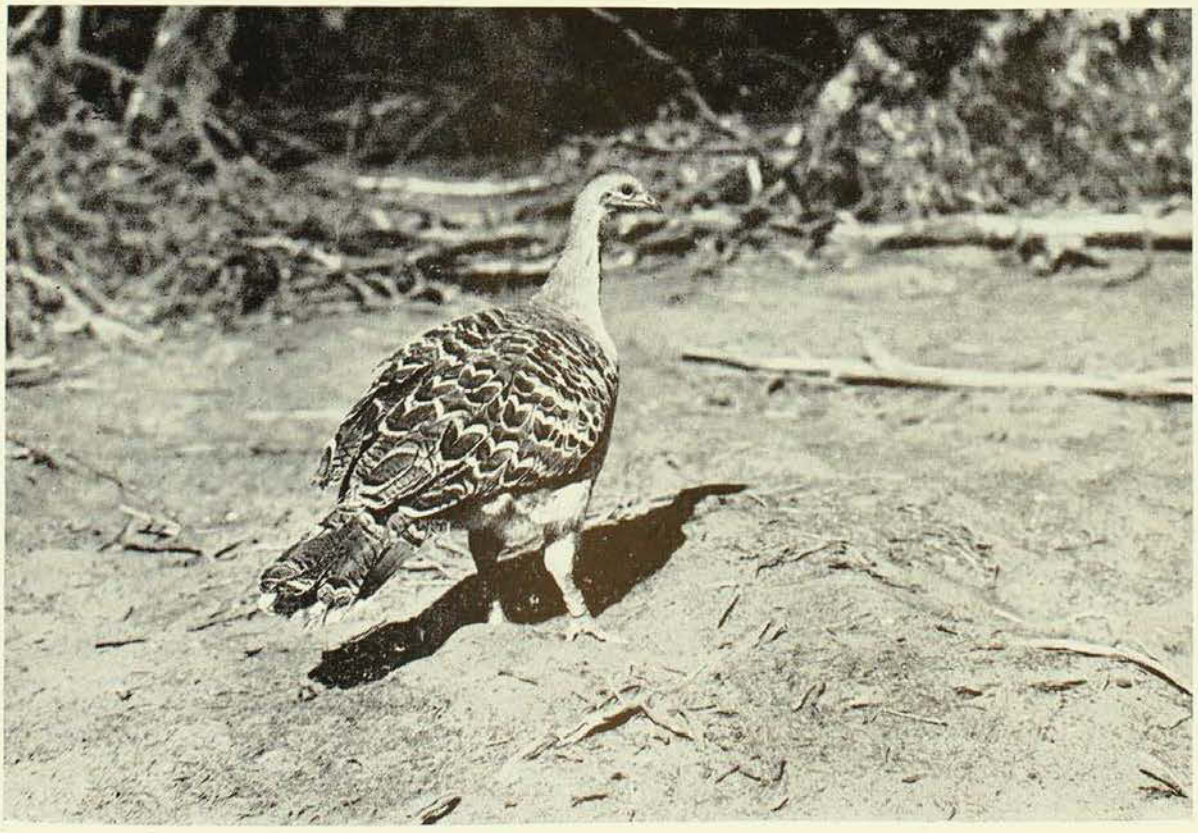
The Mallee Fowl

By H. J. FRITH
Wildlife Survey Section, C.S.I.R.O., Canberra

THE family Megapodiidae (Mound Builders), to which the Mallee Fowl belongs, comprises 7 genera and 13 species and no member of it incubates its eggs by the usual method of sitting on them; instead they all lay in holes in the ground or in mounds of decaying organic matter and leave the eggs to be hatched by the heat of the sun or of decaying organic matter. The family in confined to Australia and to parts of Polynesia, Micronesia, and Malaysia.

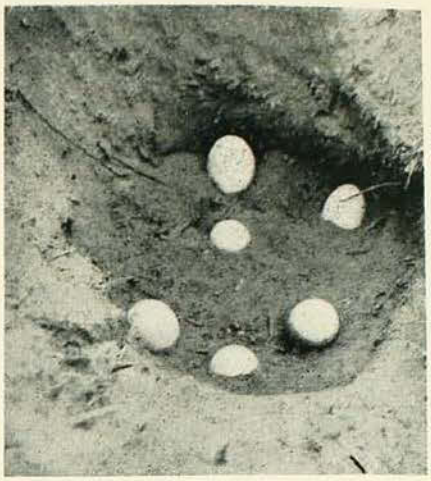
The simplest method of incubation is practised by *Megacephalon maleo* (a sole species of the genus) found in the Celebes Islands, and by *Eulipoa wallacei* (also a sole species) of the Molucca Islands. These birds simply dig a hole in the sand of an exposed beach, lay an egg, cover it, and leave it to be hatched by the sun's heat. They may lay successive eggs 14 days apart.

In New Guinea are found *Aepypodius* sp. and *Tallegallus* sp., and on the eastern coast of Australia *Alectura lathami*, commonly known as the brush turkey; it is another lone species in its genus. All these birds incubate their eggs by a more complex method than that just described. For the purpose they scrape up a large heap of organic matter from the forest floor—this may be up to 20 ft. in diameter and 9 ft. in height. Under the warm, moist conditions it rapidly ferments and when the first burst of heat is declining successive holes are scraped into it and one egg laid in each.



Male mallee fowl on nest.

Photo.—E. Slater.



Leaves, twigs and sand (scraped by the male bird into a hole he has previously prepared) are used to form the egg chamber. The number of eggs laid by a mallee fowl varies from 14 to 35.

Photos.—Author.

Megapodius sp., the jungle fowl, ranges from the Nicobar Islands in the east to Niaufou in the South Pacific Ocean, and from the Philippine Islands in the north to Yeppoon on the Queensland coast. Its incubation system varies from place to place. In some areas it merely scratches holes in hot sand, as in the case of *Megacephalon;* in other places it lays in volcanic areas where volcanic steam and heat warm the soil, and in others it constructs very large mounds of organic matter up to 30 ft. in diameter and 15 ft. high. On Dunk Island, off the coast of North Queensland, there is a range of methods in the same area, from holes in the sand to elaborate mounds.

THE MALLEE FOWL

Leipoa ocellata, the mallee fowl or lowan, differs from all other megapodes by living in the dry, hot, inland areas of Australia and possessing a complicated incubation method which utilises heat both from the sun and from fermenting organic matter. Since 1952 the author has studied mallee fowl, including colour-banded birds, in the field near Griffith, N.S.W.

DISTRIBUTION

The mallee fowl, except for an extension into the coastal areas of Western Australia, is confined to the inland of southern Australia. Within this area it is closely associated with, but not confined to, mallee, a scrub of dwarf *Eucalyptus* species. Within the habitat the distribution is further determined by the distribution of various species of *Acacia* used as food plants. There is also a close relationship between the density of the birds and the soil type, mounds and birds being more numerous on soils of lighter texture.

NESTING HABITS

The construction of the nesting mound is largely the responsibility of the male. In the autuma hole 2 to 3 ft. deep and up to 16 ft. in diameter is scratched in the soil. During May, June, and July the dry leaves and twigs over a 50 yard radius are scraped up and swept into it. In August this organic matter, wet with winter rain, is mounded up to a foot or so above ground level, and a hole about 1 ft. deep is dug into the top and then refilled with sand and leaves. This is the egg chamber. The whole is covered with the loose sandy soil and the resulting mound is carefully smoothed over. Its internal temperature quickly increases due to fermentation of the organic matter.

When the internal temperature approaches 92° F the first egg is laid, and at Griffith this is usually in the first week of September. The eggs are large, each being about 4 ins. long and weighing about ½lb.;

the female herself weighs only about 3½lb. When laid they are a delicate salmon pink but this rapidly stains a light brown in the mound. The total number varies from 14 to 35 and, depending on the female, the interval between the laying of each may be from 4 to 14 days. Owing to the large number of eggs in the clutch, and to the fact that the 7 weeks' incubation period for each egg begins as soon as it is laid, the first must hatch long before the last is laid. As soon as hatching is completed in about March or April, the male begins scraping out the mound again and preparing it for the next season. He is thus employed with it almost continuously throughout the year. Young birds often occupy a different mound each year, but as they become older they tend to settle on one mound and use it year after year.

Care of the Mound

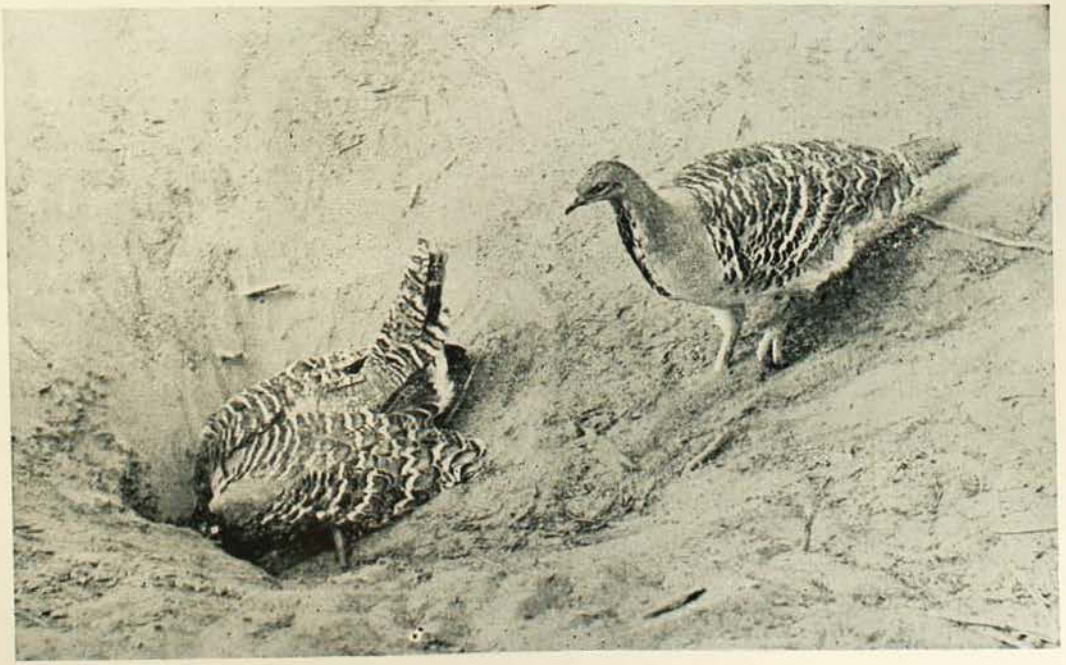
In the case of the brush turkey the male constructs the mound and savagely keeps the female away until an egg is to be laid, and only then does he allow her to approach, but with the jungle fowl the male and female work harmoniously at the mound and are probably helped by several other pairs as well.

As stated above the male mallee fowl carries out most of the work of building the mound and maintaining it but he is sometimes assisted by the female. He savagely defends it against intruders but always allows the female to approach, except in times of crisis when the internal temperature of the mound may be adversely affected; on such occasions he may actually drive her away.

When an egg is due to be laid the male visits the mound and scrapes away the covering soil to expose the egg chamber. This may entail two hours' work and results in the removal of a cubic yard or more of soil. When the egg chamber itself is exposed the female, who up to now has taken no part in the operation, assumes control and selecting a spot in its wall scrapes a niche into it. She then crouches over this hole, expels the egg and retires. The male who has remained motionless throughout this procedure now descends into the excavation, carefully covers the egg, and then restores the mound to its full height. This may mean a further two hours' work.

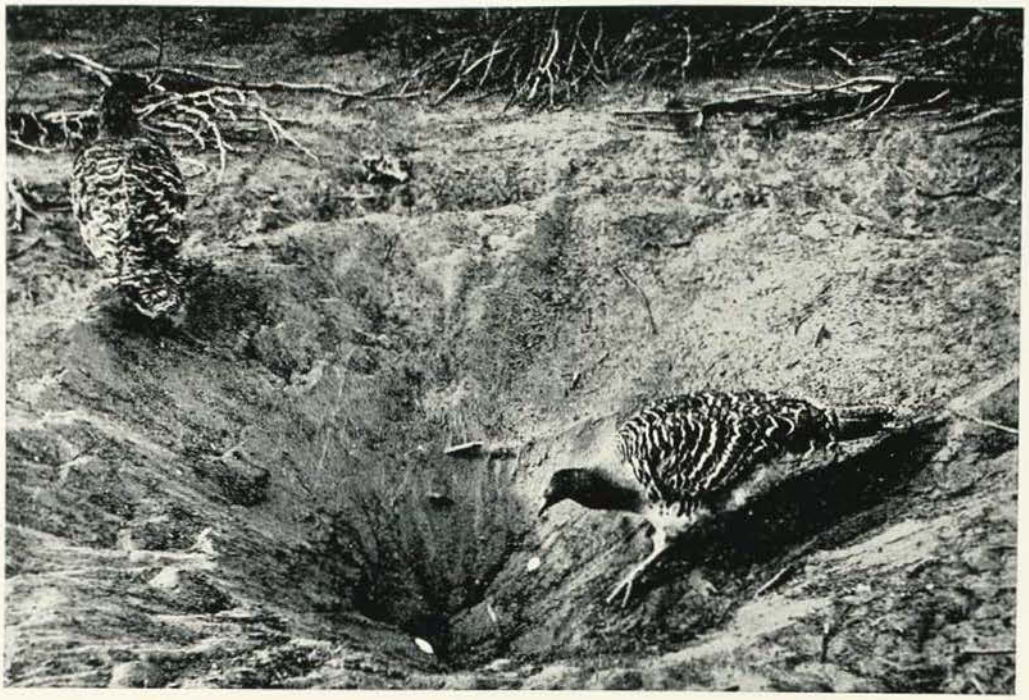
Maintenance of Mound Temperature

In addition to opening the mound for egg-laying the male tends it daily throughout the season and regulates the temperature within the egg chamber. The methods he uses have been studied by building artificial mounds and by measuring not only



Female mallee fowl laying egg, watched by male.

Photo.—Author.



Left: Female retires, having laid egg; male approaches to fill in mound. Note eggs in excavation.

Below: Mallee fowl chicks dig to the surface on hatching.

Photos.—Author.

the temperature, but also the direction and rate of heat flow, in the egg chambers of these and of natural mounds.

In an artificial mound, which exactly resembled the natural one except for the fact that it was not tended by a bird, the temperature in spring rapidly rose to 110°F which was far above the desired incubation temperature, and in autumn it quickly fell to 80°F or well below it. In a natural mound the attending male was able to reduce the temperature to the required level during spring and summer and to increase it during autumn. This control of temperature was achieved by regulating the relative amounts of heat reaching the eggs from the sun and from the fermenting organic matter.

In spring there is little heat from the sun; practically all the heat reaching the eggs is derived from the organic matter. The rate of fermentation is such that more heat reaches the eggs than is required to maintain them at approximately 92°F and so the egg chamber temperature continually tends to rise. The male bird visits the mound at or before dawn, rapidly digs into the egg chamber and allows sufficient heat to escape to restore the temperature to the required level. The excavation is then refilled with cool sand and the mound is restored. In very cold weather when

there is no heat from the sun, the increased conduction of heat from the mound surface to the air is sufficient to keep the temperature of the egg chamber down, and it is not opened. In prolonged cold spells it may be necessary to increase the insulation of the egg chamber by increasing the thickness of the soil cover in order to retain more heat.

Likewise in midsummer, when some fermentation is still taking place, it is necessary to build up the mound for insulation purposes, but this time to prevent the conduction inwards of excessive solar heat. In spite of this, however, there is a slow increase in mound temperature. In order to deal with it the male bird visits the mound every few days in the very early

morning and digs away the whole soil cover which has been slightly warmed by the sun; after it has cooled in the morning air he replaces it and restores the mound to its full height.

In autumn there is no further heat available from the organic matter and little from the sun. It is now necessary for the first time to increase the amount of heat reaching the eggs. Whereas up till now the birds have worked at the mound in the cool of the morning they now visit it in the hottest part of the day. It is opened at 10 or 11 a.m. when the sun is shining directly on to it, and the whole of the soil is removed to within 2 inches of the eggs; the mound is now a saucer-shaped depression and the direct sun heat is easily conducted to the eggs. Throughout the day the male attends the mound and periodically returns small amounts of sun-heated surface soil to the excavation. By mid-afternoon the work has been completed, with the result that the mound has been rebuilt with thoroughly heated soil and its internal temperature has been increased to 92° F.

Temperature Detection

In a further series of experiments the organic matter, the important source of heat, was removed from a mound and electrical heating elements were installed. In this way it was possible to alter the temperature of the egg chamber at will and observe the reactions of the birds. It was seen that the birds were able quickly to detect unsuitable temperatures in the egg chamber, and to alter their behaviour accordingly. By cooling the mound in spring it was possible to cause the birds to adopt their autumn-type warming behaviour, and by warming it in autumn to cause the birds to adopt springtime cooling activities, and so on.

During these studies it was concluded that the temperature of the egg chamber was measured by the inside of the bird's bill or more probably the tongue. Frequently males were seen to bury their bills in mounds and to withdraw them full of sand. Following such actions they would commence the appropriate work of either heating or cooling the mound. It is considered that the actual opening of the mound is controlled by atmospheric conditions, but that the subsequent actions are determined by the direct measurement of the mound's internal temperature.

Hatching

The young hatch beneath 3 ft. of sand and rapidly dig to the surface. By hatching eggs in a glass fronted box they were seen to dig directly upwards at a rate of about 1 foot per hour. In hot weather chicks frequently suffocate in the mound. Those that reach the surface are in a weak condition for a couple of hours, but after resting are able to run swiftly and to flutter for short distances a foot or so above the ground. They can normally fly towards the end of the day of hatching. The chicks are completely solitary and independent of their parents and of other chicks. It is believed that they do not breed until 2 years of age.

Conservation

Unfortunately the unique mallee fowl, at least in eastern Australia, is in great danger of extermination although still quite numerous in places. The introduced fox has learned to dig into the mounds and to eat the eggs; in some years 80 per cent. of the eggs in the mounds studied have been destroyed by foxes.

Though the depredations of foxes are serious, the birds have suffered even more from the destruction of their habitat. Much of the mallee in Victoria, South Australia, and New South Wales has been cleared and burned, and most of the remainder opened to grazing by sheep and rabbits. These animals destroy the *Acacia* species on which the birds feed and are undoubtedly an important cause of the decline in the numbers of the mallee fowl. The birds are also shot and their eggs eaten by irresponsible humans, despite their protection by law.

If the mallee fowl is to be preserved it will be necessary to provide carefully placed and guarded sanctuaries in western New South Wales. The Chief Secretary's

Department has recently begun this work, but much remains to be done. It will be necessary for everyone who knows of a mallee fowl mound to protect it from both man and fox, and to strive to maintain virgin mallee areas. It has been found that most landholders are very sympathetic to the cause when the unusual habits of the mallee fowl have been explained to them, and in some cases they have refrained from clearing portions of their land in order to provide sanctuary for the birds.

The general public can do much in the preservation of the mallee fowl by explaining the strange habits of the birds to less well informed neighbours. If the mallee fowl goes, Australia will have lost something unique for ever.

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Wasps

PART 1

By D. K. McALPINE

WASPS belong to an enormous Order of insects known as the Hymenoptera. After the bees, ants and sawflies have been extracted from this assemblage those that remain—the majority—are called "wasps". Many of these bear little resemblance to one another and their habits are very varied. Nearly all have two pairs of transparent wings and a narrow waist, but their are some species in which one or the other sex is flightless.

Many adult wasps feed mainly on the nectar and pollen of flowers but some are attracted to decaying or even sound fruit. The ovipositor (egg-placing apparatus of female) is used also as a sting by many wasps, either for defence or solely for paralysing the prey to be eaten by the larvae. The food of the larvae is more varied than that of the adults. The majority are carnivorous, feeding principally on the bodies of other insects, and spiders. These may be divided into parasitic and predaceous kinds, though the dividing line is not well marked. In general those forms which prey upon an actively living insect or other host over a period and only bring about its death when fully fed, may be termed parasitic. When the initial onslaught of the mother wasp or its larva brings about the immediate paralysis or death of the victim, the species is called a predator. The remaining larvae are plant feeders and usually live enclosed in galls or swellings which are induced in the host plant by their presence. These are called Gall Wasps.

There are two very strange things about the eggs of wasps which have attracted the attention of scientists. The first of these is the fact that, in general, all fertilised eggs produce females and most unfertilised eggs produce males. Thus all males are fatherless. The second peculiarity, which applies only to a few parasitic wasps, is the production of more than one larva from a single egg. This condition is called *polyembryony* and is almost unknown in other insects. Almost 3,000 polyembryonic wasp parasites have been recorded as emerging from a caterpillar and, in another species of wasp, up to 2,000 larvae may be produced by one egg. It may be seen from this that polyembryony enables an extraordinary high multiplication rate.

Wasps usually lay their eggs close to or upon the larval food. This is necessary

because of the inability of the soft, blind, legless larva to forage for itself. In a few parasitic types the larva hatches in a form called a *planidium* which has a hard cuticle and actively seeks a host of the appropriate kind. Later, within the host, it assumes the normal larval form. The pupae of wasps are often enclosed in cocoons which are composed of a silk or parchment-like material secreted from glands near the mouth. Gall Wasps do not make cocoons, there being already sufficient shelter for the pupa. Some parasites also fail to construct cocoons and pupate in the dried body of the host. In other cases the cocoons of the parasites may be seen clustered on the host's body.

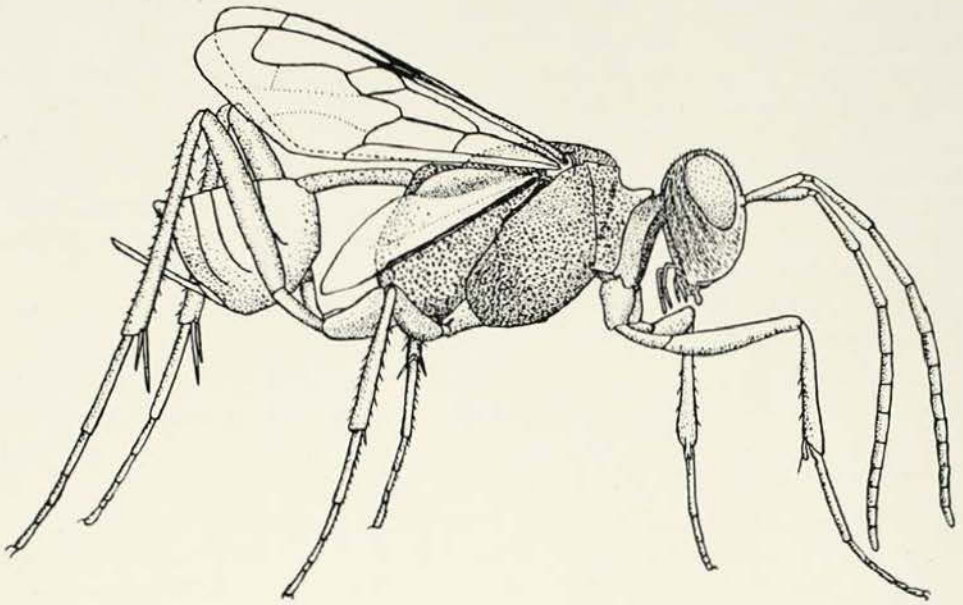
Parasitic Wasps

The parasitic wasps are the most important of all insects so far as the balance of nature (or, more correctly, *population ecology*) is concerned. They are an outstanding factor in checking the increase of moths, butterflies, beetles, flies, grasshoppers, leaf-hoppers, scale insects and even other wasps. The number of named species is in the tens of thousands but this number is small compared with the number that remains to be studied and named.

The majority of species attack the immature stages of the host, preventing their development to the adult stage. The smallest species (belonging to the families Mymaridae and Trichogrammatidae), as well as some others, insert their eggs into those of other insects. The wasp larva feeds on the contents of the egg and pupates within it. A fully grown wasp smaller than a flea emerges from the host egg instead of the expected insect larva. Some such wasps are only one-fiftieth of an inch long. Species of both the above families parasitize the submerged eggs of aquatic insects such as dragon-flies and water-bugs and have been known to swim under water by means of their narrow, fringed wings. Water does not adhere to the wings, which may be used for flight immediately after swimming. Another family (Platygasteridae) comprises somewhat larger species most of which parasitize the eggs and larvae of tiny gall midges (flies of the family Cecidomyiidae) which are often themselves not much bigger than their parasites. The eggs are laid within those of the host but the larvae do not begin to develop until the host larvae have hatched. The young parasites are often lodged within the organs of the host, some living in the stomach, others forming cysts in the ventral nerve cord or brain.

A very different kind of egg parasite attacks the eggs of cockroaches. This is the familiar Hatchet-bodied Wasp (*Evania appendigaster*) whose abdomen is hatchet-shaped and attached near the top of the thorax. It reaches a size of over a quarter-of-an-inch long which, for an egg-parasite, is remarkable. The size is made possible by the manner in which a cockroach's eggs are laid. They are laid in a group of a dozen or more contained in a horny capsule up to half-an-inch long and thus each wasp larva has much more food at its disposal and much more space for growth than do most egg parasites.

Of those wasp larvae which parasitize other wasps some choose parasites as their hosts. The resulting condition of a parasite within a parasite is called "hyperparasitism", and the wasps parasitizing parasites are called hyperparasites. In some cases the first hyperparasite or secondary parasite may in turn be parasitized by another parasite (tertiary or third parasite) and even more complicated cases have been reported. The study of parasites and hyperparasites has proved very important to those concerned with the control of insect pests. Scientists have found it possible at times to control a pest species with some degree of success by importing parasites of closely related species from abroad or, when the pest is itself an introduced species, by importing a natural parasite from its native terrain. In such cases the greatest care needs to be taken not to import secondary parasites also, as these may exert such a restraint on the increase of the primary parasites as to render them ineffective. It is obvious that, while an increase in the number of secondary or quaternary (fourth) parasites favours the original host species, an increase of the tertiary parasites favours the primary parasites and reduces the host population.

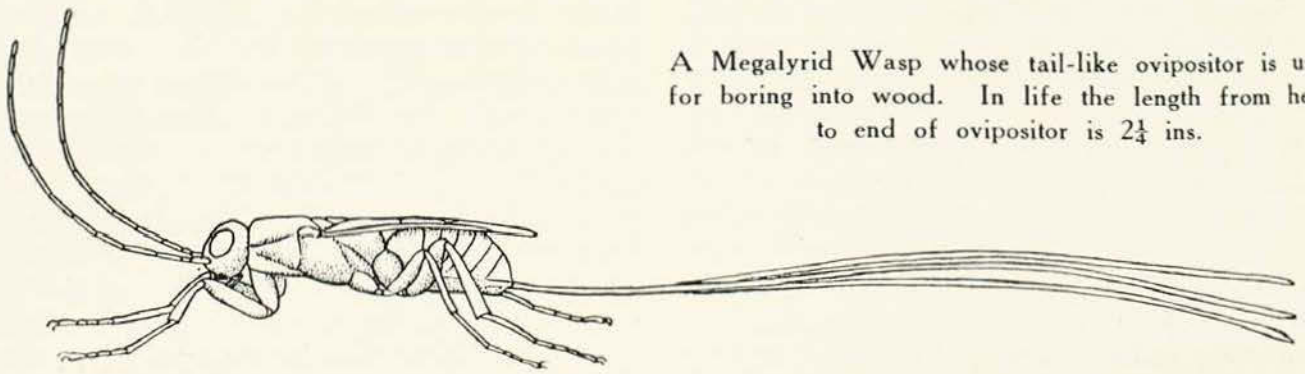


A Hatchet-bodied Wasp (*Evania sp.*). Note the peculiar carriage of the wings. The body-length of this insect (natural size) is $\frac{3}{8}$ ins.

Perhaps the most extraordinary of the larger parasites are the species belonging to the family Megalyridae. This family was once considered to be confined to Australia but some South African and Indian species are now also included in it. The ovipositor is several times as long as the body and scarcely thicker than a horsehair, even in the largest species. It seems almost incredible that such a fragile instrument should be used for boring into solid wood. Yet that this happens has been well substantiated. The eggs are laid in the burrows of wood-boring beetle grubs which the larvae parasitize. The wasp is itself incapable of entering the burrows and relies on the length of the ovipositor to reach its victims. Though it would appear that every advantage is taken of natural entrances to the burrow, or cracks in the wood, there is no doubt that the ovipositor actually bores through hard wood when other means fail. One such case observed took ninety minutes for the complete boring operation. There is still very little known concerning the habits and life history of these wasps. This is unfortunately the case with most Australian insects.

Many of the large family of Ichneumon Wasps parasitize caterpillars. One Australian species (*Lissopimpla excelsa*, formerly *L. semipunctata*) is remarkable for being the only insect known to pollinate the Tongue Orchids (*Cryptostylis*) of which there are several species in the Australian bush. Only the male wasp is concerned with pollination. He behaves as if the orchid flower were a female wasp and shows the usual mating behaviour. The pollen masses stick to the abdomen and are carried to the next flower where the pollen adheres to the glue-like substance of the stigma. Fertilization is thus effected.

(*To be concluded.*)



A Megalyrid Wasp whose tail-like ovipositor is used for boring into wood. In life the length from head to end of ovipositor is $2\frac{1}{4}$ ins.

Land of the Tree-climbing Snails

By DONALD F. McMICHAEL

TO the zoologist, the island of New Guinea is one of the most fascinating places in the world. Nearly everyone is familiar with some of its peculiar animals, especially the bewildering variety of richly plumed Birds of Paradise, and the delightful tree kangaroos. But few people have heard of the equally fascinating smaller animals which, though not so spectacular or well known, are of great scientific interest. The larger animals, especially the birds and mammals, have always attracted more of man's attention than other forms of life, so that knowledge of these warm-blooded vertebrates is much greater than it is of the invertebrate animals.

Recently I had the opportunity of visiting New Guinea to collect as many different kinds of molluscs, especially land snails, as was possible, and my travels took me to all parts of the island. This visit was made possible by financial assistance from Yale University and the Bernice P. Bishop Museum of Hawaii, two institutions which are doing much towards increasing knowledge of the biology and anthropology of the Pacific Islands.

Perhaps the most surprising aspect of the life of snails in New Guinea is that a great number of species live in tree tops! The average Australian will be very familiar with the introduced snails which are garden pests, and possibly the many different kinds of native Australian snails. But very few of these are to be found anywhere but in leaf litter and under decaying logs in the bush. Most of them are a drab brown in colour, and hide away during the day, emerging at night to feed. But in New Guinea, a large group of snails, belonging to the genus *Papuina* are always to be found on the branches or leaves of the rainforest trees. Not only have they abandoned their traditional habitat, but also their dull protective coloration and habits, for their shells are mostly brightly coloured in shades of yellow, pink, brown, violet and green; and the snails are active during the day, especially during and after rain. There are a few other places in the world which have tree-climbing snails, and in every case the snails are brightly coloured, so it seems possible that the coloration is correlated with the abandonment of their forest floor habitat, where dull browns and yellows serve a protective function. But in no other place are there so many different kinds of tree snails, and the shells have developed into nearly every shape possible for a snail, so that New Guinea could well be called the Land of the Tree-Climbing Snails.

Some New Guinea snails reach an enormous size by snail standards. In the high mountain ranges of southern Papua, the genus *Hunsteinia* often exceeds 3 in. across, and the animals weigh about ½ lb. These giants are a valued source of food for the native people. They are collected at night after a heavy downpour of rain, when the floor of the forest becomes alive with snails, large and small, actively seeking for food and mates. This same forest in the heat of the day, appears as dead and lifeless as a desert. In one hour, my native companion, Douglas, had gathered half a sugar-bag full and he and his family sat up all night cooking the catch, to enable me to take the shells with me the next morning.

These large species are native to New Guinea. A far more formidable animal in the economic life of New Guinea is the Giant African Snail, which was taken to many places in the Pacific Region during World War II by the Japanese. These creatures occur in several centres along the north coast of New Guinea, but so far have proved a major pest problem only in the Rabaul district of New Britain, where they destroy cocoa and other crops. In Manokwari, the large town and port on the east side of the Vogelkop or "Bird's Head" of New Guinea, Giant Snails can be seen

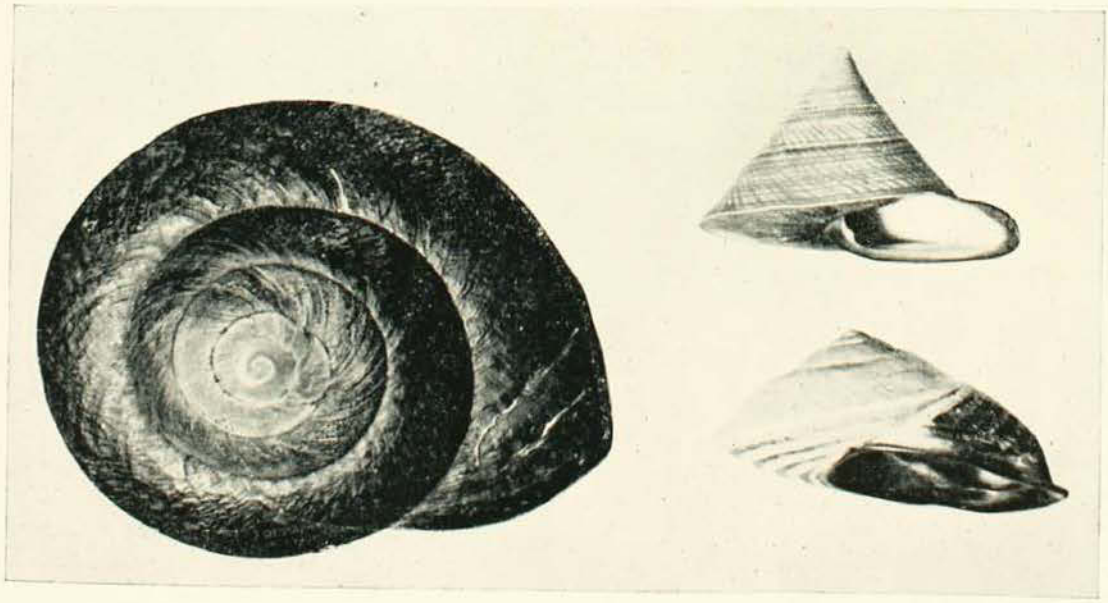
hanging from the bushes along the sides of the road, and are found everywhere where the forest has been cleared away. The snails reach a length of 7 in., but most specimens are about 4 or 5 in. long. Even so, they are a menacing threat to agriculture in New Guinea.*

Other forms of invertebrate life in New Guinea are no less interesting. One cannot fail to notice the brightly coloured spiders, the brilliant butterflies, moths and other insects, or the huge myriapods, often more than 9 in. long, and with a burning body secretion capable of scaring off any potential predator. Strangely enough, despite the wealth of animal life, the tropical rainforest is a very drab place, for the eternal green of the forest is seldom broken by any other colour. Flowers are few and far between, while the birds are lost in the tree tops, and the mammals hide during daylight hours. Occasionally one catches a glimpse of the vivid red of D'Albertis Creeper, a plant known as the "Flame of the Forest", or perhaps the brightly coloured flash of a Parakeet vanishing in the treetops. A flock of white cockatoos or a pair of hornbills flap their way across a clearing or a lizard scurries away through the undergrowth. But mostly the forest is silent, and all is covered with an unending mantle of green.

As mentioned previously, the native mammals are rare and secretive, since they become active only at night. The casual observer will be unlikely to see tree kangaroos, unless he comes across one in captivity. These animals make delightful pets, with their bear-like faces, long thick tails and ungainly walk. One unusual mammal which I was fortunate to see was the New Guinea Spiny Ant-eater, a relative of our Australian species. This had been captured by one of the primitive Moni tribesmen of the Wissel Lakes district in the highlands of Dutch New Guinea. In these highlands areas, searching for food is the principal activity of life. Every living thing is sought for food, and a large bristly ant-eater was a prize indeed. The owner of the Ant-eater could not be persuaded to part with it alive, but he was prepared to sell the skin, which I obtained for the Australian Museum, after a very complicated period of bargaining in four languages, the price being two axes, some blue beads, and twenty Dutch New Guinea guilders (about £3 Australian).

The people of the Wissel Lakes district, together with other tribes living in the high mountains of Dutch New Guinea and extending east into Australian New Guinea as far as the isolated outpost of Telefomin, form one of the most interesting ethnic groups in all New Guinea. Exceedingly primitive, they live in poorly constructed huts, are practically naked, though adorned with shell ornaments, the spines of ant-eaters and cassowary feathers, and have a

* See article in this MAGAZINE, vol. ix, No. 11, page 374.

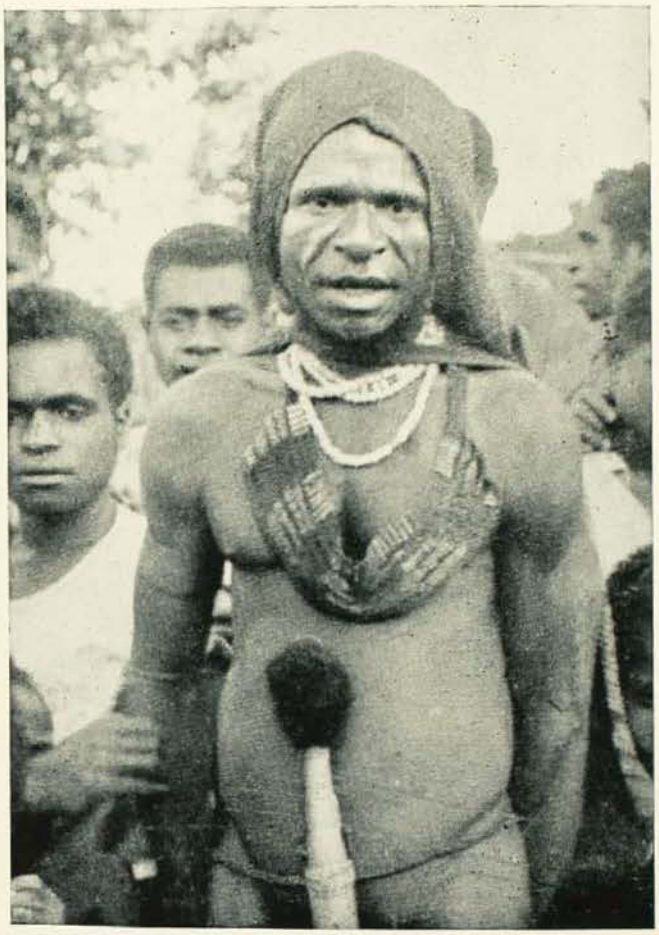


New Guinea Land Snails—*Left:* The large native New Guinea snail, *Hunsteinia*, which reaches 3 ins. in diameter and is used as food by the natives.

Right: Two types of tree-climbing snails, *Papuina hedleyi* (top) and *Papuina secans* (bottom) showing the patterned coloration and the peculiar twist of the mouth which is characteristic of this group of snails.

Photo.—H. Hughes.

The New Guinea Long Beaked Ant-eater, *Zaglossus*, from the Wissel Lakes district of Dutch New Guinea. These animals are a valued source of food, and their "beaks" and spines are highly prized for decorative purposes.



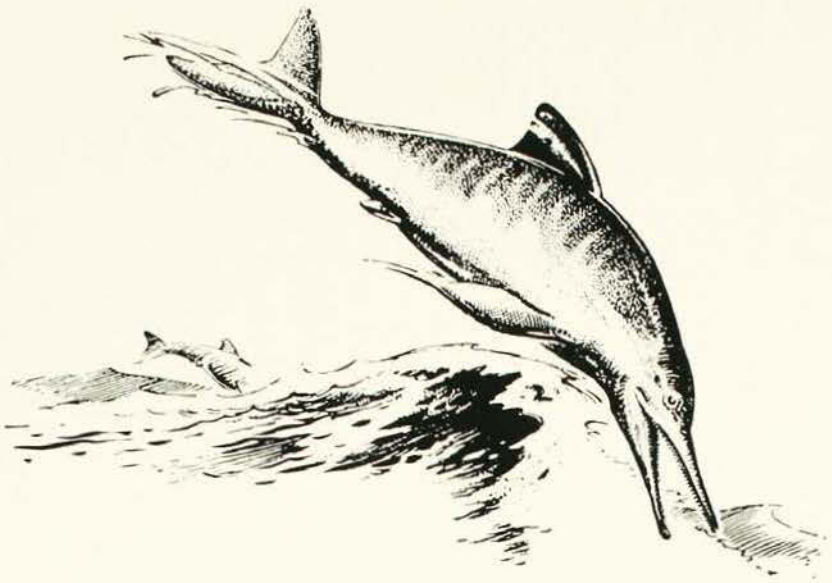
A Moni tribesman from the Wissel Lakes. These primitive people have had little contact with civilisation and are still largely uncontrolled.

Photos.—Author.

very elementary agriculture, based mainly on the sweet potato. Their only common source of animal protein is the pig, a delicacy saved for feasts and celebrations. The Wissel Lakes people are fortunate in having a second source of animal food in the freshwater shrimps or crayfish which inhabit the lakes. The native women spend most of their time in the simple hollow-log canoes fishing for these crayfish with a huge net, up to 6 ft. in diameter, carried on the end of a bamboo pole about 30 ft. long. This is dipped vertically into the water till the net strikes the lake bottom, then with a mighty heave which shoots the canoe through the water, the women bring the net quickly to the surface to yield perhaps half-a-dozen small crustaceans. Such is the lot of the Wissel Lakes women, an unending struggle for survival which usually ends in death from chronic malnutrition at a comparatively early age.

One of the zoological curiosities of the world is the beautiful Lake Sentani, situated a few miles inland from the coast near the Dutch capital of Hollandia. Approaching Hollandia by air, one flies across the limpid waters of Sentani stretching for about 15 miles in two arms, surrounded on all sides by grass covered hills, here and there the rainforest creeping down to the water's edge, and with an occasional native village on the foreshore. The lake is full of typical freshwater animals, including freshwater mussels, snails, insect larvae and freshwater fishes. However, cruising around in its deeper waters are sharks and sawfishes, the descendants of fishes which populated it many centuries ago when it was an arm of the sea. Lake Sentani is one of the few places in the world where sharks are to be found living in pure freshwater.

Despite the large number of expeditions which has visited New Guinea in recent years, collecting animals of all kinds, there are still vast areas which remain virtually unexplored, and in which many fascinating animals may one day be found.



Marine Giants Past and Present

By H. O. FLETCHER

An Ichthyosaur, showing the streamlining so essential in a fast-swimming vertebrate. Ichthyosaurs were similar to modern porpoises in size and habits.

From "Evolution of the Vertebrates" (Colbert).

AT various times in the geological history of the past the seas of the world have been inhabited by creatures of giant size. In this article we are concerned mainly with those prehistoric marine creatures which attained a length of about fifty feet or more. Though these animals are now extinct, their fossil remains found in rocks of various geological ages throughout the world are so well preserved, and in many cases so numerous, that they are almost as well known as living species. The giants of the present day oceans are the whales and of these the Blue Whale, which can attain a length of 100 feet and a weight of 160 tons, is the largest creature ever to have lived on land or in the sea.

One of the greatest of the extinct animals is the giant "White Shark", *Carcharodon megalodon* Ag., of Tertiary times. It is a very close relative of the living "White Shark" or "White Death" and except for size, would differ very little if at all in essential structure. The largest specimen of the southern living species, *Carcharodon albimora* Whitley, was caught at Port Fairy, Victoria, and its estimated weight was 3,000 lb. It measured 36½ feet in length and one of its teeth was 2 inches in height.

Teeth of the giant extinct shark have been collected in great numbers from deposits of Miocene and Pliocene age in most parts of the world. They have also been found in Pleistocene sediments, and dredgings have proved their presence on the bed of existing oceans. The large serrated teeth of this shark are not uncommon in the Miocene rocks of Victoria. Its teeth averaged about 6 inches in height in the middle of the jaw and gradually decreased in size towards the sides where the smallest tooth was at least 2 inches in height.

Considerable research was undertaken by the American Museum of Natural History, in 1909, when preparing a restoration of the jaws of this giant shark. Its teeth, of which there are an abundance, were arranged as in the living "White Shark" and the startling result was jaws measuring about 9 feet across and a gape which must have been at least 5 or 6 feet. An estimate of the length, made on a comparison of the teeth in relation to those of living species, was approximately 80 feet. This may be a slight over-estimation, but in any case the length was enormous.

It was pointed out by Ashford Dean, in the *American Museum Journal*, Vol. ix, No. 8, that in spite of its great size *Carcharodon megalodon* must have lived in great

numbers if one can judge from the quantity of teeth found in all parts of the world. From this fact it was considered that the bony fishes of those days, the staple diet of the sharks, must have occurred in vast shoals. Sharks are very rapacious creatures and the normal satisfactory daily meal of the giant shark must have been at least a ton of these fishes. It has been pointed out however, that a shark's teeth as they became worn, loosen and drop out which, as one author states, would account for what he considered must have been " a continuous rain of teeth from shark's jaws to the sea-bed beneath ".

The sharks have an interesting geological history which extends back to the Upper Devonian seas of about 350 million years ago. One of the earliest known forms was collected from a fine shale on the shore of Lake Erie, Canada, and is in a remarkable state of preservation. The body outline is almost complete and even the soft parts of the anatomy are preserved. This occurrence, however, is an exceptional one as in most cases the palaeontologist is faced with a geological record in which the only fossil evidence consists of isolated teeth and spines. The primitive sharks of the Devonian seas did not differ to any marked extent in shape and structure from those living in the oceans today.

In Australian rocks the fossil remains of these early and smaller types of primitive sharks are fairly well known. In the Permian rocks of Western Australia, about 130 miles inland from Carnarvon, an incomplete row of well preserved teeth was found and described in 1886 as *Edestus davisii* Woodward. This shark is restricted to the Carboniferous rocks of Europe and America and its occurrence in Australian Permian rocks led to a great deal of discussion. In 1937 another incomplete specimen was collected and two years later new finds of almost complete specimens proved the rows of teeth to be spiral in form and its affinities with the Permian genus *Helicoprion* were established. These peculiar spirals or whorls of fossil teeth are obviously those of sharks, but they give no clue to the type they represent.

Included amongst other Australian fossil finds are the remains, from Lower Cretaceous rocks in Queensland, of a " Porbingle " shark, *Lamna*, a genus which had a world-wide distribution and ranges through to the present-day seas where species still exist. Miocene deposits in Victoria, laid down about twenty million years ago, have yielded fossil evidence of species very closely related to the Port Jackson Shark, the Tiger Shark and the Ghost Shark.

After the close of the Palaeozoic Era and during early Triassic times, the first subdivision of the Mesozoic Era, there was a considerable and most interesting development of the back-boned animals. The land at this stage was dominated mainly by cold-blooded amphibians and reptiles. The reptiles gradually became adapted to new environmental conditions and were well on their way to the great heights they eventually attained in evolutionary history.

Certain land living groups of reptiles of doubtful Palaeozoic ancestry began to follow a definite evolutionary line which led to the highly specialised marine reptiles—rulers of the Jurassic and Cretaceous seas in all parts of the world.

Of these creatures the ichthyosaurs were the first to appear and with an apparent suddenness in middle Triassic times. They reached the peak of their development in Jurassic seas and persisted through into the Cretaceous with diminished numbers. Well before the close of that period they became extinct.

The ichthyosaurs were highly adapted for a marine existence. They possessed a fish-shaped body, a long head with jaws furnished with strong conical teeth, a large tail and no distinct neck. The legs of their land-living ancestors were transformed into paddles, used mainly for steering as movement through the water was achieved by undulations of the body and by means of the large tail fin. It has been said that they occupied the place in nature now taken by the dolphins and porpoises. The ichthyosaurs were totally unfitted for even brief sojourns on land and it is obvious that reproduction must have taken place

in the water. This fact was proved by fossil specimens which show skeletons of young ichthyosaurs within the body of a large individual.

These fish reptiles, as they are commonly known, did not attain a very great size and the largest did not exceed 40 feet in length. They are a most interesting group, however, and Edwin Colbert states in his *Evolution of the Vertebrates:* " among these reptiles there was a reversal in the trend of evolution—from distant fish ancestors, through intermediate land-living amphibia and reptile ancestors, to aquatic reptilian descendants ".

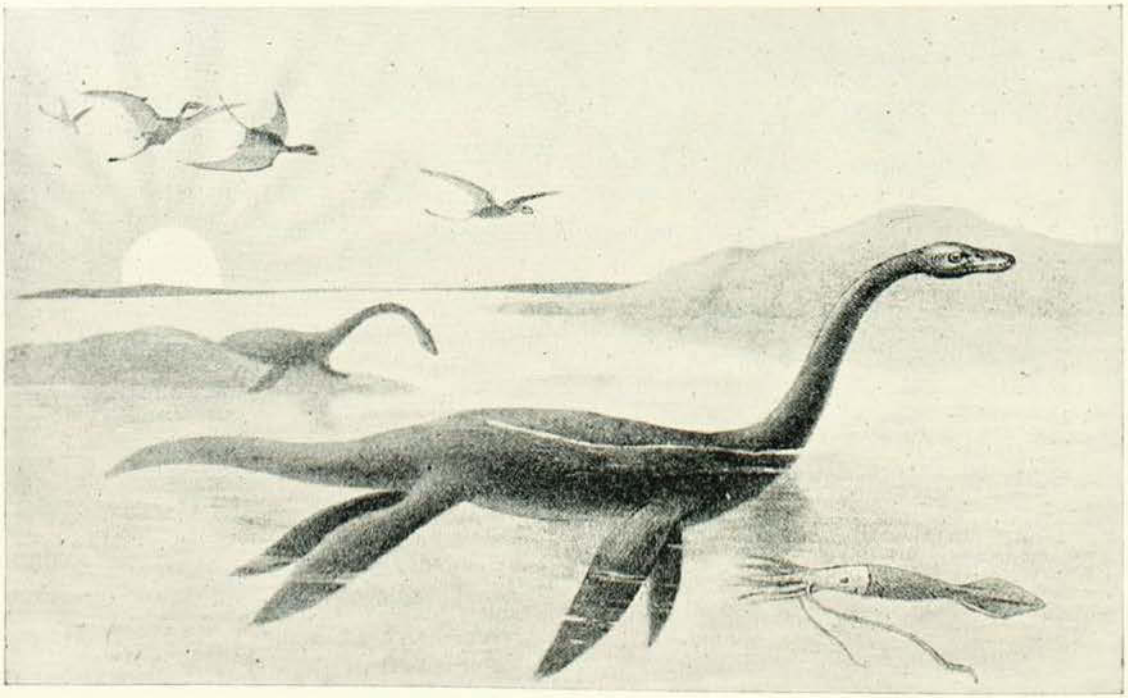
In Australian rocks the fossil remains of ichthyosaurs are not uncommon, but they do not appear until the Cretaceous period. The largest of the Australian specimens possibly attained a length of about 25 feet.

Living in association with the ichthyosaurs in the Mesozoic seas were many types of marine reptiles of varying sizes and including crocodilian and varanid-like lizard forms. The most important of them all was the extraordinary long-necked, predaceous reptile *Plesiosaurus.* This creature attained a length of at least 40 feet and although well adapted for a marine existence was not as specialised as the ichthyosaurs.

The great scientist, Cuvier, more than a century ago said that it was the most monstrous animal to have yet been found amid the ruins of a former world. In describing its structure he said that " to the head of a lizard it united the teeth of a crocodile; a neck of enormous length, resembling the body of a serpent; a trunk and a tail having the proportions of an ordinary quadruped; the ribs of a chameleon, and the paddles of a whale ". Another writer many years ago stated more briefly that it could be compared to " a snake strung through the body of a turtle ".

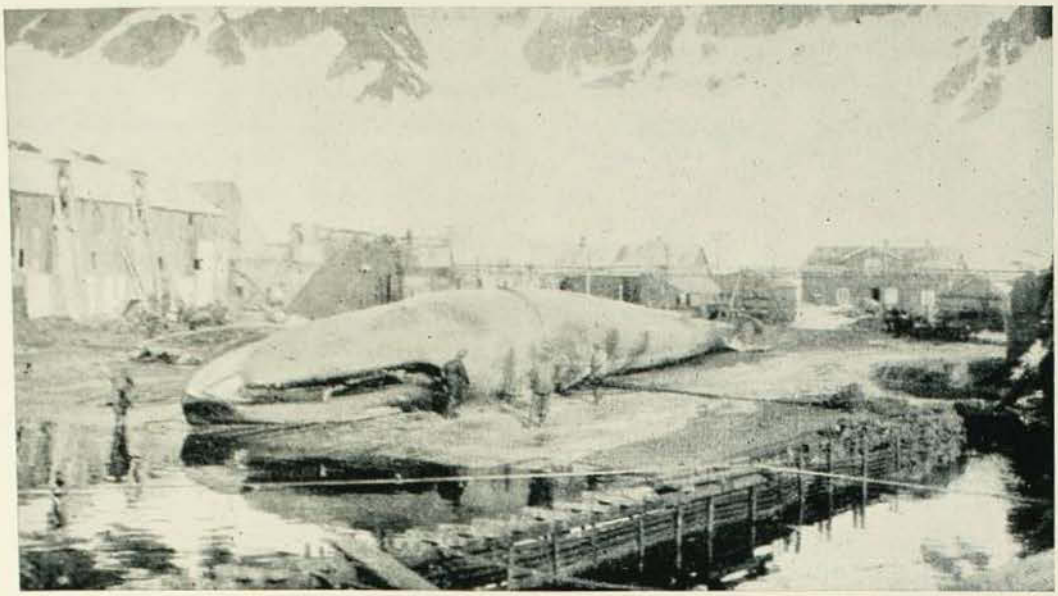
These statements give some idea of the strange combinations found in the anatomy of plesiosaurs. The body of these strange creatures was broad and flat and fairly short, the main length of the animal being taken up by its long neck. The limbs or walking legs of the ancestral types, as in the ichthyosaurs, had evolved into large paddles, but unlike that group they were much larger and were used for swimming. The later types of plesiosaurs evolved into shorter necked creatures with larger paddles for added propulsion, but nevertheless at their best they had little capacity for swift motion in the water.

It could be said that the plesiosaurs rowed themselves through the water—a



A long-necked marine reptile, *Plesiosaurus*, showing large swimming paddles.

From "Extinct Monsters" (Hutchinson).



A large Blue Whale ready for flensing at Grytviken South Georgia.

From "The Polar Record" 3:24, 1942.

means of progression far removed from the swift and darting movements of the ichthyosaurs. Their method of respiration—all marine reptiles were surface breathers—made it imperative for the plesiosaurs to be near the surface. One can visualise them swimming slowly along, long neck arched ready to swiftly dart down at fish upon which they depended for food. The plesiosaur may also have lurked in shoal waters along the coast, but whatever its food-gathering propensities they must have been quite sufficient to satisfy its hunger. The large flippers of the plesiosaurs were more than sufficient to propel them along a flat beach or coast-line and it is quite possible that at times they visited the shore and ventured on land.

The fossil remains of plesiosaurs are found distributed in all parts of the world. In Australia they are found in fair abundance in the Lower Cretaceous rocks of Queensland. The first record was made in 1867, but since that year many additional specimens have been collected. These include a gigantic species from rocks at Hughenden, Queensland, which was described by Mr. H. Longman, then Director of the Queensland Museum, as *Kronosaurus queenslandicus*. The fossil remains consist of portion of a large and massive mandible containing six very large teeth. The skull of this plesiosaur reached the huge dimensions of 12 feet in length and in comparison with other known skulls this would suggest a creature of record size.

We now come to the whales of present-day seas—giant mammals which have taken up an aquatic existence with great success. They far exceed in size and weight any of the prehistoric marine monsters. Of any known creature the large Blue Whale of the far southern ocean is the ultimate in gigantism.

The ancestral forms of the whales are completely unknown. Whales are first recorded as fossils from rocks of middle Eocene age. *Basilosaurus*, (commonly referred to as *Zeuglodon*) was one of the early primitive forms grouped together as the archaeocetes. They grew to a length of at least 60 feet.

The modern whales evolved from these primitive archaeocetes which lived and flourished in late Eocene times. In the Miocene geological period of the Tertiary era, almost all the known living families of whales had been established, including the toothed and whale-bone whales.

In Australian rocks the early *Zeuglodon* is represented by teeth from Miocene rocks in the Murray River district of South Australia. These whales were long, narrow, snake-like creatures about 60 feet long and they probably crept and swam among

the shallow waters of early and middle Tertiary seas in most parts of the world.

In late Oligocene times a small type of whale appeared which was similar in appearance to the modern porpoises. An almost complete skull of this whale was collected from the cliffs at Table Cape, Tasmania, in rocks of Miocene age, and described as *Prosqualidon davidis* by Professor Flynn, of the University of Tasmania. This type of whale has a snout which is much shorter than those of its nearest relatives found in rocks of the same age in the Northern Hemisphere. Its teeth are very similar.

The sperm-whales are represented by fossil remains found in Pliocene deposits at Beaumaris and Grange Burn, Victoria, while other toothed-whales are also recognised by teeth from sediments of the same age. The whale-bone whales are known by fragmentary fossil remains from various Tertiary deposits and a large rostrum of a beaked whale, named *Mesoplodon*, was described from Pliocene rocks at Lakes Entrance, Victoria.

Towards the end of Tertiary times the evolution of the whales was reaching its zenith and it culminated in the monsters of present-day seas. These are represented by many types of large whales which include the following:—

The Right Whales (Balaenidae); Greenland Right, North Atlantic Right and the Southern Right Whales.

The Rorquals (Balaenopteridae); The Blue Whale, the Fin, Sei, Bryde, Minke and Humpback.

The Grey Whales (Rachianectidae); the Grey Whale (a single species).

Toothed Whales (Odontoceti): the Sperm Whales.

The Rorquals include both the largest and the most abundant of all living whales, with the Blue Whale holding pride of place in the seas as the largest type, growing to a length of 100 feet or more and weighing about 160 tons. The Fin whales are a very close second as they average about 80 feet in length.

It is generally considered that the great size of the whales is due, to a great extent, to an ideal environment and a most plentiful food supply. Most whales feed on plankton, drifting or floating organic life found at various depths of the ocean and particularly abundant in the colder waters of the world. At times the Antarctic sea is so crowded with small crustaceans, a favourite diet of the whales and known as "Krill", that it could be said to form a "plankton soup".

In referring back in geological history to the prehistoric creatures of the seas one is impressed by the great number of individuals and the variety of species found in the fossil state. When it is considered that the known fossil remains represent only a minute fraction of a past fauna it is obvious that the ancient seas must have teemed with life. Not only did they contain the many giant forms, but there must have been present an abundant food supply to satisfy their appetites. This is a feature which has been remarked on by many authors, but obviously it would be impossible to even suggest a figure regarding the numbers of the many groups represented.

An indication of the numbers of extinct giant animals inhabiting the seas at any given time in the Mesozoic seas, may perhaps be gained from the living whales. After a good deal of research it has been stated that it would be impossible to estimate the number of whales living in the seas today. Some idea of the numbers however, may be gained from the whales caught by whaling companies in Antarctic seas during an open season extending from about the 8th December to 7th March. During the 1938-39 season, 38,321 whales were caught including 14,059 Blue Whales, 20,788 Fin Whales, 2,591 Sperm Whales, and 883 other species. It would be safe to say that since whaling began on a commercial basis at least half a million whales have been killed in the last half century in Antarctic waters alone. At the present time the number of whales which may be caught legally each open season in the Southern Ocean and below lat 40° S., is 16,000 Blue Whale units, which represent

TABLE OF GEOLOGICAL SYSTEMS AND THE SUCCESSION OF LIFE

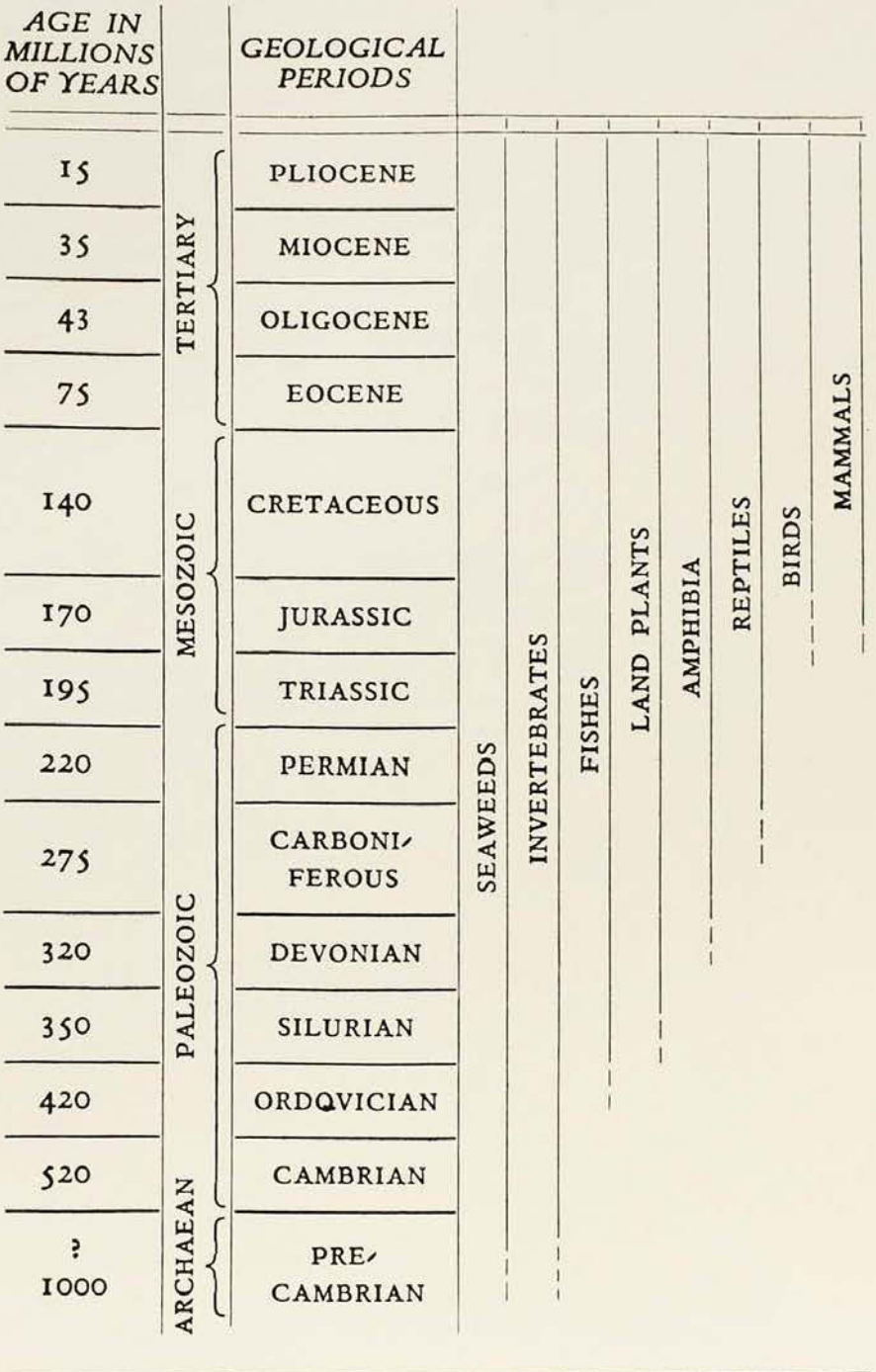


CHART OF GEOLOGICAL TIME. The small blank space at the top represents the last million years of the Pleistocene and Recent Times, about 25,000 years.

From "Living Fossils" (Burton).

a catch of 320,000 whales every twenty years. The life span of a whale is not yet known, but it is known that they reach maturity in three or four years when they begin breeding. A Blue Whale at birth measures about 20 to 25 feet.

These are surprising figures and even though it is impossible to use them as a means of estimating the numbers of the extinct marine reptiles which frequented the ancient Mesozoic seas they certainly provide food for thought.

Nature Quiz

Q.: Do the females of all kinds of prawns carry eggs?

A.: The question is apparently a live one among both professional and amateur fishermen. Many believe that the carrying of egg clusters or the so-called "berried" state is the sole indication of breeding in every kind of female prawn. For this reason the local kinds netted commercially have attracted more than usual attention because of an absence of egg-bearing females in numerous catches for marketing. From time to time the finding of an egg-laden prawn in the nets has led to an erroneous assumption, and such specimens have been brought triumphantly to the Museum as evidence of breeding. Disillusionment follows when it is pointed out that these are a different kind of prawn.

The facts can be simply explained. The prawn grouping (Penaeidea) to which the schooling commercial species belong differs from all of the other far more numerous kinds of prawns which carry clusters of eggs on the underside of the body; the females pass out their eggs to float free in the water, where they hatch and release the young larvae.

Book Review

THE PRIVATE LIFE OF FISHES: By M. Constantin-Weyer. Richard Bell, London, 1956; distributed by Putman & Co. Ltd. 5¼ x 8 in., 150 pp., frontisp., 18 pls. & 14 text-figs. Price 15/- Stg.

Translated from the French by Ray Turrell, this entertaining book about fishes and the conditions under which they live is unusually refreshing because Constantin-Weyer does not take for granted the axioms of ichthyologists, but thinks things out for himself. The author has travelled widely and brings a scientific training as well as a fisherman's and naturalist's observations to bear on the anatomy, physiology and psychology of fishes which are here briefly described for lay readers.

Excellent photographs appear as plates and the line-drawings in the text are the work of the well-known ichthyologist and aquarist, Mr. A. Fraser-Brunner. Some words which may be unfamiliar to English readers (micelle, encephalon, hypermetropic, etc.) are not explained and the chapter on optics is rather technical, but there is little to criticise otherwise. There are a few misprints and no index. The new name *Upsilon tau* is introduced for the Toad-fish, *Opsanus tau* on page 143.

At times humourous, even discursive and whimsical, one feels the author's heart is in the right place, although he cavils against his fellow Frenchmen and certain Americans and Englishmen. Most of the fishes dealt with are Northern Hemisphere types, yet this is a book which might profitably be read by Australian naturalists who will reassure M. Constantin-Weyer concerning the Australian Lungfish (p. 129) which he thinks "unhappily seems doomed to disappear because of its excellence as food". This fish is protected by law in Queensland and is holding its own in the rivers there.

G. P. W.

List of Fish Types

Type specimens, the actual examples upon which new scientific names are based, are of great value for future reference by classifiers and must be carefully preserved for later generations. The Australian Museum has many hundreds, perhaps thousands, of animal "types" and lists of these are being prepared. One such list which has been issued, for the use of professional ichthyologists and institutions, is a List of Fish Types. Mr. G. P. Whitley, Curator of Fishes, has completed this list to coincide with the celebration of the bicentenary of the publication of the tenth edition of Linnaeus' *Systema Naturae*, the foundation upon which modern taxonomists are still building. The list has taken many years to compile and has necessitated a complete overhaul and re-organisation of the fish collections.

Hawaiian Tree Snails

The Australian Museum is to acquire a collection of Hawaiian Tree Snails of the genus *Achatinella*, made last century by the American malacologist J. T. Gulick. These shells were the basis of one of the classic pioneering studies in evolution. Together with a map of Ohau Island prepared by Gulick and showing the distribution of the various species and races, they will be a valuable and historic addition to the collections.

The Curator of Shells, Dr. D. F. McMichael, spent three weeks in Queensland during January, visiting Heron Island Biological Research Station and other centres. Marine molluscs were collected for the Museum and field studies on some Queensland Volutes undertaken.