The AUSTRALIAN MUSEUM MAGAZINE

Vol. VII. No. 9. JUNE, AUGUST, 1941. Price—ONE SHILLING.

White Goshawk.

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

THE AUSTRALIAN MUSEUM

HYDE PARK, SYDNEY

BOARD OF TRUSTEES.

PRESIDENT:

F. S. MANCE, A.I.C.A.

CROWN TRUSTEE:

F. S. MANCE, A.I.C.A.

OFFICIAL TRUSTEES:

HIS HONOUR THE CHIEF JUSTICE.
THE HON. THE PRESIDENT OF THE LEGISLATIVE COUNCIL.
THE HON. THE COLONIAL SECRETARY.
THE HON. THE ATTORNEY-GENERAL.
THE HON. THE COLONIAL TREASURER.
THE HON. THE SECRETARY FOR PUBLIC WORKS.
THE HON. THE MINISTER OF PUBLIC INSTRUCTION.
THE AUDITOR-GENERAL.
THE PRESIDENT OF THE NEW SOUTH WALES MEDICAL BOARD.
THE SURVEYOR-GENERAL AND CHIEF SURVEYOR.
THE CROWN SOLICITOR.

ELECTIVE TRUSTEES:

G. H. ABBOTT, B.A., M.B., CH.M.
E. C. ANDREWS, B.A., F.G.S.
C. GORDON MACLEOD, M.A., M.D., CH.M.
G. A. WATERHOUSE, D.Sc., B.E., F.R.E.S.
THE HON. F. E. WALL, M.D., M.L.C.
PROF. A. N. ST. G. BURKITT, M.B., B.Sc.
PROF. W. J. DAKIN, D.Sc., F.L.S., F.Z.S., F.R.Z.S.
FREDRICK W. MARKS, F.C.A. (AUSTR.).
H. B. MATHEWS, B.A.
FRANK B. SPENCER.
PROF. ERIC ASHBY, D.Sc. (London), A.R.C.S., D.I.C.
G. M. GOLDFINCH.

DIRECTOR:

A. B. WALKOM, D.Sc.

Assistant to the Director:

J. R. KINGHORN, C.M.Z.S.

SCIENTIFIC STAFF:

Mineralogy and Petrology.
T. HODGE-SMITH.
R. O. CHALMERS, A.S.T.C.

Palæontology.
H. O. FLETCHER.

Lower Invertebrates.
F. A. McNEILL.
A. A. LIVINGSTONE.
ELIZABETH C. POPE, M.Sc.

Conchology.
TOM IREDALE.
JOYCE K. ALLAN.

Entomology and Arachnology.
ANTHONY MUSGRAVE, F.R.E.S.
K. C. McKEOWN.
NANCY B. ADAMS.

Ichthyology.
GILBERT P. WHITLEY, F.R.Z.S.

Amphibia, Herpetology, and Ornithology.
J. R. KINGHORN, C.M.Z.S.

Mammalogy and Osteology.
E. LE G. TROUGHTON, C.M.Z.S., F.R.Z.S.

Anthropology and Ethnology.
ELSIE BRAMELL, M.A., Dip.Ed.
F. D. McCARTHY, Dip. Anthr.

LIBRARIAN:

W. A. RAINBOW.

PREPARATORIAL STAFF:

G. C. CLUTTON, *Articulator.*
H. S. GRANT, *Taxidermist.*

HONORARY SCIENTIFIC STAFF:

Zoologists.
PROF. T. HARVEY JOHNSTON, M.A., D.Sc.
ASST. PROF. E. A. BRIGGS, D.Sc.
H. LEIGHTON KESTEVEN, D.Sc., M.D.
MELBOURNE WARD, F.Z.S.

Entomologists.
G. A. WATERHOUSE, D.Sc., B.E., F.R.Z.S.
T. H. GUTHRIE.

Ornithologists.
A. F. BASSET HULL, M.B.E., F.R.Z.S.
K. A. HINDWOOD, C.F.A.O.U., F.R.Z.S.
A. J. MARSHALL.

Archæologists.
PROF. J. L. SHELLSHEAR, M.B., Ch.M.
GEORGE A. THOMAS.

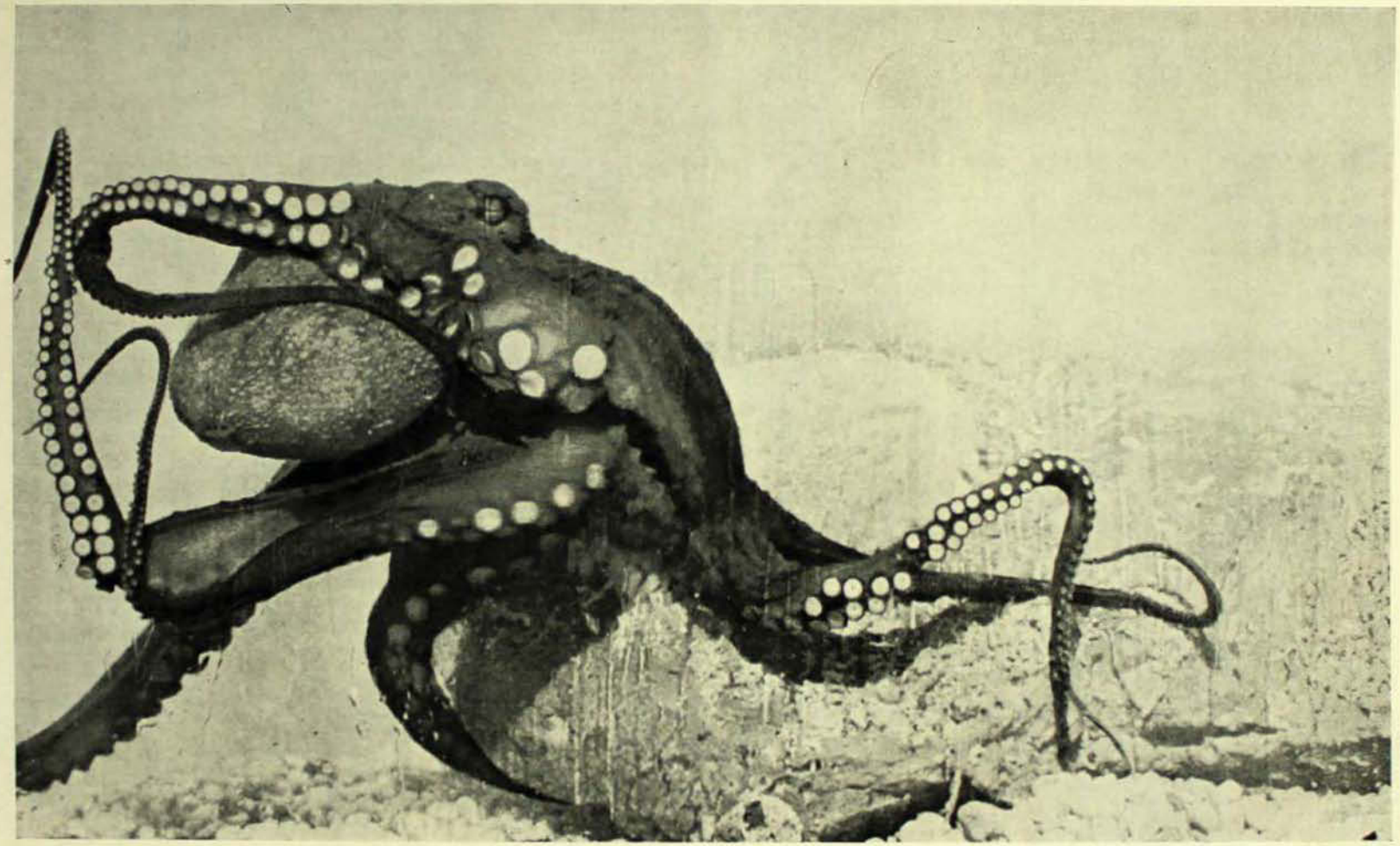
THE AUSTRALIAN MUSEUM MAGAZINE

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

● OUR FRONT COVER. The White Goshawk (*Leucospiza novae-hollandiae* Gmelin) is by Lilian Medland. It is one of a series of post cards issued by the Australian Museum.

This beautiful bird is the only bird of prey possessing entirely white plumage. It is even more perfect in form than the famed European Goshawk, a bird beloved of the ancient falconers, of whose flight poets have sung. The first bird of prey, and one of the earliest of all Australian birds to be taken to England, its snow-white plumage created quite a sensation. The White Goshawk ranges from the North-western Australia eastwards, and down the whole east coast of Australia, including Tasmania. It frequents scrub and heavy forest country, and feeds chiefly upon insects, though it is not above taking small birds—and even chickens—on occasion. The nest is usually placed high in a tall tree, and two bluish-white eggs are laid.

VOLUME VII, NUMBER 9. JUNE–AUGUST, 1941.



The female octopus provides a remarkable example of parental care of eggs. Throughout their incubation, a period of many weeks, she mounts guard over them, and any attempt to dislodge her or the eggs is ferociously repulsed. (Page 294.)
(Photo. by courtesy of the Royal Zoological Society of N. S. Wales.)

THE AUSTRALIAN MUSEUM MAGAZINE

Published by the Australian Museum - - - - - - - - - - College Street, Sydney
Editor: A. B. Walkom, D.Sc. Annual Subscription, Post Free, 4/4

Vol. VII, No. 9. June–August, 1941.

Capsules or Girdles?

By JOYCE ALLAN

UNDER this somewhat enigmatic title lies the story of the egg-laying habits of certain soft animals, the molluscs, frequently called shellfish. The term 'shellfish', however, in its true sense includes other shelled animals, such as crustaceans, and as many molluscs do not possess a shell and cannot be called shellfish, it is proposed to adhere to the more correct name 'mollusc' for the soft-bodied members of the phylum Mollusca, examples of which are the snail, the oyster and the octopus.

The habits of molluscs are always an interesting study. Their variety of protective adaptations, methods of obtaining food, and diversity of breathing and locomotion, are fascinating subjects, but possibly of greater interest are those habits associated with reproduction and the welfare of the offspring. Among molluscs the sexes are distinct or united. In more highly developed species, such as squids, cuttle-fishes, octopods and allied forms, and many gasteropods, the sexes are separate and in some cases are accompanied by sexual dimorphism. The great majority, however, like most bivalves, the land and freshwater snails, sea-hares and sea-slugs, have both sexes in the same individual. The Australian commercial oyster, which has been thoroughly investigated by Mr. T. C. Roughley,[1] is an example of a bivalve which is able to change its sex periodically from male to female and vice versa.

Reproduction of molluscs in all cases is effected by means of eggs. In a few instances these are known to hatch within the parent; but the majority of molluscs are oviparous. To a certain extent, the eggs as well as the larvae are exposed to the same dangers as the adults, those of pelagic organisms being exempt, however, from the influence of most factors normally affecting the shore living molluscs. The chief risks which beset the eggs and larvae of shore forms are predacious animals, stranding on the shore, and disintegration of the eggs. The main problem facing the parent mollusc is to deposit its eggs in an environment similar to that required by the parent for its own existence and in situations where they will obtain the necessary warmth, air and protection, and be surrounded by food which will be required by the young on emergence.

Though molluscs exhibit the same instinctive care as insects and higher animals in placing their eggs where they will be safe from injury, examples of parental care after deposition of the eggs

[1] Roughley: *Proceedings of the Linnean Society of N.S.W.*, Vol. lviii, 1933, pp. 279-332.

are known to occur only in certain groups, principally the octopods and related molluscs belonging to the class Cephalopoda, and the Cap Limpets. In contrast to this parental care we find in the majority of cases that the eggs are abandoned to their fate. But whether after-care or desertion is the rule, the parent is able to avoid disintegration of its eggs by enclosing them in strong horny capsules or in a gelatinous cover; stranding is avoided by attaching them firmly to rocks, weeds, stones, empty shells or sand. Species exposed to strong wave action, as along our surf-swept coast, may adjust their life cycle by spawning in calm seasons; where risk to a free-swimming larva would be considerably greater it is believed that some species abbreviate, or even omit altogether, a free-swimming stage in development.

The number of eggs laid by an individual mollusc at one spawning varies from a few to a hundred or so among the land snails, to many thousands in the bivalves, most of the gasteropods, and the octopods and allied forms. Most bivalves disperse their eggs into the sea where fertilization takes place, but in some the eggs are retained and hatched within the shell of the parent, where partial protection is later given to the larvae. The eggs of land molluscs are laid among debris on the ground or a little below the surface, and may be carried from these environments by flood waters or on the wings and feet of birds. But in the case of marine molluscs, the majority of which have a short free-swimming stage after the eggs hatch, the moving sea acts as the principal vehicle for transportation of the young to new spots. With millions of larvae committed to a sole agent such as the sea for dispersal, the greater number will be transported in the one direction. This is the probable explanation why assemblages of a single species will be found clustered in one spot, and not for any wish for a gregarious life. An excellent example of this occurs along the New South Wales coast, where the rocks at and above high tide are covered with congregations of tiny blue-grey Australwinks, *Melaraphe unifasciata*, which separate widely as they reach the adult stage.

Although before they have established themselves many young molluscs drift from the safety of the shore, where partial protection has been afforded them during their development from the egg, to the open sea where they perish, enough larvae survive to carry on the race abundantly; permanency is provided for by the extreme fecundity of the molluscs. When the larvae perish, the delicate glassy shells, which every mollusc possesses in its early life, whether it is shell-less or not, drop to the sea bottom and become part of a constantly accumulating deposit.

The molluscan egg-masses, often of elaborate design or exquisite delicacy, provide considerable interest and speculation along the shore, especially during spring and summer months, when the adults move into shallow water to breed. Sometimes a collector fortunately finds a mollusc in the process of egg-laying, and then identification of the eggs is possible, but at other times the mass is unaccompanied, and unless it is already known, the exact species to which it belongs is uncertain. A number so far can only be classified according to their genera or families, but a helpful guide is the fact that the strong-shelled, carnivorous molluscs as a rule lay their eggs enclosed in tough horny capsules or firm sandy girdles, whereas the thin-shelled and shell-less vegetable feeders enclose theirs in delicate gelatinous girdles or strings.

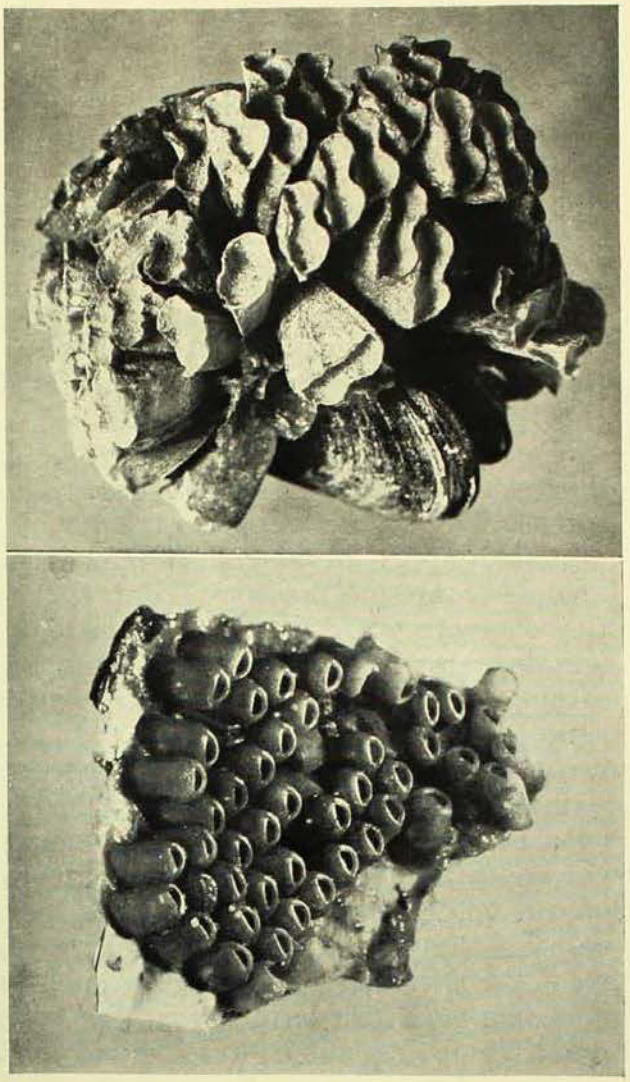
In previous articles in this MAGAZINE, reference has been made to the eggs of molluscs when dealing with certain species. Amongst these have been the two largest types of capsular egg-masses found in Australia, those of the Bailer shell and False Trumpet shell animals. In both these, which may reach a length of eight inches, the tight mass is of creamy yellow capsules cemented together, but whereas the young Bailer mollusc when it emerges from its capsule

has a shell resembling that of the parent, the immature shell of the False Trumpet animal is totally unlike that of the adult. The capsules are soft when they first emerge from the parent, but harden when in contact with the air. Within each are at first a number of ova undergoing early development, but severe competition exists among the embryos, and the stronger eat the weaker, until as a rule only one survives in each capsule.

A few common examples are described here of the two main types of structures, capsules and girdles, adopted by molluscs of our shores for enclosing their eggs. As mentioned earlier, a number have been dealt with in previous articles, and some interesting examples are exhibited in the Conchological Gallery in this Museum.

The best example of a capsular egg-mass found along the New South Wales coast and in southern Australia is that of the banded Whelk, *Pleuroploca australasia*. This is found attached to weeds, empty shells or other bodies in pools, or washed up on beaches, and consists of a bunch of a dozen or so creamy-pink, bell-shaped capsules with fluted edges. When the young embryo is ready to emerge, the capsule, which by this time has deepened in colour and become very brittle, splits across the top, allowing it to escape and commence a new phase of its life. With certain variation in number, shape and size, these horny capsular egg-masses are typical of the majority of shore gasteropods, particularly carnivorous species, and many kinds may be found at low tide during a single visit to a part of the shore known to be populated with these molluscs. With some species, the young emerge, not through a split, but through a hole in the capsule, and sometimes a complete mass of egg-capsules will be found showing this hole in each one.

In certain groups of molluscs, although the ova are laid in capsules, these are not horny as the previous ones, but are gelatinous, like small balloons. A parent may lay a large number of these capsules, each containing possibly only a single embryo, or else lay one large gelatinous capsule containing masses upon masses of delicate strings of ova. The Cephalopoda, that is, the octopods, squids, cuttle-fishes, Paper and Pearly Nautili and so on, is a large class of molluscs associated with this type of egg-case, and no better example can be found locally than the egg-mass laid by the common Sydney octopus, the egg-laying habits of the female of which have been studied on several occasions at Taronga Park Aquarium. When first laid, the capsules are milky white and opaque, and number many thousands. They are usually elongated, attached by stalks in

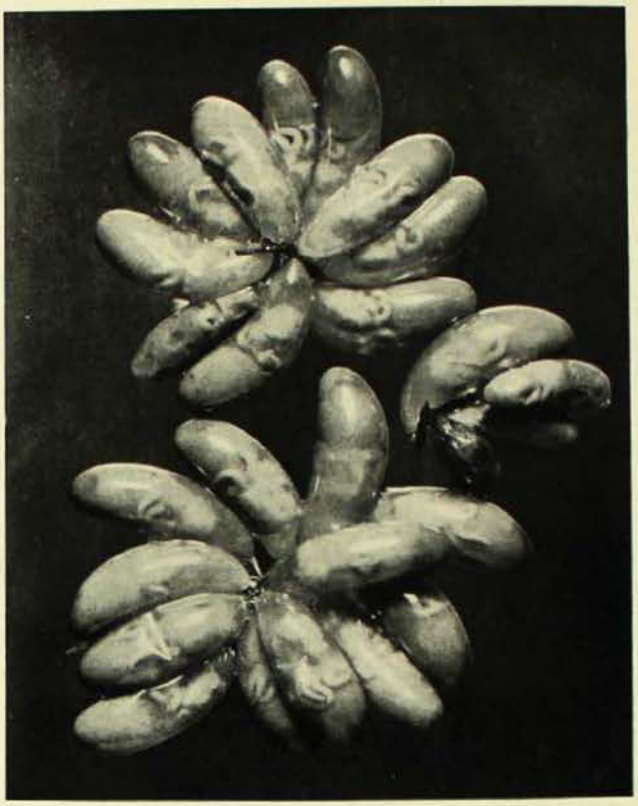


Strong horny egg capsules such as these are typical deposits of many carnivorous molluscs of the shore. The bell-shaped capsules figured above belong to the banded Whelk, embryos of which escape through a slit in the top. In contrast to a slit-like opening, is the rounded opening shown in the lower illustration. All the embryos have hatched from this egg cluster.

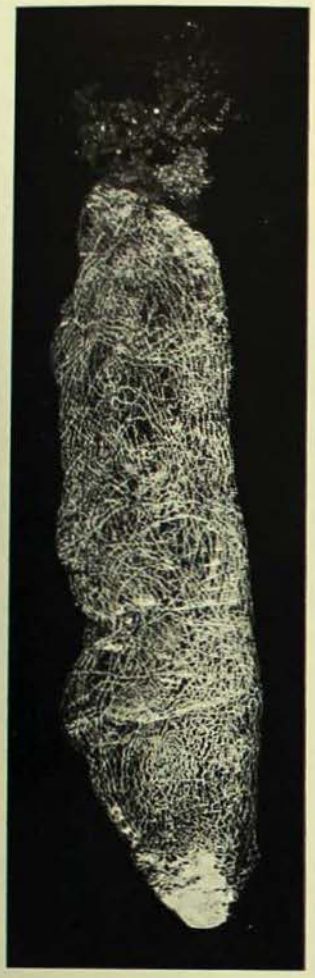
groups to a main stem, and at first are all partly enclosed within a membranous substance, which hardens and breaks away as the eggs develop, leaving the capsules exposed to the action of the water. In a short while the capsule clears and, with the aid of a lens, one can see the tiny octopus developing. With the Cephalopoda, five to six weeks may elapse before the young emerge from the capsules, but in many other groups of the mollusca, the period is considerably shorter.

The habits of the female octopus during incubation of her eggs are most interesting, as she represents one of the best examples of parental care found amongst the molluscs. From the time the eggs are laid until they hatch, the female parent mounts guard, resents any attempt to dislodge her or them, and continually aerates them by a current of water forced from a tube-like funnel situated between her head and body, or by a constant and uncanny movement of her writhing arms. This activity increases as the eggs begin to hatch, the parent helping the procedure by lifting the egg-mass up with her arms. With each such movement a fresh batch of young emerge from their capsules and dart to the surface of the water. The young octopod emerges, as a rule, tail first through a slit at the end of the capsule, and is a very delicate miniature of the adult, displaying even at that early stage, when only a few millimetres long, a remarkable range of colour changes. The strong maternal instinct exhibited by the female parent dominates all other reactions. She refuses food throughout and after the eggs disperse usually dies.

The eggs of all cephalopods have a capsular shape, although the arrangement of them varies. Some are in mop-like bunches, or, as in the case of the small blue-ringed octopus found in rock pools round Sydney, are like small white peas, each separately attached to the rocks by a broad thick stalk. Among cephalopods, sexual dimorphism is more evident than in other groups. The male is generally more slender than the female, and also develops a specially modified arm during the breeding season. The Paper Nautilus, or Argonaut, is a remarkable example of this sexual difference, the female reaching many times the length of the male. She furthermore secretes a very beautiful, delicate white shell which is used as a cradle for carrying and protecting her eggs. The female is not attached to the shell, as normally happens with other shell-bearing molluscs, and the shell is held in place by a pair of her arms furnished with web-like expansions for this purpose. The grape-like bunches of eggs are deposited in the shell behind the mollusc, and, as they gradually develop, the parent is forced from the shell, leaving the young free to embark on their new life. During the month of September in particular, female Paper Nautili, complete with shell and eggs, are common in the vicinity of Montagu Island, on the south coast of New South



Portion of a cluster of egg capsules deposited by a female octopus frequenting the Great Barrier Reef of Australia. A young octopus can be seen clearly in a stage of development within each capsule. Notice the curled arms, and in one capsule the large eye.



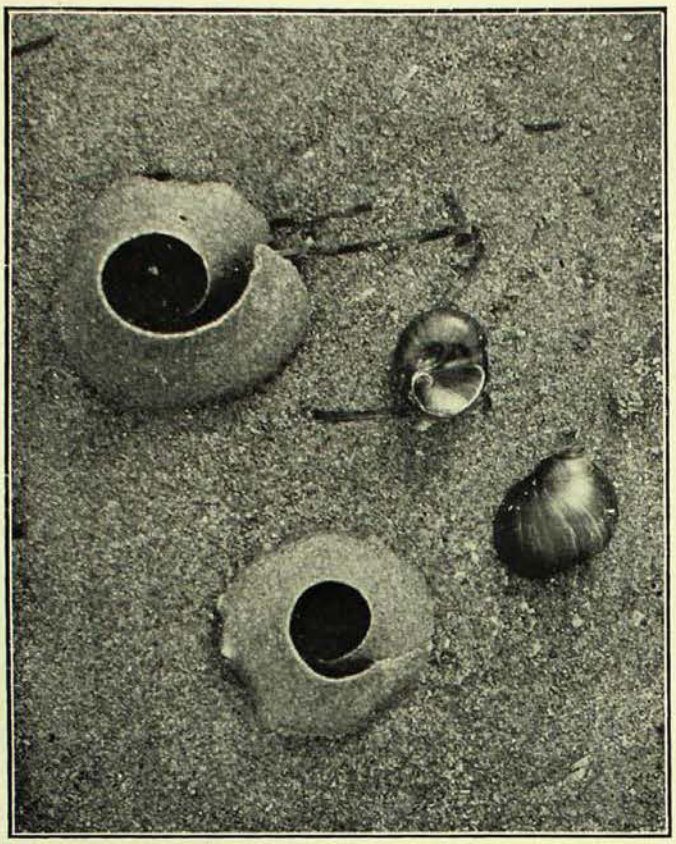
Very fine, twisted strings of countless numbers of tiny eggs are enclosed within this large, single, finger-shaped egg capsule deposited by a swimming mollusc, Aglaia cyanea. It is more than four inches long and provides an excellent example of a parent depositing its eggs in one large gelatinous capsule.

Wales, where the fishermen collect the parents for bait.

Several groups of molluscs occurring in Australia exhibit the single large gelatinous type of egg-capsule, within which many thousands of minute ova are arranged in masses upon masses of fine strings. One of the best examples of this belongs to a soft, white dweller of tidal flats round Sydney, *Philine angasi*, which carries a delicate white shell within the fleshy folds of its body. Its single egg capsule is attached to sand by a thread and the strings of minute ova can be clearly seen within. Another larger one, about 4–6 inches long and sausage-shaped, has recently been found in considerable numbers at Angourie, near the Clarence River Heads, by Mr. A. A. Cameron, a keen collector in that district. This is the egg deposit of a swimming mollusc, *Aglaia cyanea*, which has been particularly common there during this year. The vast mass of egg strings can also be clearly seen within this capsule as with the previous species. The parent of this egg deposit is another mollusc which carries a small shell internally within the folds of its body. Though other groups possess similar egg masses, the two examples given afford sufficient illustration of the type.

Sand snails, members of the family Naticidae, possess quite an individual egg-case, which has been mentioned in previous articles in this MAGAZINE. These are often found round Sydney, and are associated with the two common species of our tidal flat zone. The egg mass takes the form of a collar-shaped sandy girdle, which under the water is soft and hangs together, but, when cast ashore, becomes brittle and is easily broken. The eggs are laid in a sticky mass of jelly moulded over the shell and covered each side with sand grains, and the manufacture of it is such that on completion the mollusc is able to move away, leaving the eggs safely enclosed in this girdle. This sandy egg-girdle of the Sand Snail seems a half-way stage between the horny and gelatinous type of capsule, and the graceful gelatinous girdles of the sea-slugs and the masses of egg-strings laid by sea-hares.

The nidamental girdles of the sea-slugs are found during spring and summer in particular, wound up like watch springs or stretched out like ribbons, on weeds, rocks and sand flats along the coast. They are usually attached by one end, and inside the girdles are rows of tiny eggs which take about a fortnight to hatch. How the delicate girdles survive the buffeting they receive, even in calm waters, is amazing. The peculiar, spaghetti-like masses of egg-string laid by the flabby but ornamental sea-hares are characteristic of these molluscs only. The gelatinous strings, 2–3 millimetres thick, may measure fifty feet or more when unravelled, and every portion of them contains tiny ova, representing millions in one spawning. As these egg strings are favourite food for predatory animals, it will be seen that this extreme fecundity



Sandy collar-like girdles are egg deposits characteristic of sand snails. They are laid by the molluscs on tidal flats during summer months, and although they are soft and hang together under water, become brittle and soon break after exposure to air. The many thousands of eggs are laid in a sticky mass covered each side with sand.

is necessary to carry on the race. The development of the sea-hare egg is rapid, as is that of the sea-slug, and after a little more than a week the young will be noticed actively emerging from their inner covering and ready to break through the outer gelatinous one of the string.

The early stages in development of young molluscs are the same as in all animals, the original cell splitting up into many cells until the resulting mass looks like a mulberry. Ultimately a veliger stage, characteristic of the Mollusca, is reached, a young shell is formed, and a foot develops. Many of the larval forms of molluscs, animal and shell, differ considerably from the adult and have even been described as distinct species. The characteristic markings and sculpturing, and final features of shells belonging to those molluscs which retain them throughout their lifetime, arrive with maturity, which may be as early as the first or second year of their existence.

Natural History Films

Once a month a short film on some Natural History subject will be shown in the Museum Lecture Hall at 2.30 p.m.

The screening will occupy from twenty minutes to half an hour, and there will be a short talk about each film by an officer of the Museum. An opportunity will be given for members of the audience to ask questions at the conclusion of each film.

This series was inaugurated on 22nd May when the film "Some Inhabitants of the Great Barrier Reef" was screened before an audience of two hundred. Additional to this film was one depicting microscopic pond life. That the display was appreciated was evidenced by the many questions asked.

The programme for 1941 is as follows:

June 19: "Birds of the Great Barrier Reef."

July 17: "Creatures of the Rocky Seashore."

August 21: "Exploring the Ocean Surf Beach."

September 19: "Life on a Tidal Flat."

October 16: "The Platypus."

Additional films may be added to the above.

Admission is free.

Tess: A New South Wales Police Dog

By T. HODGE-SMITH

TESS, the first dog owned by the Police Department of New South Wales for official purposes, died in December, 1940, at the age of nine years and nine months. She was sired by the grand champion Claus of Braemar from the dam Suzanne of the Meadows. Tess was an Alsatian, a breed descended from the sheep dogs of Thuringia and Württemberg, Germany. In that country the breed, as it is known today, originally evolved. Its high degree of intelligence makes the Alsatian invaluable for police work.

Tess was acquired by Constable A. Denholm at the age of three months, and was trained and cared for solely by him until the time of her death.

She was probably best known to the people of this State for her amazing repertoire of stunts performed at various police carnivals. But she has a fine record of faithful work undertaken in the interests of justice. Constable Denholm gives the following incident as probably the most outstanding of her many notable feats.

A little girl had been brutally murdered. Tess was taken to the place where the child was last seen and given some of the child's clothing to smell. She immediately set out upon a trail which she followed to a certain shed. The dog entered the shed, smelt the clothes on the bed, and then lay down.

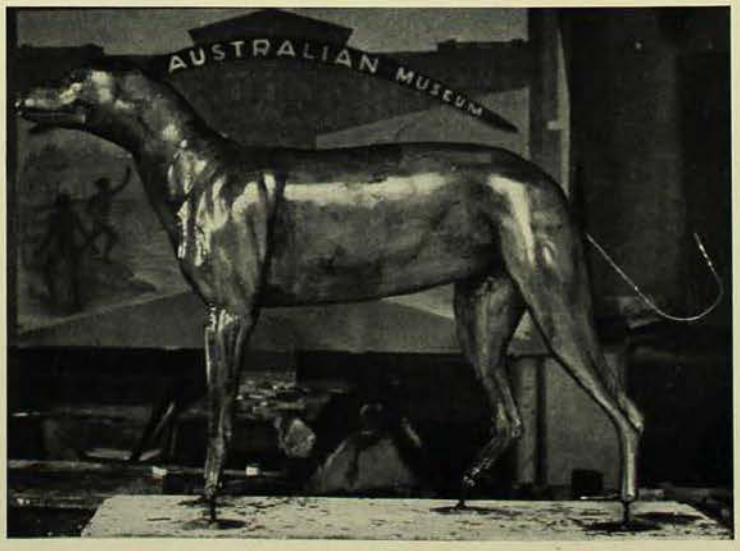
Here the police found a man's shirt and, on being given the scent of this, Tess immediately set off upon another trail which she followed without hesitation to the bank of a creek. Here she entered the water and swam to a sack floating on the surface. This sack contained the body of the child. In this case Tess followed first the scent of the victim and then that of the murderer, who later paid the full penalty of the law.

At the request of the Commissioner of Police, the Trustees of the Australian Museum undertook to mount Tess. One method of mounting an animal has been described by Mr. E. Le G. Troughton in a previous issue of this MAGAZINE.[1] In this instance a modification of that method was used.

First the dog was skinned and the skin sent away to be tanned. In the meantime the body of the animal was placed in its most characteristic position as indicated by Constable Denholm, and a plaster mould of the body taken. Using hessian as a reinforcement for the plaster of Paris, two comparatively thin casts were made from each half of the mould. Joining these together, a hollow cast, or manikin as it is called, was produced.

Without giving the matter a second thought, it might be imagined that all that is now necessary is to place the skin on this perfect replica of the skinned dog

[1] E. Le G. Troughton: New Marsupial Groups in the Australian Museum, AUST. MUS. MAG., vi, 8, 1937, pp. 255-259.



The manikin ready to receive the skin.

The skin being placed on the manikin.

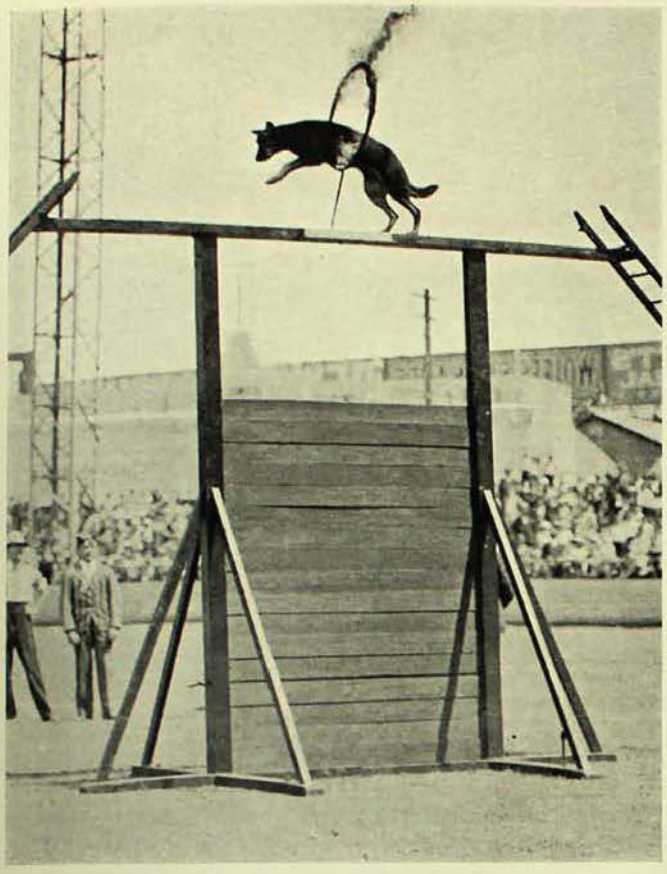
and the job would be finished. It must be remembered that the manikin is that of a dead dog with all its muscles relaxed, so that it is necessary to bring up the proper muscles by adding a little here and carving away a little there, until at last the manikin is of a really live dog. Not a little of the success of the finished article depends on the skill of the preparator in achieving this result.

Now the skin is returned ready to be put on the manikin. If you saw that skin placed on the manikin, with the paws reaching to about the knees of the dog and leaving the belly quite uncovered, you would be certain that someone had made a mistake. Such, however, is not the case, and you would notice that the preparators are not a bit disturbed.

In the process of tanning the skin shrinks, but the preparator knows that by soaking the skin he is able to stretch it. Even so, he does not have too much to spare, for he has to put it on a solid body and not on the soft pliable body of a live animal. This stretching and sewing of the skin around the manikin calls for a great deal of care. The work in modelling a life-like manikin would be lost if care were not taken to see that the skin fits snugly into the creases between the various muscles. This is done by carefully pressing and fixing the skin into these creases.

There still remain the feet and head to do, the latter, in this case, the most difficult part of the whole job. If it were just a dog to be used in a museum group it would be comparatively simple, but it is "Tess", and Constable Denholm can distinguish Tess's face from that of any other Alsatian, though he is unable to tell just what constitutes that difference. A photograph may give the preparator a good general idea, but it may actually lead him astray in the matter of detail. A tiny wrinkle of skin may be the merest fraction too large or too small and the face is no longer that of Tess.

The completion of the work.



One of Tess' many tricks.

Constable Denholm is brought in to help in producing the correct effect. He complains that there is something wrong with this side of the face, but he does not know exactly what it is. Then the preparator taps here and pulls there with his special instruments and asks if that is it. "No", says the constable, and then suddenly, in the midst of more tap-tapping, he calls, "That's it, that's Tess!" And so on until he is satisfied that it is in reality the face of the dog that he knew so well. He does make one qualification, for the dog looks as if someone had thrown a packet of pins at her because each little fold and contour must be firmly pinned until the skin is quite dry.

There are still one or two details that are of interest. The cartilage of the ears is replaced by sheet lead and the tail is not included in the manikin, but is mounted on a stout wire. This gives a wide scope in the final adjustment of these important parts.

Now the dog is set aside for a few days to dry out; then the pins are withdrawn, the hair brushed and combed, and the dozen or so odd things so necessary to give a true picture of the live Tess are completed.

No doubt more people will see Tess as a mounted specimen than saw her in life. How many will realize the technical skill, artistic appreciation, and knowledge of animal anatomy required to produce such a result?

The Small Cabbage White Butterfly

A NOTE

By G. A. WATERHOUSE, D.Sc., B.E., F.R.E.S.

In my article in the last issue of this MAGAZINE, on "The Small Cabbage White Butterfly", I omitted to mention that the caterpillars, besides feeding on cabbage, cauliflower and similar vegetables, also feed on nasturtium and mignonette. This is important because, although by means of suitable sprays the pest in a measure can be controlled in the vegetables, the other plants mentioned can easily carry on the pest and so complete eradication cannot be obtained.

During the last two months three species of our local white butterflies have been flying in my garden on the North Shore Line, but no specimen of the Cabbage White has been seen, although a careful watch has been kept for it.

A hunter, armed with boomerangs and a bark shield and wearing a marsupial fur apron, returning from the chase with a snake.

The Food Supply of the Aborigines

By FREDERICK D. McCARTHY

THE gathering of food and its preparation occupies much of the time of the Australian aborigines, and distinguishes them sharply from the gardening peoples of the Pacific Islands.

On many occasions I have been out in the bush with friends who have remarked that they would not care to live on the country as did the aborigines, let alone support a family on the results of their foraging. In this respect, it is well to bear in mind that many white men lost in the bush have died of starvation, though, of course, in times of drought the same fate has overtaken aborigines notwithstanding their intimate knowledge of the resources of their tribe's territory. Generally speaking, the aborigines have an ample supply of food in normal seasons, mainly because they eat everything which contains nourishment for the human body. Australia, however, is a land of droughts, and during these periods the aborigines in all parts of the continent are forced to spend practically the whole of their time searching for anything in the nature of food. They also resort to such practices as infanticide to limit the number of hungry mouths to be fed. Food, therefore, is a problem in the relationship of the aborigines to their environment.

In the fertile parts of Australia, especially in the vicinity of permanent streams and along the coasts, there is an abundant supply of food for a nomadic people, and so the bulk of the aboriginal population was centred in the marginal areas of the continent, especially in eastern, northern, and south-west Aus-

Men using multi-pronged fish-spears. The bark canoe is made of one slab pleated and tied at each end.

tralia, where tribal territories are comparatively small. In the arid interior it is necessary for the local groups to wander over much more territory than elsewhere to obtain an adequate supply of food. It is interesting to note that, although all Australian aborigines are nomads, this fundamental mode of life varied sufficiently, according to environment, to produce three main economic groups. Firstly, there are the fishing tribes who live along the coasts, subsisting on fish and molluscs, whales, dugongs, turtles and other mammals of the sea; they wax fat while marine foods are plentiful, but in the winter, when fish are scarce, they are compelled to live on short rations and even abandon the coast to try the nearby bushlands. This change was forced upon the natives of Port Jackson who are reported to have been emaciated and starving during the winter months. Secondly, there are the bush people who live on a diet of mammals, birds and reptiles, eked out with insects, freshwater fish and molluscs, yabbies and vegetable foods; they are often looked down upon by the fishing tribes, who call them "tree-climbers" and other names denoting inferiority. Finally, there are the plains-men who hunt over vast territories in the interior, terrain in which water is one of the great problems of life and which is inhabited by a scantier supply of food-producing creatures than are the forests and coasts. On the average, the physique of the natives inhabiting the semi-desert areas of the continent is said to be inferior to that of the tribes which live in areas where Nature is more bountiful.

Many people are under the false impression that the native women are forced to do most of the work while the men live a life of comparative ease and laziness. In point of fact, the men lead an extremely busy life in which the performance of ceremonies and the protection of their families are most important aspects. Thus the ability of the aborigines to live on the country is due in no small measure to the division of labour between the sexes, a logical distribution of tasks which contributes greatly to their perfect adjustment with their environment. The women are the gatherers of plant foods and small animals of all kinds for which they search patiently and diligently on their daily excursions, and if their menfolk are unsuccessful in the hunt, the contribution of the women has to be relied

A family having a snack of roasted pippies gathered in the wash of the waves on the beach; one is being placed on the fire by the man.

upon. The men concern themselves with hunting the larger game, using nets for fishing, and traps for catching animals and birds. For both sexes the daily tramp to obtain food is a strenuous task, titbits being eaten on the way, but all aim at bringing home enough for the main meal of the day, in the evening. Success depends considerably upon the individual's knowledge of the country. The men are born and usually die in their own group's territory because of religious ties, and their store of local information of this nature is gradually built up from the cradle, for they are taken out into the bush as children by the women, and as youths by the men. The women, when married, join their husband's group in strange territory and, consequently, have to work hard for the subsequent few years to satisfy their family's requirements.

The animal food of the aborigines, and their methods of obtaining it, form a subject too comprehensive to be dealt with in any detail in this brief article, but it may be summarized. The large game animals, such as kangaroos, emus and cassowaries, are either speared, trapped in pits, or hunted into a netted or fenced-in yard with the aid of dogs and then despatched with clubs. Wallabies are chased along their pads into conical traps set in a brush fence, and a variety of traps are set to catch ground birds and small mammals. The hunter may conceal himself in water-holes to kill birds with spear or club or seize their legs with his hands. A noose on a long stick is employed to catch bustards, scrub-turkeys, scrub-hens, and other birds. Nets are set across alleyways in the forest and across streams so that flocks of parrots, parrakeets, ducks and other birds will fly into them. Snakes and lizards are struck with clubs or caught by the hand. A productive practice is to burn off areas of scrub, grass or bracken, and to kill with spear or club many of the mammals attempting to escape, and to collect snakes, lizards, and other game which have been roasted by the fire. Fish of many kinds are eaten and the methods of catching them vary widely. Some fish are caught by groping on a muddy bottom and setting the foot on the victim. The

Men resting in camp. The hut is made of bark, as are the container and shield. Other weapons are scattered about the entrance.

water in a pool is stirred up and the fish struck with a club or scooped up in hand-nets as they come to the surface. The poisoning of water with special plants is a universal practice and more than twenty of these fish-poisons are known to have been used by the aborigines for the purpose. Spears are used in all parts of the continent for fishing, and harpoons on the Queensland coast for the larger denizens of the sea. The men often dive into the water to transfix fish with spears. Hooks and lines are used mainly by the women. Bobbing is carried out with fish-bait for eels, or sticky spider-web for small fry. There is a large variety of fish-traps made of cane, hollow logs, stones, and brush fences. The nets may be in the form of hand-scoops, oval types dragged in shallow water, or long nets set across streams and inlets.

Among the invertebrates the molluscs are the most important item of food, and they form a staple article of diet for the coastal people; in the interior mussels are eaten in large quantities. Roth, when Chief Protector of Aboriginals, Queensland, listed ninety-three varieties in that State without making any claim to the list being complete. Many shellfish occur in great numbers and may be gathered with little trouble. Early chroniclers stated that in Port Jackson and Botany Bay the natives spent a considerable amount of their time in this work, and their fireplaces were surrounded by discarded shells. Green ants, the larvae of wasps and other insects, the honey of bees, various grubs and caterpillars, March-flies, beetles, and moths are among the contribution of the insect world to the menu of the aborigines. Crabs, prawns, lobsters and yabbies also provide delicacies in the diet, as do wood-borers from logs immersed in water.

Roth has listed two hundred and forty kinds of plant foods as a fair proportion only of those used by the aborigines in Queensland. They comprise nuts, fruits and seeds, roots, tubers and bulbs, and fungi. Some are eaten raw, others are roasted in the ashes. Seeds and nuts are pounded between stones, ground into a powder, and made into a damper. If necessary, poisonous secretions are leeched out by soaking the raw substance in water. In the interior of the continent, dampers made of grass seed, which

Man using a stone knife to cut up a dolphin or "porpoise".

is produced by certain plants in enormous quantities, formed a staple food. To obtain these essential and seasonal ingredients of the menu, the aboriginal women have to search in swamps and the banks of streams, and in every nook and cranny of forest and plain.

Finally, the natives eat various clays, and also the outer covering of ant-hills, either as powder or in the form of prepared cakes.

The search for food, its capture and preparation, has a background of mythology and religion which adds a touch of romanticism to the task of the aboriginal men and women. Each natural species which provides food (and others also) has a story about its origin as have many features of the landscape, and these tales are told to the children by the parents. Throughout the continent the fauna and flora and natural phenomena are totems of individuals, clans, and moieties, and are further subdivided according to whether the tribe is organized in four sections or eight subsections. These totems exert an important bearing upon modes of behaviour especially in respect to marriage, kinship relationships, and to the totem species itself. Special ceremonies, known as *talu*, are carried out at the totem-centre by the tribes of central and northern Australia and on the east coast, for the purpose of increasing the numbers of the totem; in these rites, held beside a pool, a heap of stones, a hole in the ground, on river and sea shore, the water is splashed about or pieces of stick or stone from the site are distributed, this act representing the dissemination of the spirits which become animals. In some areas, a sacred song is chanted during the rite. By means of these ceremonies, the aborigines appeal to their culture-heroes, beneficent beings responsible for the creation of the world, to ensure a supply of future necessities. Thus the living people, their environment with its fauna and flora, and the spiritual ancestors, form a closely interwoven unity, the higher knowledge of which is known to the men and not to the women. The male from boyhood begins to undergo ordeals and rites during his initiation to test his ability to be given this knowledge. During his

Men collecting oysters on a mangrove flat. This is usually the work of the women-folk.

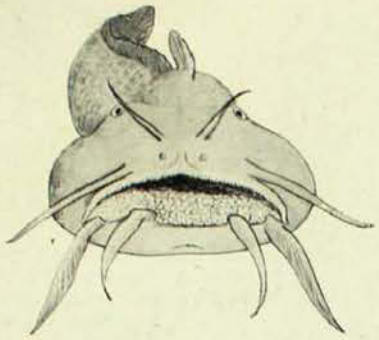
youth, he has to observe taboos upon many of the animals which are sources of food, but most of these restrictions are lifted as he progresses to full adult privileges at the conclusion of his initiation. Thus food is bound up with every other aspect of aboriginal culture, and study of it cannot be divorced from these associations.

Illustrations are from photographs of the natives of the Port Macquarie district, taken by the late Thomas Dick.

Australian Aboriginal Art

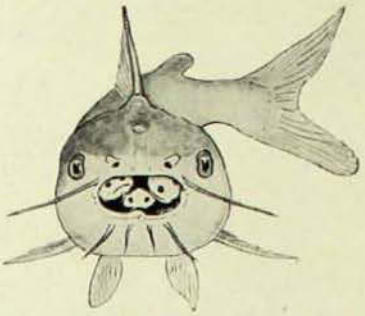
The Australian Museum is organizing an exhibition of Australian aboriginal art which is to be held in one of the exhibition galleries of David Jones Limited, Sydney, in August. The aim of this is to create a wider interest in a source of inspiration that can make a definite contribution to Australian art generally, and thus the exhibits are to be arranged in three groups. The first section will comprise specimens, photographs and drawings to illustrate the art of the aborigines, and among them will be featured bark paintings and grave-posts from Arnhem Land, reproductions of cave paintings and ground drawings from various parts of the continent. The second section will consist of exhibits, contributed by craft workers and commercial artists, which will demonstrate the application of aboriginal motifs in such media as pottery, fabrics, book illustrations and posters, and as a theme for house and building decoration. The third section will include paintings of aboriginal life, and murals based upon their religious beliefs and mythology, designed to draw attention to a rich field of inspiration as yet hardly touched by our artists. It is intended to arrange a series of lectures on the aborigines and their art, and to organize competitions for textile and poster designs.

Although this is the first exhibition of its kind held in Sydney, individuals and institutions invited to exhibit have responded magnificently, and the large number of interesting exhibits promised ensures the success of the venture. The exhibition will demonstrate that the art of the aborigines may no longer be compared with that of children, and it might serve to impress upon the public that the expression of an aesthetic sense was a deep-seated and natural trait in the character of the aborigines.



Front view of Estuary Catfish (Cnidoglanis macrocephalus), Sydney; drawn from life. Note large mouth, eight barbels, and pointed tail.

The Catfish and its Kittens



Service with a smile: young Catfish (Nedystoma dayi) being carried in mouth of parent, Strickland River, Papua. Note forked tail and six barbels. (G. P. Whitley, del.)

By G. P. WHITLEY

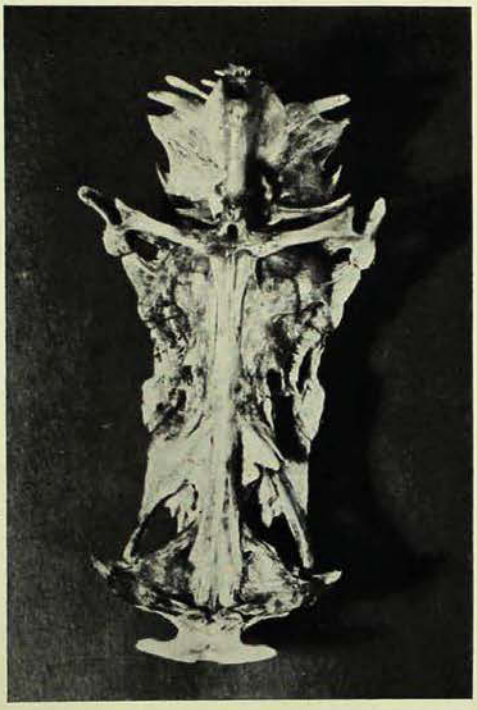
CATFISH! The very word spits scorn. Mention it to a fisherman and he will invariably reply that he has caught 'thousands' of the brutes when angling for more respectable fish, and he will describe, with picturesque embellishments, his disgust and loathing for the ugly and venomous creatures. Yet catfishes should be more popular (if we get rid of our prejudices) because their flesh is good to eat, is not very bony, and should be profitably canned; to the naturalist they are interesting because of their unusual structure and habits.

Of all the tribes of fishes, the catfish family is probably the easiest to recognize, for the feelers or barbels which radiate from near the mouth are characteristic. William Dampier wrote, as long ago as 1684, that: "The Catfish is much like a Whiting. . . . It hath a great wide Mouth, and certain small Strings pointing out from each side of it, like Cat's Whiskers." He noted too that huge catfish prevented Indians from diving for treasure amongst sunken Spanish wrecks.

There are well over one thousand species of catfishes in the world, and the group, if homogeneous (which may be doubted), is the most widely distributed of all freshwater fishes. Some kinds are marine and a few apparently crossed Wallace's Line many thousands of years ago, with the Burramundi and Lungfish, to populate Australian waters. Here we have about thirty different kinds, some of them not yet scientifically described. For present purposes we may divide our catfishes into two main groups—the pointed-tailed family Plotosidae and the fork-tailed Tachysuridae; the former are mostly freshwater and the latter marine or estuarine, but there is some overlapping and the final classification of the species is too technical to be detailed here. Australian catfishes are modestly coloured, range in size from about six inches to three feet or so, and are not as striking in appearance as some of their foreign relatives.

But, if our catfishes are not gaudily coloured, or armoured with huge scales, like the Brazilian ones, though they do not swim upside down like the *Synodontis* of the Nile, have no suckers to steady themselves in torrents or potholes, give no electric shock, or become blind through living in dark cave-waters, and, as far as we know, though they do not leave water and breathe air for long periods, they are of great interest, if only because of their breeding habits and paternal care for their young. Though our male catfishes grow no beard like *Xenocara* in America, and do not freeze in ice-bound ponds or thrive in hot springs as other American ones do, each of our species has its fascination, could we but unravel its

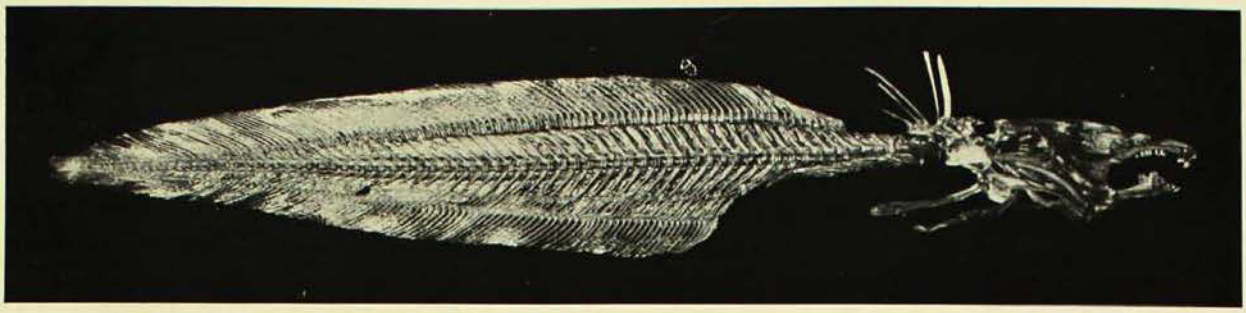
history. In South America, some tiny spiny catfishes live in the gills of their giant relatives and suck their blood, and, *horribile dictu,* even penetrate the bodies of human bathers, but our rivers hold no such terrors. Though many of our marine catfish exceed three feet in length, none grows to the enormous size of the famous Wels (*Silurus glanis*) of Eastern Europe which was even credited with devouring human beings: "Thus, from one individual mentioned by Sonnini, were recovered the stolen or strayed remains of a good-sized boy; from the paunch of another . . . a man's hand, with three gold rings on the fingers,[1] was pulled out; and though the 'corpus delicti' was not found upon his person, the circumstance of finding any part of a man stowed away in such a pantry was sufficient to create strong suspicion of violence and unfair play. . . ."



The Crucifix in the skull of a Moreton Bay Catfish (Neoarius).

Catfishes have been described as the "vacuum-cleaners of the rivers" since they search the bottom-mud for all kinds of food, with "each ferocious feature grim with ooze". Though omnivorous, they prefer animal food, and are largely nocturnal in habit. It is doubtful if they do any marked damage to the fauna of streams in Australia—probably they do more good than harm by their scavenging. Preferring muddy habitats, catfishes are peculiarly modified in several respects. Their eyes are small, their vision limited, but this is compensated for by the feelers which doubtless act as organs both of touch and taste. Some are very sensitive to changes of weather and restless during thunderstorms. All have inside their bodies an air-bladder or swim-bladder, much as in many other fishes, but with the addition of an elastic spring mechanism, modified from the fourth vertebra, with muscles which cause the bladder to vibrate and, it is believed, produce a noise. The internal ear of a fish is mainly an organ of balance, but in catfishes it is linked by small bones (Weberian ossicles) with the swim-bladder, so they probably hear one another when swimming in schools in murky water. Some catfishes have the habit of congregating in an almost solid ball of fishes, and I have seen such spheres of waving fins and tails over the sandy shallows of lagoons at Lord Howe Island and in Queensland. The bush children, the late W. W. Froggatt told me, describe this procession as "catfish going to church". And this brings me to another remarkable feature: the crucifix in the fork-tailed catfish's skull. In the West Indies and on the Orinoco River, natives make the sign of the cross when a catfish is caught, for the lower surface of the catfish skull bears a remarkable resemblance to a crucifix. Some little bones form a halo and the outstretched arms of the central figure are pierced as if by nails at their extremities. If the skull be shaken, the ear-bones rattle, and devout natives, to whom the catfish is a sacred object, regard this as symbolic of the casting of dice for the garments of Jesus after the crucifixion. The sacred and profane names of the bones are these: the halo is part of the Weberian apparatus; the arms of the cross and the 'wings' above are transverse processes of part of the complex fourth vertebra; the arms of the figure are ascending processes of the parasphenoid or post-temporal; the piercing of the hands is the articulation of the catfish's shoulder-girdle; the dicebox is the bulla; the body, and stem of the cross, are para-

[1] An 18th century parallel to the 'Shark arm case' of more recent years! Here quoted from Rev. C. D. Badham's "Prose Halieutics", 1854, p. 307.—G.P.W.



Skeleton of Estuary Catfish to show that the second "dorsal" fin is really a prolongation of the tail-fin and not supported by interhaemal bones like the anal fin below.

sphenoid. Patches of teeth on the vomer form the pierced feet or, according to some versions, the "inscription" at the foot of the cross (incorrectly, because Christ's accusation was "set up over his head"—Matthew xxvii, 37). The granulated upper surface of the cranium is said to represent a hooded monk with outstretched arms, or the breastplate of a Roman soldier; the dorsal spine is the spear, and other bones simulate the nails and other implements of the crucifixion upon Golgotha, the place of a skull.

Everyone knows how impervious to blows on the head a catfish is because of the casque, or strong reinforcement of the upper cranium; the best way to kill the fish is to stab it in the middle of the head, near the snout, where there is a gap in the skull known as the fontanelle. This gap is a primitive feature, notable in sharks, but not found in more highly organized fishes; in the latter it has joined up just as the fontanelle of a human baby soon becomes a solid skull.

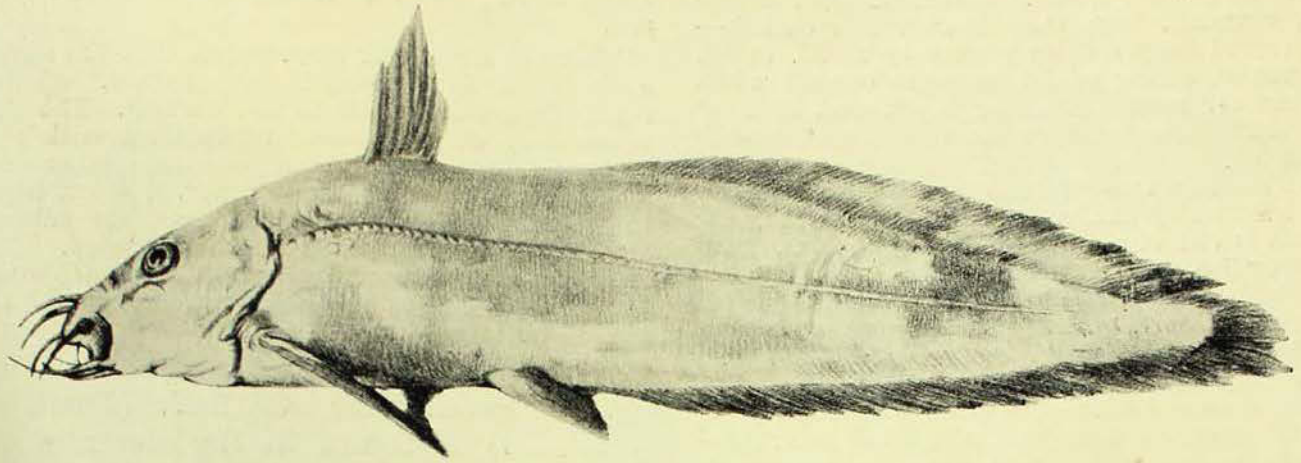
Although catfishes have "spines" before their dorsal and pectoral (side) fins, these are not the same as the separate spikes in the fins of, say, a Perch or a Snapper. The spine of the catfish is a hardened agglomeration of several soft fin-rays which have fused; the point is sometimes soft and exhibits separate tips, or the fin behind it is attached to the spine after the manner of a gaff-topsail. How the serrations have come about can be seen in the articulations of the outer rays of the tail fin; instead of being transverse joints as in most fishes, the articulations are each bent to form the rudiments of a hook or serrations. In many species, the spines are hard and barbed and can inflict a nasty wound as the fish struggles. Even a slight scratch is enough to cause intense pain. In some foreign catfishes, a poison gland and duct are present, but in most kinds the dirty slime on the fish is probably sufficient to cause pain and suppuration, and even, according to Griffith, locked jaw. There is a locking mechanism too by which the catfish can erect its spines and hold them rigidly in place. When the fish is swallowed by birds like the pelican or cormorant, these spines may cause great pain and even death. In one of Audubon's paintings, a cat, the Ocelot, is shown fishing for catfish.

Let us now consider our particular Australian catfishes and their peculiar breeding habits. Catfish totems have been reported from Cape York, Queensland, and the Fly River delta,[2] and the aborigines sometimes carved images of catfish on rocks. They were often mentioned in the journals of our old explorers and overlanders, who found them a welcome food. Probably the most popular was the Tandan, Dewfish or Freshwater Catfish, *Tandanus tandanus*, first described by T. L. Mitchell.

On the Maranoa River on 26 October, 1846, Mitchell noted:

I had previously observed, elsewhere, in the aquatic weeds growing in extensive reaches, clear circular openings, showing white parts of the bottom, over which one or two fishes

[2] Haddon: Anthrop. Torres Strait, v, p. 156, fig. 11c; McConnel, Oceania, i, p. 204, and map.



The Freshwater Catfish (Tandanus tandanus) of the Murray River-system, drawn by the famous explorer, T. L. Mitchell, and published in his "Three Expeditions", 1838.

continually swam round in circles. I now found in the dry bed, that such circles consisted of a raised edge of sand, and were filled with stones, some as large as a man's closed fist. Yuranigh told me that this was the nest of a pair of these fish, and that they carried the stones there, and made it. The general bed of the river where I saw these nests, consisted wholly of deep firm sand; and that the fish had some way of carrying or moving stones to such spots, seemed evident, but for what purpose I could not discover.

William Blandowski, writing of the fishes of the Lower Murray River, Victoria, in the 1850's, refers to *Tandanus tandanus* as the "Eel-fish or 'Kenaru' of the Yarree Yarree" and says of it:

An olive-green coloured fish, with eight long feelers round its mouth. Eyes yellow. An Asiatic form of fish, which lives here in the Murray and in Billibongs. Is very much esteemed by the natives as food, and prohibited to their young men. Swims with great rapidity, even in shallow water. Ploughs the water with its powerful dorsal fin, and is therefore easily recognised and speared by the natives. They often hurt their fingers on the sharp back fin, and then say it is a "saucy fellow." It is unquestionably the best eating fish in the Murray, and grows to the size of two feet, weighing from 7 to 8 lbs. It lives principally on very small shells, and muddy spots are its favourite places of abode. It is not scaled.

The Freshwater Catfish (*Tandanus tandanus*) makes a ring, mound or depression in the river bed for its nest. Concerning this, D. G. Stead states in his *Fishes of Australia*:

This species possesses the interesting habit of forming a mound or nest in which to deposit its eggs. The nest is formed either of sandy grit or pebbles (if the latter are available), and is often at least 3 ft. in diameter. During the process of incubation it is jealously guarded by one or other of the parents. In regard to the formation of this nest, one man, who had been fishing for many years on some of the western rivers of New South Wales, informed me that he had seen the fishes carrying pebbles in their mouths to the desired spot. Others state that the mound is formed by a simple fanning motion of the tail; this fanning also tending to dislodge the more minute particles, and so leave the coarser particles behind for the formation of the nest.

Further evidence is supplied from the pen of Mr. H. K. Anderson, formerly Inland Fisheries Officer. At Colombo Creek, near Chesney's Dam (Murrumbidgee), on 10th and 11th November, 1914, he speared five catfish which were guarding nests, and all were males; they were about twenty inches in length. He writes:

Although not generally recognised, our catfishes, both estuarine and fluviatile, are excellent eating. If anglers only realised this, few if any of these fishes, which are plentiful in all our estuaries and rivers, would be wantonly destroyed as they are at present, owing to the prejudice existing against them due to their unprepossessing appearance. If the angler would only take the trouble to skin a 3 lb. to 5 lb. catfish, and take off the flesh from tail to head in one fillet from each side, leaving behind nothing but the fins and vertebrae, he would find the flesh beautifully white and containing no bones, and when grilled, fried, or boiled (according to taste)

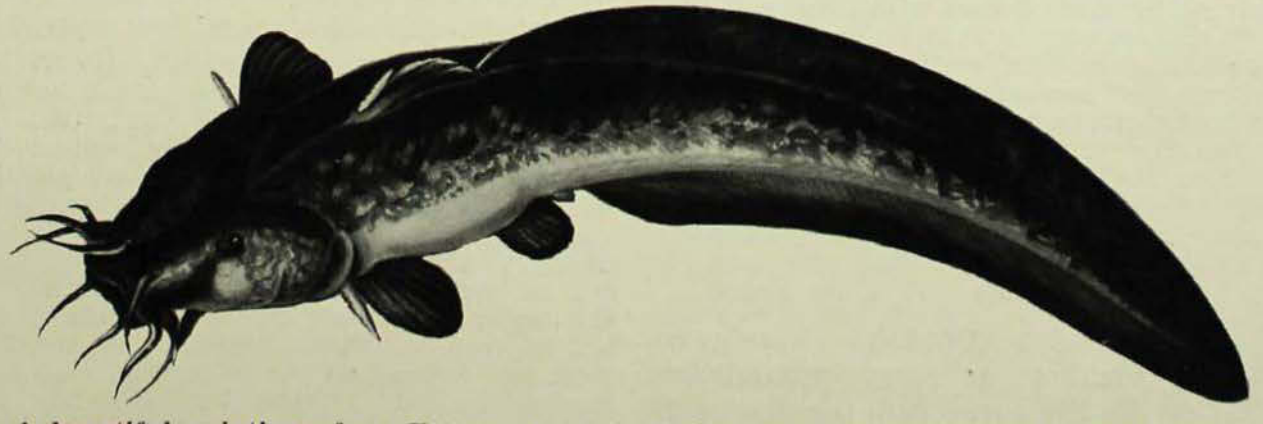
that he had a most attractive and appetising dish, "fit for the gods". Murrumbidgee fishermen complain that they cannot sell catfish—they could supply them profitably at 3d. to 4d. per pound, owing to the numbers caught when netting for gold and silver perch and Murray cod; but none seems to realise the economic value of the catfish; hence the fisherman puts them back in the river, keeping only what he and his family can consume. The fresh-water catfish is one of our nest-building species. The male catfish with fins and tail makes a saucer-like hollow in the soft silty or sandy bed of the watercourse, usually on a gently sloping bank, where the water is two to three feet deep. He covers the bottom of the nest with sticks, stones, etc., and, when all is ready, sets out in quest of a mate. After an interval—it may be an hour or a day—he reappears, driving before him an apparently unwilling female catfish. At times he is gentle and persuasive; at others, savage, and with spines erect he literally forces her into the nest and swims round and round to keep her there. Presently the male fish swims in beside his mate and a quivering of the bodies is noticed, but no discolouration of the water such as is caused by the milt of other fishes. After a while the female catfish departs, unhindered by the male, who now keeps lonely vigil—he swims perpetually round and round over the nest, only altering his regular movements when disturbed by the presence of men, or when chasing away any small fish that dares to trespass near his nursery. If a little stone or piece of mussel shell is thrown in, it is immediately seized by the fish, and carried well away from the nest before he drops it.

For about 16 to 18 days the male catfish continues his arduous duty. By this time the fry are three-quarters of an inch long, with nearly absorbed yolk-sac. Eggs were taken from a nest 15 minutes after the female was allowed to depart—they were evidently fertile. Fry were taken from a nest which had been watched over by the male for 10 days—they were just hatched or hatching. Other fry were taken from a nest after 18 days—they were three-quarters of an inch long, able to swim about, and had nearly absorbed the yolk-sac.

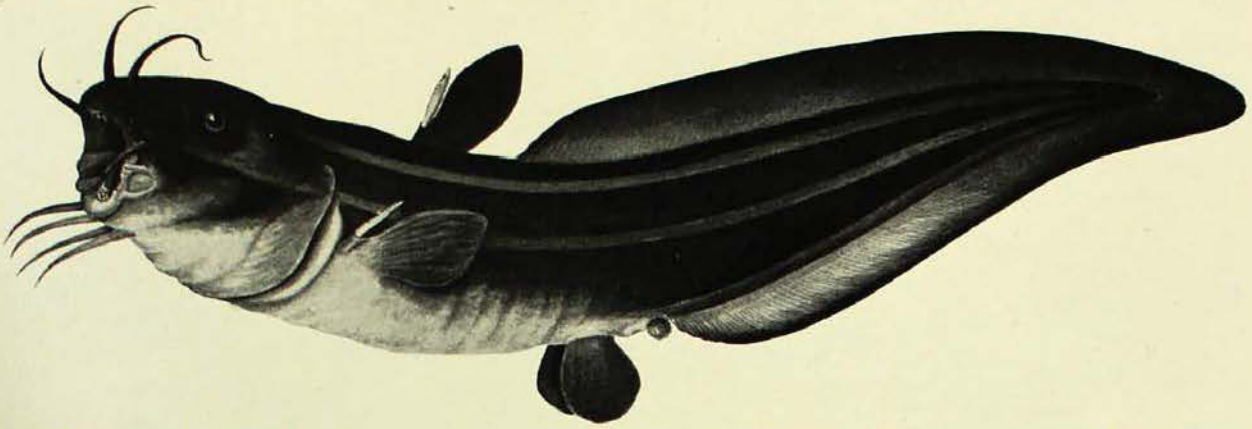
There is a popular impression that the catfish ejects poison through his spines, causing fearful wounds. This is not correct. The only poison on their spines is identical with that collected on the spines of any other fish inhabiting the same waters, viz. natural slime, to which microscopic organisms have adhered and become more or less decomposed. The catfish carries a more powerful armament than most fishes, but is no more venomous than the golden or silver perch, Murray cod, etc., which inhabit the same waters.

The Freshwater Catfish (*Tandanus tandanus*) is found in the rivers of the Murray River system from Queensland and New South Wales to Victoria and South Australia; also in Western Australia. It is served as "jewfish" in some country hotels and settlers are beginning to cultivate it for food in their dams.

Allied to *Tandanus* is the Inland Catfish, or Short-finned Dewfish (*Neosilurus*), of which genus there are half a dozen forms in various tropical rivers of Australia and Papua, some being found even in Central Australia. The largest are about 17 inches long, and they differ from *Tandanus* in having a less developed second dorsal fin (really an extension along the back of the tail fin and not a true dorsal fin, being unsupported by interhaemal bones as is the anal fin below). A curious catfish from the rivers of north-western Australia is *Anodontiglanis*, which is six inches long and has no teeth in the mouth, only in the pharynx.



A beautiful painting of an Estuary Catfish (Cnidoglanis macrocephalus) made about a century ago by Dr. James Stuart, quarantine officer at North Head, Sydney. The dorsal and pectoral spines are erect and rigid; the tip of the tail-fin is pointed, not forked.
(Reproduced by courtesy of the Linnean Society of New South Wales.)



Another of the series of over 200 beautiful paintings of Sydney animals by Dr. James Stuart. This Striped Catfish drawing is labelled "Plotosus flavolineatus—coloured J.S., Octr., 4/[18]40."

(Reproduced by courtesy of the Linnean Society of New South Wales.)

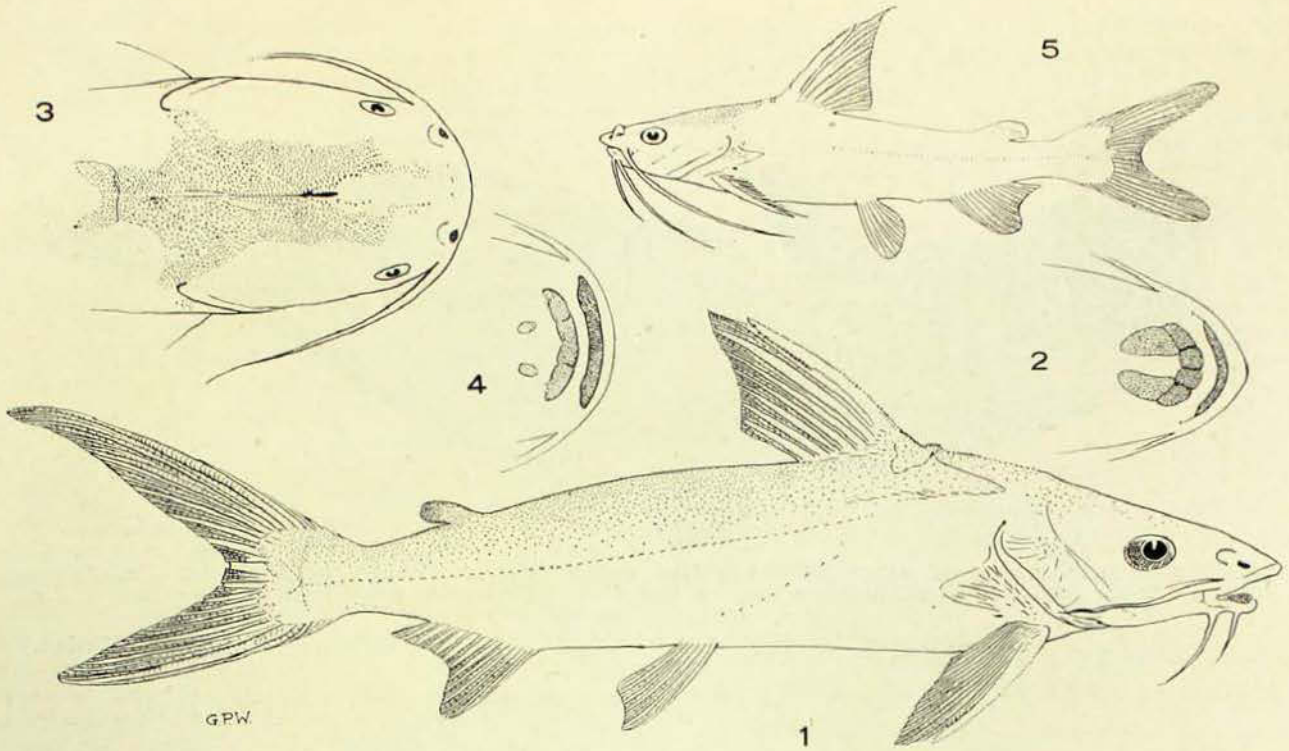
The rest of our pointed-tailed catfishes are marine (littoral or estuarine): these include the ugly Estuary Catfishes (*Cnidoglanis* and *Euristhmus*), loathed by Sydney fishermen, and the White-lipped Catfish (*Paraplotosus*) and the Striped Catfish (*Plotosus*) of our warmer waters, and some others; the usual size is up to one foot long, but some Estuary Catfish may attain three feet. Some have a peculiar bush-like structure, the dendritic appendage, near the vent.

The fork-tailed or sea catfishes ascend rivers, but are mainly found in the sea. Our best-known species are the Giant Salmon Catfish (*Netuma*), which exceeds three feet in length and is recorded up to 60 lb. in weight, and the Lesser Salmon Catfishes (*Neoarius, Pararius, Tachysurus*), which rarely attain two feet. The Northern Pout (*Nemapteryx*), with a long filamentous dorsal ray, and Colclough's Catfish (*Hemipimelodus*) are little known tropical species. The breeding habits of all these would repay observation. For instance, the Giant Salmon Catfish (*Netuma thalassina*) was found to carry its eggs and young fry in its mouth! Mr. D. G. Stead recorded 26 such ova and fry from the mouth of a single parent fish (probably the male) in the Richmond River, New South Wales; a selection of the large eggs and developing embryos is here illustrated. See also the sketch of a Papuan catfish (*Nedystoma*) with its young in its mouth at the head of this article. Of course, the devoted father cannot feed when he is carrying the young, and his mouth becomes very distended and almost choked by his sheltering brood. This phenomenon is called buccal incubation or oral gestation, and occurs also in some other fishes, such as many of the Soldier Fishes (Apogonidae), certain Cichlidae, and our Burramundi (*Scleropages*).

Occasionally an egg may be split accidentally and a young fish develops with two heads.[3] These abnormalities do not live long, for two heads are not better than one.

Of the breeding habits of the Lesser Salmon Catfish (*Neoarius australis*) we know even less. D. G. Stead stated that it "builds nests upon the sandy beds of rivers, making circular basin-like excavations about 20 inches in diameter; at the bottom of which the eggs are laid,

[3] Illustrated in THE AUSTRALIAN MUSEUM MAGAZINE, Vol. vi, No. 5, January-March, 1937, p. 156.



Giant Salmon Catfish (Netuma) from Port Jackson (fig. 1), with the characteristic pads of teeth on the roof of its mouth (2). The casque and top of head, showing fontanelle, of a Lesser Salmon Catfish from Darwin is shown as fig. 3, with its tooth-pads (4). Figure 5 illustrates another Lesser Salmon Catfish (Pararius) from the Hughenden district, Queensland. Note the forked tails, and, in figure 1, the hook-like joints of the rays in the tail-fin presaging the serrated spines of the dorsal and pectoral fins.

(G. P. Whitley, del.)

being then covered over with several layers of large stones". However, Mr. Stead found a mature female, nearly 2 feet long, in 20 fathoms of *salt* water, off North Head, Sydney, in May 1934. This is the southernmost record of the species, which is common in our northern rivers and in Queensland; the female appears to have much longer ventral fins than the male. Probably this catfish, like others, is migratory—sometimes even a catfish may look at a kingfish.

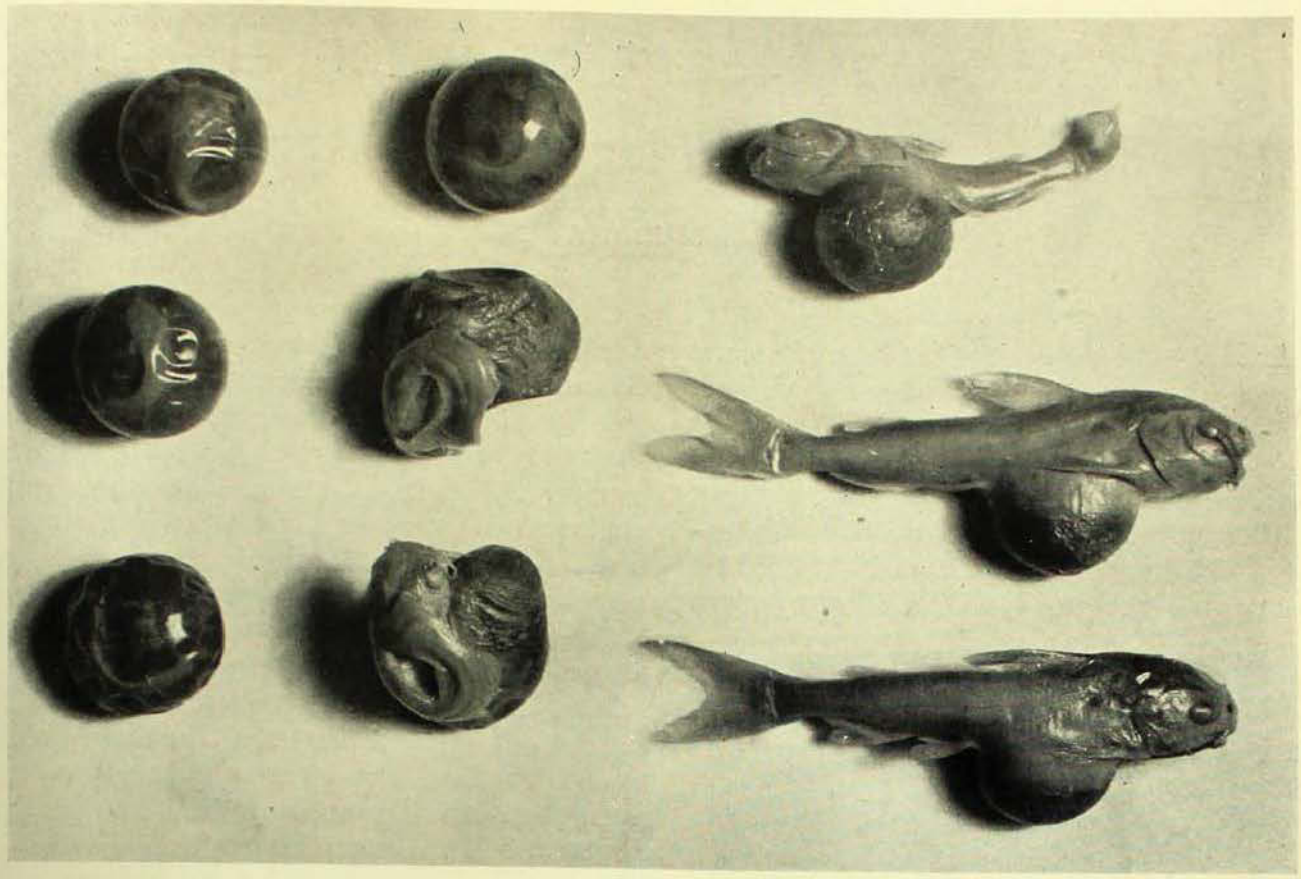
Some of the South American catfishes carry the eggs and young in a spongy mass on the lower surface of the body or in wrinkles of skin, but I know of no Australian case like this.

Examples of all the strange catfish features mentioned in this article may be seen at The Australian Museum.

Rarely is it that the Museum workers enjoy such enthusiastic co-operation of the kind recently shown by Mr. A. A. Cameron of Harwood Island near South Grafton. Every moment that this successful collector can spare is devoted to observations of the marine fauna of the coast adjacent to the mouth of the Clarence River. A great deal of the data and specimens collected has proved the existence of a substantial and previously unsuspected southward extension of tropical forms in this area.

Crustaceans and molluscs are the groups in which Mr. Cameron has extended our knowledge of range and breeding habits, especially the beautiful animals known as sea-slugs. In life these have very gaudy bright coloration, combined, frequently, with fantastic form. Unfortunately such loveliness cannot be preserved so they must be studied in nature.

Miss Joyce Allan, of this Museum, is at present on a visit to this locality. She will prepare coloured sketches of the living animals which will be examined anatomically later. Some of these animals are elongate and snail-like, but adorned with bright filamentous ornaments of various colours and arranged in series. Others are round and disk-like, and have many patterns. These may have branches on the back similar to the ornaments on the previous ones, while others may have feather-like appendages on the sides. Colours range from red to orange, blue or black, green and yellow and other combinations.



A selection from twenty-six eggs and young fish from the mouth of a parent Salmon Catfish (Netuma) from the Richmond River, New South Wales.

Popular Science Lectures

For many years past the Popular Science Lectures delivered at the Australian Museum have been an important and attractive feature of its activities.

These lectures, which are illustrated by films, lantern slides and specimens, are held on Thursday evenings at 8 p.m. on the dates listed below. There is no charge for admission.

Two lectures have already been given. The first on May 15 by Dr. C. T. Madigan, M.A., was on the Simpson Desert, to which he was the leader of an expedition. Mr. H. O. Fletcher, of this Museum, was one of that party, and readers of this MAGAZINE may recollect an article by him which appeared in the December, 1939–January, 1940, issue. The second lecture was delivered on May 29 by Mr. G. P. Whitley, his subject being "The Study of Australian Fishes".

Other lectures of this series will be:

June 12: "The Social Life of the Australian Aborigines", Professor A. P. Elkin, M.A., Ph.D.

June 26: "Film-making on the Rocky Seashore", F. A. McNeill.

July 10: "The World of the White Ant", K. C. McKeown.

August 28: "Who's Who Among the Reptiles", J. R. Kinghorn, C.M.Z.S.

September 11: "Life Histories of Some Australian Butterflies", G. A. Waterhouse, D.Sc., B.E., F.R.E.S.

September 25: "Biology in War", Professor E. Ashby, D.Sc., A.R.C.S., D.I.C.

October 9: "The Romance of Gold Mining in New South Wales", T. Hodge-Smith.

October 23: "Wandering Through China", E. A. Briggs, D.Sc.

November 13: "A Museum Man in America", E. Le G. Troughton, C.M.Z.S., F.R.Z.S.

To the Red Heart of Australia. II

Erldunda to the Macdonnell Ranges

By A. MUSGRAVE

AT Erldunda Station we were shown a caged collection of local birds. In one cage were some of the rare Princess Alexandra Parrots, *Polytelis alexandrae,* beautiful birds with long tails, first discovered in 1863 by Waterhouse, while on McDouall Stuart's Expedition overland to the Timor Sea.

In another cage were Bourke Parrots, *Neophema bourki,* Diamond Doves, *Geophelia cuneata,* and Budgerigars; in another were Ring Necks, *Barnardius barnardi,* while two Corellas (white cockatoo-like birds), *Kakatoë tenuirostris,* and a Major Mitchell, *Kakatoë leadbeateri,* were tied to perches. While we waited for the truck to catch up, we were treated to one of the magnificent sunsets which are so typical a feature of the Red Heart of the Continent, storm clouds assisting, and the bright crimson streaks persisted until we had made our camp about a mile along the road.

Between Erldunda and Henbury Station we stopped to examine specimens of the Desert Oak, *Casuarina Decaisneana,* a tree which has been described by the late Sir Baldwin Spencer as "one of the most interesting and certainly one of the most picturesque of the trees of Central Australia". In his two-volume work entitled *Wanderings in Wild Australia* (p. 53), he further points out that "young plants up to a height of fifteen feet, have exactly the appearance of enormous funeral plumes, and are often met with

Desert Oaks growing near Erldunda Station, Central Australia. Above: Adult oaks. Right: Young oaks. (Photos. A. Musgrave.)

in large numbers, sometimes forming regular plantations where the older trees have been burnt out or died down". We came across such a grove of these cypress-like trees, and it is hard to conceive that a plant with hard spiky foliage, such as we find in the juvenile examples, could develop into a tree with drooping pendulous foliage. The branchlets have very long segments and four bristly teeth, and their greyish cones measured, in two examples collected, 2–2¼ inches in length and 1¼–1½ inches in diameter.

Henbury Station on the Finke River, with its red sandhills changing colour in the sunlight, was our next stopping place. About 52 aboriginals of the Arunta tribe lived in huts on the sandhills near the homestead, for the station property is the meeting-ground of the tribe, and here they carry out their rites and initiation ceremonies. Henbury has the only camel mail in Australia, 105 miles from Rumulea, though the station is only about 98 miles from Alice Springs. Henbury is also the site of the world-famous meteorite craters; but time did not permit us to include them in our itinerary.

Passing through Gill's Station, managed by the well-known identity Bob Buck, we drove through mountainous country, an ever-changing panorama with its variations of reds, browns, and purples, and with corresponding changes in the shapes of the hills, flat-topped, rounded, or rugged, spilling great boulders down their sides or dotted with green spinifex. Eventually we camped in the Waterhouse Range about two miles from the Owen Springs Station, after a day in which we had been satiated with colour.

THE MULGA ANT.

At our next camp, about two miles from the Hermannsburg Mission, were many nests of the Mulga Ant, *Polyrhachis macropus*, a species with a wide range. It was first described by the late Professor W. M. Wheeler, from specimens collected in the Everard Ranges, C.A., under the name of *Polyrhachis longipes*, in the *Proc. R. Soc. S.A.*, 1915; but next year he altered the name to *P. macropus* owing to his first name being already in existence for another ant. Photographs of the nest of the ant were sent to Professor Wheeler, who reproduced them in his paper and remarks: "It appears also to be very distinct in its habits . . . instead of nesting under stones, like *P. femorata* F. Smith, *micans* Mayr, and *sydneyensis* Mayr, of Eastern Australia, it builds a beautifully regular crater, the rounded surfaces of which it thatches with a layer of mulga leaves." We had met with the ant and its craters on the Arcoona tableland, which extends its range further to the south. Sometimes grass seeds germinate beside the nest and grow round it, partly concealing it. An earlier account of this nest is given by the late Sir Baldwin Spencer in his work, p. 103, in which he says: "I tried to examine the nests of two other species of ants that are very characteristic of the whole of the Central area from Ayer's Rock in the south to the Burt Plains in the north. One has the form of a mound upwards of two feet in diameter and about six inches high, with a large crater-like depression at the top. The ants arrange a thick deposit of the long, dry phyllodes of the Mulga tree, so as to cover the dome. They are all placed in a perfectly radial manner and give the nest a very definite appearance. . . ."

Nest of the Mulga Ant (Polyrhachis macropus) near Hermannsburg, Central Australia.
(Photo. A. Musgrave.)

TO PALM VALLEY.

At the western end of the Missionaries' Plain, which lies between the Macdonnell Ranges to the north and the James Range to the south, is the Lutheran Mission of Hermannsburg. Beyond the Mission down the Finke River, you must proceed over sandy or rocky ground to reach the famous Palm Valley, some 13 miles from the Mission. At the time of our visit, all the aborigines of the mission with their families were engaged in making a road to the valley, and on our arrival at the working party some miles down the valley we found ourselves in a setting suggestive more of a Biblical landscape than an Australian one, as camels, donkeys, horses, and aborigines of all ages proceeded along the sandy track. From them we got horses and a guide to conduct us to the palm grove discovered by the explorer Giles in 1872.

On our way we passed on our left some amazing rock formations; one, the Amphitheatre, was very attractive, and another showed curious butte-like structures. A solitary palm grew at the head of what would have been a waterfall in rainy weather, and near it was a huge wall of red rock. Then we descended a deep valley with the walls on the northern side towering up for some hundreds of feet, the lower ledges supporting many plants called Cycads or Macrozamias, *Encephalartos Macdonnelli,* while a few specimens of palms were growing among the rocks in the creek. A mile or so further on we came to an open area, and then the walls of the gorge closed in; we were in Palm Valley. Here a group of palms grow mirrored in some large rush-lined pools. The palms are few in number, but some were young and others were very tall, but all combined to make a beautiful picture, with the red rocks behind and the intense blue of the Central Australian sky. The palm growing here is *Livistona Mariae,* very similar to our local Cabbage Palm, *L. australis,* and evidently a survival from a past which supported a much richer flora.

HERMANNSBURG MISSION.

The Hermannsburg Mission lies on the northern bank of the Finke River at the foot of the Kirchauff Range. A big mountain rising up at the back of the white buildings of the settlement creates a feeling inspired by the well-known lines, "By Nebo's lonely Mountain", an Eastern sentiment still further heightened when a few camels with their packs and riders proceed leisurely towards the mission.

The mission itself, over which we were conducted by its head, Pastor Albrecht, is situated about 80 miles from Alice Springs, and the mission property embraces an area of about 1,400 square miles, which at present carries about 2,000 head of cattle. After the 1926-30 drought, only 287 cattle remained out of 4,000 head. There are about 290 people, including 110 children, in permanent residence in and about the mission. Pastor Albrecht gave us a few figures as he showed us round the buildings, so as to give some idea of the magnitude of the work of the mission. Over £2,000 are required annually to finance the Mission, which every year uses 80,000 lb. of flour (wholemeal and mixed), 7,000 lb. of sugar,

Palms, Livistona Mariae, in Palm Valley, Central Australia.

(Photo. C. Carroll.)

Standley Chasm, in the Macdonell Ranges.
(Photo. C. Carroll.)

800 lb. of tea, and a ton of soap, locally made; while three bullocks are killed every week. We were shown the garden near his house in which were growing date palms, oranges, lemons and mandarins, of which last-named only one tree was bearing, the fruit being reserved for the sick. Water is pumped from a spring some miles away by means of a diesel engine to irrigate the garden. Water is an important factor in this arid region, which, in 1938, had only 585 points.

We saw the kitchen garden, in which 4,000 cabbages and cauliflowers had been planted, but these had all fallen victims to some insect pest, apparently the cabbage moth. At the Pastor's house we saw the pedal wireless set, which has helped to revolutionize life in the outback. We were also shown examples of aboriginal handicrafts, mulga wood boomerangs, walking sticks, mats, wallaby skin rugs, etc., but as Mr. Albrecht explained, his reason for showing them was to dispel the idea that the aboriginal was unfitted to do this class of work. It was from this mission that an aboriginal, Albert Namatjira, trained by a Victorian artist, Mr. Rex Battarbee, achieved quite a success with an exhibition of water colours in Melbourne in December, 1938, forty-two of his pictures being sold within a week for £140.

The mission also cares for a floating population of natives who come in from the great open spaces for medical treatment. During the drought many of the natives suffered from the vitamin deficiency known as scurvy, and lemon juice had to be sent up from Adelaide.

Finally we saw the school house, wash house, shower house, and lastly the little church, with its inscriptions in German and Arunta.

Having inspected the mission, we retraced our steps towards Alice Springs, visiting *en route* Standley Chasm, that amazing cleft in the Macdonnell Ranges, where we found cycads growing as in Palm Valley.

Next day I bade farewell to my friends and boarded the 'plane "Moresby" for Adelaide, and within six hours of leaving "the Alice" I was back amid the green foliage of Adelaide, and all my joys and trials of this brief reconnaissance of the Red Heart of Australia fading memories.

Linked Destinies

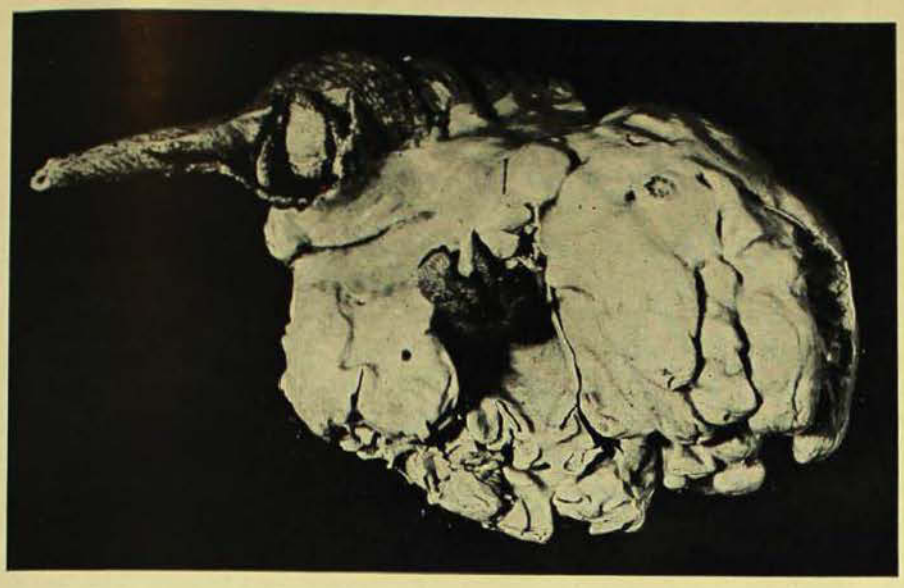
By ELIZABETH C. POPE, M.Sc.

IN every natural habitat there is a definite group of organisms which depend on one another, leading a kind of linked existence, bound together by a great many interlocking relationships. Among the more obvious relationships are those which link plants and animals, or animals to other animals, because they depend on each other for food. For example, a flesh-eating animal cannot live in "splendid isolation", but must have other beasts on which to prey. Similarly suitable food plants must be present before a herbivorous animal can live in an area. Even these plants, in their turn, cannot grow without the activities of certain bacteria and earthworms, whose job is concerned with the fertilizing and turning over of the soil.

Not only do these animals and plants depend on each other for food supplies, but their lives are linked in a host of other ways. Thus flowering plants rely mainly on the activities of birds and insects to carry the fertilizing pollen grains to one another, and so the continuity of their species actually depends, in this case, on the presence of animal pollen-carriers. Trees and shrubs offer shelter to many animals and even the individual animals themselves generally harbour a great many lesser forms in their warm dark interiors. Some of the intruders may be harmful to their hosts and "live on them", doing untold damage in the process. Others are not harmful and merely live in friendly relationship with the host. Sometimes host and "boarder" share the same food supply without affecting each other in any way, in which case the relationship is called by the special name, commensalism, and they are said to be messmates. It is not intended to deal with the broader aspects of animal and plant relationships, but rather to mention some of the peculiar and intimate associations which may be encountered.

Occasionally animals which appear to have no interest in common are found sharing the same home—they have come to some kind of working arrangement whereby they see little of each other and do not interfere with one another's activities. Such a "Box and Cox" type of arrangement seems to be in existence where the little North American Prairie Dog and a small Burrowing Owl share the one home. The Prairie Dog forages by day and spends much time basking in the sun (hence its popularity as a zoo exhibit), whilst the owl is nocturnal in its habits. When one is home the other is out on business bent—one belongs to the day shift and the other to the night shift of the animal workers.

In the marine world many cases may be cited where animals live side by side, one affording shelter to the others without deriving any benefit in return. On a timber sample, recently taken from the waters of Rose Bay, Port Jackson, was a most amazing collection of animals all attached to one oyster. Immediately next the oyster was a yellow sponge the surface of which was covered by Bryozoa or "sea mats", whilst running in and out of the crevices were two species of crabs, a few bristle-footed worms and hundreds of amphipods (tiny crustaceans similar to the sand hoppers and sand fleas to be seen on the local surf beaches). No benefit would be gained by the unwitting bearer of this great load and probably, in the long run, the mass of organisms would



An Atlas of the Marine World. The hermit crab, hiding in its shell, carries round in his shelly home a massive yellow sponge. Another crab, joining the seekers after free transport, is seen occupying a hollow in the sponge. The tunnel has been worn by the constant comings and goings of the crab.

become detached from its anchorage on the timber sample by reason of its own weight and sink to the bottom of the bay to perish there, choked by mud.

Hermit crabs, which protect the soft hinder parts of their bodies by wearing the discarded shells of molluscs, frequently camouflage their homes by masking them with a growth of sponge. The latter forms an excellent protection by reason of its repellent smell and because the hard, needle-like spicules which form the supporting skeleton are unpalatable to other animals which soon learn to avoid it and so the hermit crab goes unmolested. By this arrangement the sponge, living normally attached to the one spot, is transported about and is thus possibly enabled to gain more food than before.

An association where mutual benefit definitely accrues to both members of the partnership is found in the case of the corals and the tiny single-celled plants or algae which live in their flesh. As a by-product of the life processes of the plants, oxygen is produced and is used by the coral which also consumes and digests some of the algae for food. In return the coral produces among its waste products certain substances containing nitrogen which the plant absorbs and uses for its own purposes. Such a partnership, where the benefit is mutual, is known as symbiosis. Sometimes the partners in a symbiotic relationship become so dependent on one another that they cannot live apart. Termites, commonly called "white ants", eat wood fibres which are quite indigestible and, were it not for the presence of thousands of tiny single-celled animals in their gut, they would be in a sorry plight. Their protozoan partners act as "chemical tin-openers" for their hosts, breaking down and partially digesting the wood fibres to a substance more suitable for assimilation by them. In return for this great service the termites provide food and ample shelter for their helpers. When deprived of the aid of the protozoan partners the termites die of starvation because they have lost the art of digesting cellulose.

Sometimes very complicated relationships exist between animals which are bound together because one is parasitic on the other. The Liver Fluke of the sheep, *Fasciola hepatica,* is a splendid example of a complicated relationship. The adult flatworm inhabits the liver and bile ducts of its host, where it lives on the tissues and causes a general lowering of the condition of the sheep, with a

consequent lowering of the wool production. Finally, in bad cases, the sheep will die. As is the case with most parasites, the life history is complicated and still one other animal host—a small fresh-water snail—becomes involved in the chain of relations. Eggs are laid by the fluke and pass to the exterior in the faeces. Should these eggs be deposited in a swampy place, or directly into the water, they hatch and a small swimming larva, the miracidium, emerges. When this larva encounters a fresh-water snail of a certain species it burrows into the soft flesh and feeds on the tissues. In the snail the larva changes and multiplies by budding into numerous small individuals and these proceed through two or three further larval stages in the life history, emerging once more into the water as thousands of microscopic, tailed, tadpole-like individuals, the cercariae. Each cercaria wriggles to the edge of the pool and settles down on a blade of grass and forms a protective sheath around itself. Here it waits in the hope that it will be eaten by a sheep before it perishes of exposure. When swallowed by a sheep along with the blade of grass, the cercariae emerge from the cyst and make their way to the liver and bile ducts of the new host. This is indeed a complicated animal relationship, for not only are there the relations between the parasitic flatworm and its final host, but also a new element has been introduced in the form of an intermediate host (the snail) whose presence is absolutely necessary in order that the life cycle of the worms may be completed.

No one knows how parasitism has been evolved in the past, but it seems reasonable to believe that it arose by gradual stages somewhat as follows. The relationship might start as a harmless association, where the partners merely live together. Then there might follow a stage where they begin to dine, as it were, from the same table and become commensals. The visitor might then begin to compete with its partner for food, and should there not be enough food for both, then, perchance, the loser might turn and begin to feed on its mate, thus adopting a parasitic mode of existence, so that what began as a simple partnership has by the keenness of that competition which we call the "struggle for existence" been turned into parasitism. All this is, of course, conjecture, but it seems reasonable to suppose that the course of events might have followed along these lines, because among animal relationships it is possible to observe all stages between partners which are completely independent of one another and others which are absolutely dependent on the presence of their host or associates.

The Honourable Sir Samuel Walder, Kt., M.L.C., was elected to the Board of Trustees of The Australian Museum on 8th May.

Sir Samuel Walder has had a distinguished career in the public and commercial life of this State. For many years he has given generously of his time and organizing abilities in many activities. A prominent member of the City Council of Sydney, he served the city with conspicuous success as Lord Mayor for a term. He took a leading part in the arrangements for the 150th anniversary celebrations in 1938 commemorating the founding of British settlement in the south Pacific.

* * * *

Miss Elsie Bramell, M.A., who, in the Department of Anthropology, had been a member of the staff of The Australian Museum since 1933, resigned early this year upon her marriage to Mr. F. D. McCarthy, also of that department. Miss Bramell contributed to the pages of this MAGAZINE from time to time and results of her researches have been published in the *Records of The Australian Museum* and other scientific journals.

* * * *

Mr. M. W. F. Tweedie, B.A., Assistant Curator of the Raffles Museum, Singapore, recently spent some weeks at this Museum examining our collections of crustacea. He was particularly interested in shore crustacea, especially the crabs of the mangrove zone, and mantis shrimps. Apart from zoology Mr. Tweedie is also an authority on prehistory, and matters in this field also claimed his attention.

* * * *

Miss M. H. Hardy, B.Sc., of the Queensland University, was engaged here for some weeks investigating the classification of sponges and examining our collections.

Australian Insects. XIII

The Earwigs—Dermaptera

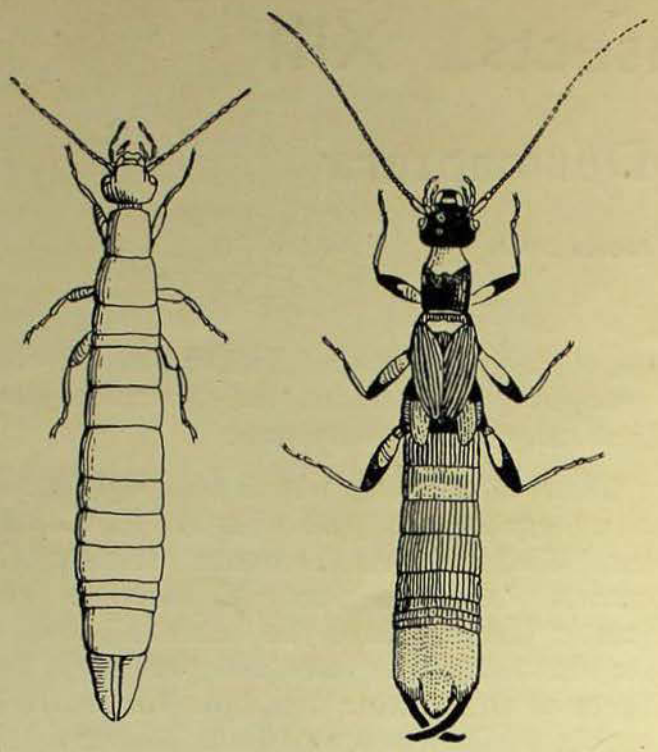
By KEITH C. McKEOWN

THE earwigs form a very distinct order, the Dermaptera, although they were for long included, with so many other varied groups, in the Orthoptera. That they have affinities with the Termites (Isoptera) is indicated by the fact that a damaged earwig was once described as a white ant. The group is not particularly numerous in Australia, and some forty species have been described, or about a twentieth of the known earwigs of the world.

The insects are slender, elongate, and may be distinguished at once by the presence of a pair of stout forceps or 'pincers' at the extremity of the abdomen. The wing-covers are extremely short, looking rather like a schoolboy's Eton-jacket, and the large flying wings have an extremely complicated venation, enabling them to be intricately folded into a small packet and tucked away out of sight beneath the wing-covers. The use of the forceps is far from clear, and there are a number of schools of thought each with a different opinion. It has been considered that they are employed in folding the wings and stowing them away; some think that their purpose is the seizing of prey, while others have reported seeing insects impaled upon their points. Again, they may be defensive, and this is, perhaps, the soundest explanation, for, although incapable of harming humans, some species are capable of inflicting a sharp nip with their pincers if carelessly handled. Whatever their actual purpose, the insect itself seems to realize that they have a publicity value, for, when disturbed, the earwig curls its abdomen up over its back and opens the forceps in a threatening manner, while running for the nearest cover. I have had earwigs brought to me under the mistaken idea that they were scorpions!

That the earwig has a bad reputation is widely known, and who has not heard the belief that the creature 'deliberately crawls into the ears of sleepers and gnaws its way into the brain'? Despite its absurdity, the idea still persists! The facts of the matter are, however, entirely lacking in such sensational features. If an earwig ever did crawl into a human ear, the happening was purely an accident, the misguided insect being in search of a hiding place; the sequel is, of course, wholly legendary, and beyond the prowess even of an earwig—except, of course, such mythical species as that around which such folk-lore has gathered. A very reasonable explanation of the name 'earwig' is that it is a corruption of 'earwing', for from its shape and venation the wing certainly does bear some resemblance to a human ear. So much, alas! for popular superstition!

The life story of the earwig is extremely fascinating and, although the life-histories of many of our Australian species are quite unknown, a generalized account of their habits will be sufficient to show its interest. By day earwigs are retiring, hiding in burrows in the soil, under stones, or under the bark of trees, coming out at night to live their lives, feed, mate, and behave as earwigs have, no doubt, done since the earliest times. In its choice of food the earwig is not at all fussy; it is practically omnivorous, and its diet ranges from the petals of flowers, or fruit, to other insects, living or dead. In captivity, I have found that the common shore earwig scorns little in



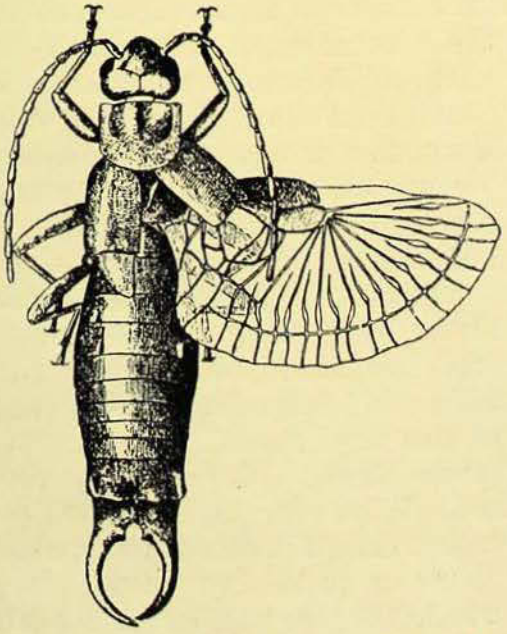
The Giant Earwig (Titanolabis colossea), and the beautiful Apachyus australiae.
(N. B. Adams, del.)

the way of food, and will thrive for several months on a very mixed ration.

The female earwig is among those rare insects which show some maternal devotion for their eggs and young, not merely leaving them by the way-side to take their chance as best they may. The earwig must receive praise as a good mother. Deep in her burrow in the soil she lays her eggs, to the number of some fifty to ninety, in a little heap, and stands guard over them until they hatch. Should these precious eggs become scattered in the soil, she will carefully seek out each one, and as carefully stack them up again, and resume her guard. With the hatching out of her children, the little mother's cares do not cease; she watches over her youngsters with, if possible, greater persistence. The little earwigs shelter under her body, peeping out from between her legs like chickens from under the wings of a hen. At last the young are large enough to fend for themselves, and the mother, free from her domestic cares, can devote her energies elsewhere.

The young earwigs, resembling their parents in all but wings and wing-covers, grow, moult their skins, and grow again, until maturity is attained. From four to six moults have been recorded during this period of immaturity. At first the forceps are slender, but they grow stouter with each moult, and assume their adult form with the last casting.

One of the commonest and most widely distributed earwigs is *Labidura riparia,* which tunnels in the banks of rivers, creeks, and the excavated tanks or dams of the pastoral areas. It is a light brown insect with the long and somewhat straight-sided forceps yellowish. It can usually be collected by splashing the banks in which it lives, with water, to drive it from its shelter. *Titanolabis colossea* is a huge black and completely wingless species, measuring over an inch and a half in length, with thick, blunt, finger-like forceps; it is one of the largest earwigs in the world. Perhaps the most beautiful of all earwigs is *Apachyus australiae,* nearly an inch and a half long. It is extraordinarily flattened, enabling it to hide beneath closely fitting bark on the tree-trunks of the forest areas of the Dorrigo, New South Wales, which it frequents. It is strikingly marked with black, brown, and creamy white. Many small and inconspicuous species are contained in the family Labiidae.



The introduced European Earwig (Forficula auricularia)—Male.
(After Chopard.)

A comparatively recent immigrant to this country is the European Earwig (*Forficula auricularia*), which appeared some years ago at Bombala, New South Wales. It has now spread over a wide area in south-eastern New South Wales, and is firmly established on the Blue Mountains. It destroys flowers, and is a pest in gardens and orchards. The shape of the forceps differs markedly in the two sexes; those of the male being strongly bowed like callipers, but those of the female are almost straight, curving inwards at the tips. It is an insect to be closely watched, for it may become a pest of considerable economic importance, as it has done in New Zealand.

Butterflies Attracted by Brilliant Colours

By G. A. WATERHOUSE, D.Sc., B.E., F.R.E.S.

IT is well known that some butterflies may be more easily caught when they are attracted to certain bright-coloured flowers. In north Queensland such flowers as the common red Hibiscus are often visited by large butterflies as the green Birdwing and certain large Nymphalids. The Birdwing is also attracted by bright yellow flowers such as pumpkin. Indeed the late F. P. Dodd had planted his garden at Kuranda with plants with bright flowers so as to get a supply of butterflies in this easy way. On my visits to Kuranda I always found his garden, which he kindly allowed me to use for the purpose, the best collecting spot for the larger species in the district.

At Cairns I have caught the large blue Swallow-tail (*Papilio ulysses*) by taking out with me an old and battered specimen and attaching it to a low bush. This species always flies far out of reach of the net, but any males within a distance of about 50 yards flew down to the bait to investigate and so were easily caught. Once I pinned the bait to the top of my hat and forgot about it. Later on I remarked to my companion that *P. ulysses* seemed to be very fond of me. He told me to take off my hat and I would see the reason. The females of this butterfly are not attracted in the same way, but are said to be attracted by bright red cloth or flowers.

Recently when catching *Ogyris amaryllis*, a brilliant blue butterfly, near Sydney I mentioned this to my friend, Mr. C. W. Wyatt, and wondered if this blue butterfly would be attracted by blue colours. He decided to try the experiment. He cut butterflies out of brilliant blue, brilliant red and silver tin-foil and climbed about 20 feet up the trees around which the butterflies were flying and placed the baits there. He was successful in catching several butterflies attracted to the baits, whereas on a previous day on the same tree he had been able to catch only one specimen. The butterflies were definitely attracted to the bait, but only to the bright *red* colour and not to the blue or silver. On another day I watched his method. First of all the red baits were placed within a few feet of the ground, then Mr. Wyatt climbed a tree around which the butterflies were flying and placed baits there. They were definitely attracted by the red and settled within a few inches of it and so were easily caught. Only males were caught in this way. No specimens were attracted by the baits placed near the

ground and we came to the conclusion that the males do not see the bait until they are within about 10 feet of it. On the first occasion, several males were attracted and caught, settling right beside the bait; only one female approached the tree and she eventually settled on a twig about three feet from the bait and actually out of sight of it. So it is a moot point whether the bait attracts both sexes or only males. We should like to make further experiments with the bait placed near to big clusters of *Loranthus* round which the females flutter and to test whether the bait is more attractive to them than the dull red flowers of the *Loranthus*. We propose to make further experiments with bright colours to see if we can attract other high flying butterflies.

Other bait to attract butterflies is found in sap exuding from trees, decaying fruit and even decaying animal matter which attracts the males of the Purple Emperor in England. Some of the rarest of the Indo-Malayan butterflies have only been caught when attracted by cattle dung.

In tropical regions immense numbers of butterflies may be noticed sucking the moisture from puddles along side roads or tracks. They arrange themselves in regular order and appear from a distance like large flowers on the ground. Many dozens can be caught in this way. Most of the specimens of *Papilio parmatus* in the Australian Museum were caught at Cooktown whilst they were sucking moisture from a drying pool alongside the road.

The Late Dr. F. E. Wall, M.L.C.

By the death of Dr. Frank E. Wall, M.L.C., on April 1 the Board of Trustees of The Australian Museum lost not only one of its members, but also one who linked the early days of the institution with the present time. Dr. Wall was elected to the Board in October, 1926, and had always manifested an interest in the institution.

His grandfather, Mr. W. S. Wall, and his grand-uncle, Mr. Edward Wall, arrived in New South Wales in 1840—more than a century ago—under engagement to the government as naturalists. William Sheridan Wall subsequently became curator of the Australian Museum;[1] his brother was the naturalist with Kennedy's ill-fated expedition to Cape York. Thus for more than one hundred years the family has a record of public service.

Dr. Wall's interest in medicine extended into its public aspects. For his services in the preparation of a report on the public hospitals of the State he was appointed to the Legislative Council in 1917. He was made a member of the Board of Health in 1925 and of the Medical Board in 1939. He was also a prominent member of the recent Parliamentary Select Committee on Hospitals, Honoraries, and Graduands.

Dr. Wall leaves a widow and a son, Bombardier Ian Scott Wall, 2nd/15th Field Artillery, A.I.F.

Probably Dr. Wall's greatest service to the State was his acquisition of the secret of the manufacture of the improved anthrax vaccine from the late John McGarvie Smith.

McGarvie Smith made a deed of gift to Dr. Wall of all rights to the use of the vaccine outside the State and of all his bacteriological equipment. Dr. Wall in turn transferred the gift to the newly created McGarvie Smith Institute, receiving nothing but out-of-pocket expenses for a service the value of which was computed at the time at £1,500,000.

[1] W. S. Wall was the author of *A History and Description of the Skeleton of a New Sperm Whale lately set up in the Australian Museum*, 8vo., Sydney, 1851. This was reprinted in 1887 and 1891. It forms *Australian Museum Memoir I.*