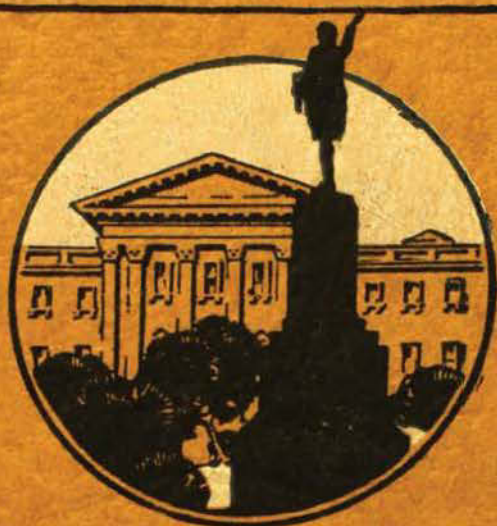


*The*  
**AUSTRALIAN  
MUSEUM  
MAGAZINE**

EDITED BY C. ANDERSON, M.A., D.Sc.



**The Egg-Laying Furred Animals of Australia**

*Ellis Le G. Troughton*

**The Oceanic Angler Fishes - - Gilbert P. Whitley**

**Some Australian Wood-Destroying Insects**

*Nancy B. Adams*

**The Way of the Wasp.—Part I - Keith C. McKeown**

**In the Haunt of the White Hawk. Wild Nature of  
the Otway Forest - - Charles Barrett, C.M.Z.S.**

**Snails - - - - - Joyce K. Allan**

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# THE AUSTRALIAN MUSEUM MAGAZINE

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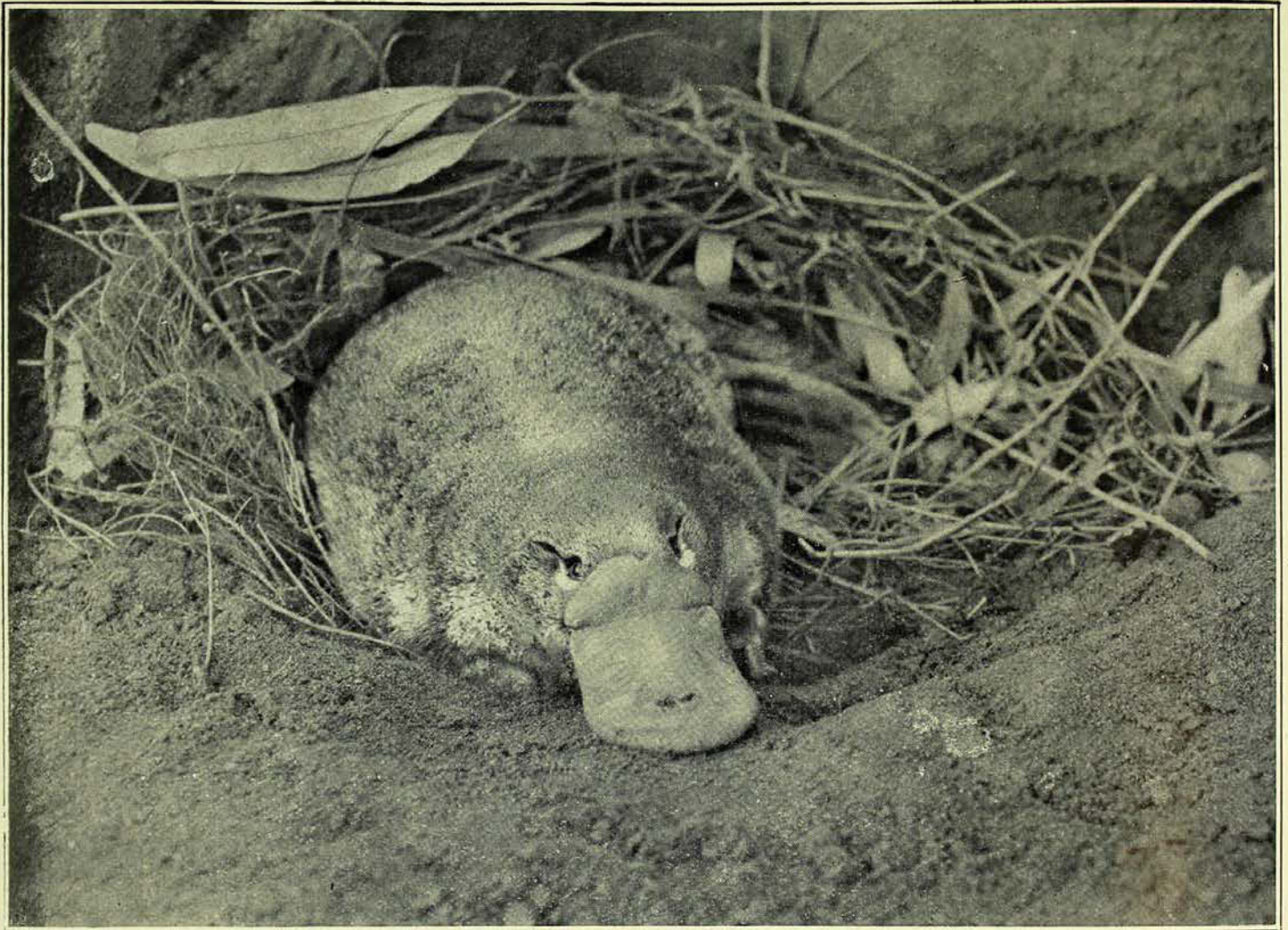
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Female platypus leaving the nest which has been exposed. The nostrils on the "bill," groove in which the eye and ear are enclosed during submergence, and fur-texture are beautifully illustrated. Owing to the researches of the platypus authority, Mr. Harry Burrell, the first living platypus to reach a foreign shore arrived at the New York Zoo in 1922, where it survived an hour's exhibition daily for nearly two months. The surprising feat of transportation was achieved by Mr. Ellis S. Joseph, well-known animal dealer, in a "platypusary" contrived by Mr. Burrell. The ingenious contraption included a rising labyrinth to simulate the burrow, rubber-floored to avoid hurting the paws, and apertures guarded by rubber gaskets to squeeze the water from the fur, an operation which normally is largely performed by the webbed forepaws.

[From *The Australian Encyclopædia*.



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VOL. IV, No. 10.

APRIL-JUNE, 1932.

## The Egg-Laying Furred Animals of Australia

BY ELLIS LE G. TROUGHTON.

ALTHOUGH several kinds of marsupials occur in America, they have developed the maximum variety of strange forms in Australia, while no living egg-laying mammals are found elsewhere in the world. Because of this our continent has been described as a colossal natural history museum, stocked as it is with many types of animals whose ancestors died out long ago elsewhere, and the description applies most aptly to the platypus and its egg-laying cousins, the Spiny Ant-eaters, or so-called "native porcupines." These intriguing creatures are literally living fossils walking, as it were, in a geological sleep, or like zoological Rip Van Winkles, retaining their peculiar form and habits as if they had slept for millions of years and then awoke to continue their primitive existence.

That they have altered but little in recent geological ages is suggested by the fact that no fossil remains have yet been unearthed which illustrate a gradual evolution, but it is certain that the skeleton retains definite traces of reptilian ancestry, which evolution has eliminated from all

other furred animals. These reptilian ancestors gradually developed characteristics typical of the mammals of today, firstly giving rise to a group of very primitive furred animals which were insect eaters and laid eggs. An early branching of this stock produced the platypus and ant-eater, while from a later offshoot have descended the higher mammals which evolved means for bringing forth active young.

### THE MONOTREMES, AND WHY THEY ARE MAMMALS.

Lowliest members of the class of furred animals known as Mammalia, to which man also belongs, the platypus and Spiny Ant-eaters are the sole surviving representatives of their order, termed the Monotremata. The word monotreme, meaning single opening, refers to the single vent or outlet common to both the organs of generation and elimination, a feature shared with birds, reptiles, and amphibians, with which is correlated the egg-laying habit. However, excepting only that active young are not born, monotremes

possess all the characteristics of mammals, such as the furry covering and suckling of the young, which so definitely separate them from the other back-boned creatures such as birds, reptiles, and fishes. Furthermore, the platypus, though leading an amphibious existence, possesses a diaphragm separating the chest from the abdominal cavity, and breathes ordinary air as do whales and all other mammals.

Whatever the actual history of their origin, these furred egg-layers are true mammals and the laying of eggs is due either to the retention of a primitive habit or to an adaptation to their peculiar mode of existence. It is easy to say so now, but imagine the flutter in the scientific dovecotes of Europe when the first platypus arrived, probably as a badly preserved skin; indeed, no other animal has caused greater controversy, something of which is sketched below.

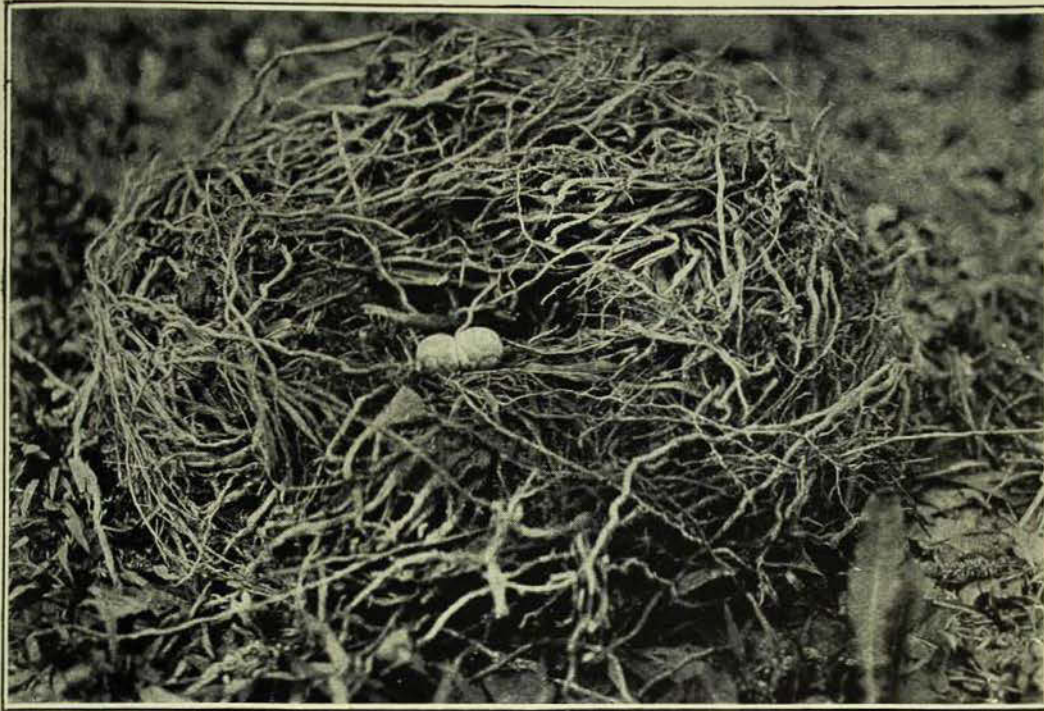
#### THE DISCOVERY OF THE PLATYPUS, AND EARLY RESEARCHES.

The platypus, which has been called Duckbill, Duckmole, and even Watermole, was apparently first observed by colonists of New South Wales in 1797 on the banks of the Hawkesbury, according to the following extract from Collins' *New South Wales*, probably referring to the first specimen captured: "The Kangaroo, the Dog, the Opossum, the Flying Squirrel, the common Rat, and the large Fox-bat (if entitled to a place in this society), made up the whole catalogue of animals that were known at this time, with the exception which must now be made of an amphibious animal, of the mole species, one of which has been lately found on the banks of a lake near the Hawkesbury . . . the most extraordinary circumstance observed in its structure was, its having, instead of the mouth of an animal, the upper and lower mandibles of a duck. By these it was enabled to supply itself with food, like that bird, in muddy places . . . while on shore its long and sharp claws were employed in burrowing; nature thus providing for it in its double or amphibious character." Collins' work was not published until 1802, but was written in diary form so that the above was

probably the first written account, though not the first published.

So strange did the creature then seem to scientists that one gave it the name *paradoxus*, and a veritable paradox it must have seemed, with its furry mammal's coat, duck-like bill, and webbed feet. Fortunately for the sanity of those unravelling these contradictory features, the even more paradoxical fact that the platypus laid eggs and then suckled its young in the mammalian way was not then known. In fact the naturalists approached their task somewhat gingerly, the general feeling being summed up by Knox, the celebrated Edinburgh anatomist, writing in 1823: "It is well known that specimens of this very extraordinary animal when first brought to Europe were considered by many to be impositions. They reached England by vessels which had navigated the Indian seas, a circumstance arousing the suspicions of scientists, aware of the monstrous impostures which the artful Chinese then practised on European adventurers—these oriental taxidermists were quite notorious for their skill in constructing non-existent animals for sale to credulous seamen, such as the so-called 'eastern mermaid,' to be seen occasionally in curiosity shops to this day, consisting of the forepart of a monkey skilfully stitched to the tail of a fish."

However, in 1802, complete specimens dissected by the great anatomist Everard Home proved beyond all doubt the existence of the quaint creatures, and then ensued a struggle for additional material for study, and a controversy which raged for nearly a century. Was the platypus a true mammal, or should it be placed in a separate class of back-boned animals? This was long debated until eventually it was properly placed in a sub-class of the mammalian group containing all the furred, milk-suckling, air-breathing, warm-blooded vertebrates. Such conclusions, however, were not reached without much argument, about it, and about, as Omar would say. Even the French argued excitedly with each other, and their fellow naturalists across the channel, thereby placing a severe strain upon the "entente zoologique."



Twin eggs in a nest composed entirely of reed roots. The colour of newly laid eggs is glossy white, and their compressibility is shown by the flattening where the eggs have adhered after laying.

[After Burrell.]

The discovery of the mammary or milk-secreting glands in 1824 by Meckel, a German anatomist, added to the furry covering, should have settled the mammal question, but the Frenchman Geoffroy, quite undaunted, returned to do verbal battle. The platypus, he said, was not a mammal because certain organs showed it to be an egg-layer; it was not a bird, having neither wings nor feathers; nor was it a reptile for the blood was warm and the lungs were separated from the abdomen by a diaphragm. In short, he said it was a mammal without the mammalian characters, therefore the platypus should have a class to itself. No wonder that confirmation of the milk-feeding apparatus upset the French scientist, and it is amusing to relate that in a despairing effort to disprove the idea, Geoffroy declared they were merely the so-called milk-glands of whales, then believed to secrete not milk but a substance which thickened in the water and was then devoured by the young. After elaborating this explanation, Geoffroy was unfortunate enough to secure a nursing porpoise and found that the glands actually secreted milk, which those of the platypus were proved to do in 1832. It must be admitted that the uncertainty

regarding the platypus was contributed to by the fact that both it and the Spiny Ant-eater are devoid of teats by which the young of marsupials and all other mammals are suckled, the milk actually oozing from pore-like openings and being licked up by the juveniles. Where the early workers were most misled, however, was in the failure to realize that while primitive characters are retained by the monotremes, many

of the paradoxical features are adaptations to environment, rather than primitive or degenerate; thus in the platypus the webbed feet and the highly sensitive duck-like bill are adapted for aquatic life.

#### THE EGGS OF MONOTREMES.

Identity as a mammal being settled, there arose the intriguing question whether eggs were laid or not. The great Professor Richard Owen believed the young were hatched within the parent, whereas Geoffroy rightly contended that eggs were actually laid. In spite of a published report that two white compressible eggs had been found in a box imprisoning a platypus over-night, the matter was debated hotly for more than eighty years. The question was not settled finally until 1884, when W. H. Caldwell, a Cambridge zoologist who came out especially to investigate the reproduction of marsupials and monotremes, obtained eggs of both platypus and "porcupine" in the Burnett River district of Queensland. This fact was announced to the scientific world dramatically by cable sent by Caldwell to the British Association for the Advancement of Science then sitting at Montreal.

As to the kind of egg laid by the platypus, there was originally much confusion, largely based upon an aborigine's statement reported in 1822 that the animal laid eggs "about the size, shape, and colour of those of a hen." Although this error may have been due to a misunderstanding, subsequent accounts were distinctly "henney," except on one occasion when the eggs of the common long-necked tortoise from a sandbank on the Hawkesbury were attributed to the platypus.

Actually the monotreme eggs are rounded and barely three-quarters of an inch in diameter, and the shells are not brittle like those of birds, but composed of a tough leathery substance, known as keratin, which forms the tough covering of the eggs of many reptiles, and is also the basic substance in the egg-shells of birds. Soft, compressible, and of a dirty white colour, two eggs are usually laid by the platypus, though single ones and occasionally three are found, often sticking together after they are laid. A single egg is laid by the Spiny Ant-eater and carried in the temporary pouch of the female until hatched.

Primitive relationship is shown in that the eggs are large-yolked like those of reptiles, and in the total lack of any prenatal union of the blood-stream such as exists in a primitive way in some reptiles, and in all marsupials. Owing to the incomplete nature of the "navel-cord" connection marsupials are born in a relatively undeveloped condition, and so in the monotremes there is nothing bird-like about the eggs, which merely anticipate ordinary mammal birth, at an earlier stage than marsupials, owing to the embryo being nourished solely by the egg contents.

#### SKELETAL LINKS WITH REPTILES AND MARSUPIALS.

In the past it was supposed that monotremes had close reptilian affinities because of the poison-spur in the platypus, and repeated assertions were made that they were cold-blooded animals, or without a constant body temperature. Though relatively low, however, the difference of blood temperature to that of other mammals is not as great as supposed,

while there is no reason to regard the poison gland and spur of the platypus as showing any physiological affinity with venomous reptiles.

Usually dentition provides the most instructive fossil evidence, but in the monotremes the teeth have degenerated and it is in the skeleton one finds structural links with early reptilian ancestors, and a marsupial feature which must be a relic of that early mammalian parting of the ways.

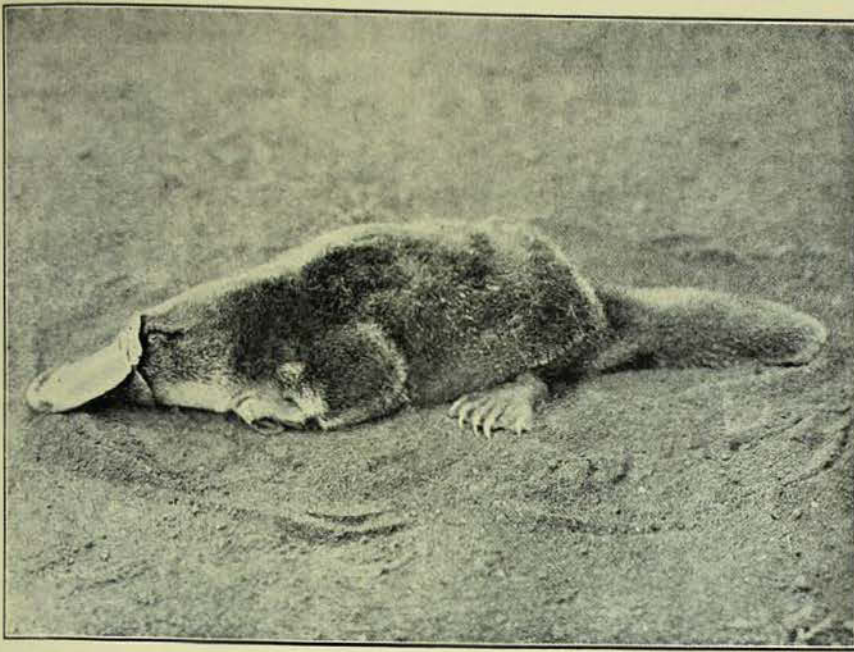
One distinctive feature of the skeleton is the presence of a T-shaped bone (episternum or inter-clavicle), the stem of which articulates with the breast-bone, while the cross-piece is in close relationship with the collar-bones; this bone does not occur in other mammals save as an obscure vestige in certain examples, but is well developed in most reptiles. Another characteristic feature is a bone (the coracoid) amongst those supporting the forelimb, similar to that of the lower air-breathing vertebrates, which in all the higher mammals is reduced to a mere vestige. The most striking skeletal feature in common with the marsupials is that the monotremes have the characteristic epipubic or "marsupium" bones jutting out from the pelvis. These are commonly supposed to aid in supporting the pouch, but that this is their function is doubtful, for they are equally developed in both sexes. They are possibly a heritage from reptilian ancestors, in which they were associated with the abdominal muscles.

The skull is peculiar in that the constituent bones become fused comparatively early, the surface assuming a smooth polished appearance. In this respect as in the form of the snout, the platypus and ant-eaters are superficially bird-like, though the resemblance is actually not close, and the skull, although possessing certain reptilian features not shared with higher mammals, is very definitely mammalian.

#### THE BRAIN AND SENSES.

The brain falls short of the normal mammalian standard in some respects, but not much more so than the marsupial brain, and although there is no essential difference in brain structure between the platypus and ant-eater, there is a great





A male platypus at rest, showing the shield-like hind extension of the "bill" above and below, and the position of the forepaw while bearing the weight; when walking its claws grip and the paw then doubles over on to the knuckles. The web is similarly folded back when burrowing.

[After Burrell.

difference between the two in brain development. The cerebral hemispheres, seat of higher brain activities, of the ant-eater are larger and much more highly organized, due doubtless to the wide difference in habits. The apparatus of the sense of smell is rather highly developed in the ant-eater and much less elaborate in the platypus, the comparatively circumscribed environment of the latter not calling for as much intelligence as in its more freely roving relatives. Making up for the deficiency of sense of smell the leathery bill of the platypus is charged with minute nerve papillæ, which appear to involve a specially refined sense of touch, which, beneath the water and in subterranean tunnels, is probably more useful than either sight or smell.

#### THE PLATYPUS—ITS HABITS AND HAUNTS.

The platypus is confined to the region of Australia lying east of 138 E. long., possibly excepting Cape York, and to Tasmania; the westernmost occurrence known is the Leichhardt River, North Queensland, and the Murray, Onkaparinga, and Glenelg Rivers, just within the borders of South Australia. According to that well-known authority, Mr. Harry Burrell, in his famous work "The Platypus," they inhabit a varied range of waters,

from clear, icy, rapid, alpine streams, to a height of 6,000 feet on the Kosciusko tableland, to the warm, rather turgid waters of the Queensland coastal plain, and from large lakes to small waterholes.

Though the general appearance is well known, it may be stated that the adult males attain to about two feet, the tail accounting for five or six inches, and the coat is of velvety umber brown fur above and from greyish-white to yellowish-chestnut below. The snout is superficially not unlike a duck's bill, but instead of being horny, in life it is soft, moist, and of leathery but flexible skin, so charged with nerve endings that it is a highly specialized sense-organ,

replacing the whiskers of non-aquatic mammals. This peculiar muzzle is admirably adapted for nuzzling in submerged slush, like a duck, in search of food, which consists of immature molluscs, small prawns, aquatic insects and their larvæ, and worms, the food being taken in with much mud and sand, which appears essential to mastication. Time below while feeding averages about a minute, and a similar time is spent chewing the catch at the surface; it is usually supposed that the food is first shovelled into the cheek-pouches, but for various reasons Burrell considers the pouches to be used rather for holding the grit employed in mastication, and aiding in the sifting process. It is pointed out that large prey, such as adult shrimps, cannot possibly be pouched whole, and must be carried to the surface. There is no ear-lobe, and both the eye and ear are completely enclosed within a facial furrow during submergence, when the sense of touch alone appears to be fully functioning, though above water the hearing is acute and the eye perfectly placed to observe the sloping banks above.

The fore-foot is both the main swimming and burrowing organ, providing a unique example amongst mammals of a sort of reversible adaptation for very diverse



A typical platypus haunt on the Macdonald River, N.S.W., where the banks, shaded by river-oaks, are ideal for burrowing. Granite boulders in the centre are favoured sunning places for long-necked tortoises, the eggs of which were confused with those of platypus long ago.

functions; on land the portion of the web, extending well beyond the claws when swimming, is folded back under the palm so that the stout claws can be used in burrowing and walking. The webbing of the hind-foot does not extend beyond the bases of the claws and the member is scarcely used in swimming, though providing the main thrust on land.

Aquatic habits having rendered a pouch superfluous and the body comparatively defenceless, the tunnelling habit has been adopted to provide shelter and the burrows are of two distinct kinds. There is a resting burrow, or general living quarters occupied by males or females separately, and quite apart from the more elaborate nesting burrow constructed by the female alone, wherein her eggs are laid and the young reared. The low-arched breeding tunnel roughly conforms to the body, the length of the burrow averages from fifteen to sixty feet, the average distance underground is fifteen inches and, contrary to popular belief, the entrance is above water, the occasional under-water one being due to change in the water level, the normal nesting-burrow entrance being from about four to twelve feet above water. The nests may be constructed of grass and gum leaves, thin willow switches,

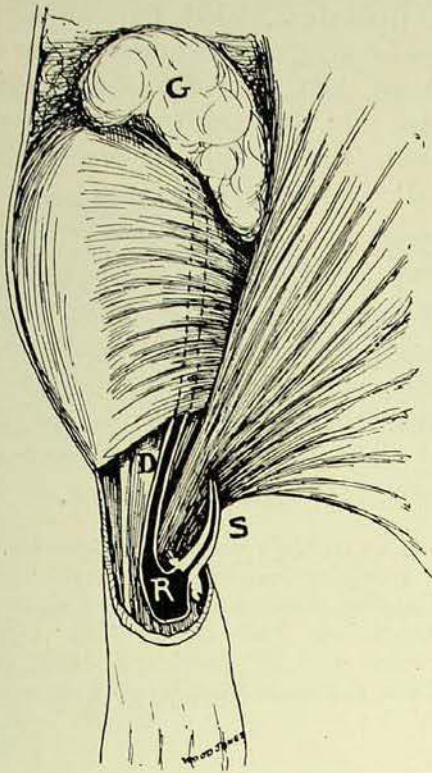
or reeds frayed out by the animal's jaws.

The period of incubation is not definitely known, though estimated by Burrell to be about fourteen days, and possibly less; his experiences also suggest that the mother does not leave the nest between the time the eggs are laid and the young are able to suckle. During incubation it is supposed that the mother holds the eggs, as she does the newly-hatched young, in

[After Burrell.

the middle of her curled up body, thus accounting for frequent cohesion of the eggs; this embrace of the young naturally brings them in proximity to the breast, where their spasmodic movements stimulate the flow of milk which is exuded from enlarged pores and sucked from the skin. On retiring to lay, the female plugs the burrow behind her with from about three to nine barriers of soft earth averaging from six to eight inches in thickness and tamped firm by pressure with the tail, which is often bare above as a result; this cunning device of barriers, which so frequently misled early investigators, provides protection from enemies and ideal brooding conditions, and is not merely to resist flooding, as the nest is higher than ordinary flood levels.

Abroad mainly in the early morning and late twilight, the platypus normally feeds twice daily, and is not so generally aquatic as its structure suggests, the time in the water probably averaging less than two hours out of the twenty-four. The only means of attack or defence is provided by the sharp, curved, hollow ankle-spur of the males, through which poison manufactured in a gland in the thigh is injected when the spur strikes into flesh. There is, of course, no reptilian



Hind limb of a male platypus dissected to show the poison-gland (G), tube or duct (D), reservoir (R) at the base of the hollow spur (S) through which the venom is injected into the wound.

[After Wood-Jones.]

affinity in this apparatus, though symptoms resulting are said to resemble those of non-fatal snake-bite and fatal results ensue with small animals, injection of varying doses causing a maximum effect of death in ninety seconds in rabbits.

#### THE SPINY ANT-EATER, ECHIDNA, OR SO-CALLED "NATIVE PORCUPINE."

The Spiny Ant-eaters of the mainland, Tasmania, and New Guinea are the nearest living relatives of the platypus, sharing with it the distinction of being the only furred animals which lay eggs. The name "porcupine" is very inappropriate, as the true porcupines of Europe and America are really rodents, more closely related to rabbits and rats than to marsupials and the lowlier egg-layers. Spiny Ant-eater is the most suitable name, referring to the protective covering of quills, which are really developed from greatly enlarged hairs, and to the natural food which consists mostly of ants. The food is obtained by the rapid thrusting out of the long sticky tongue, to which ants and other small insects adhere, the snout being slender and pointed instead of

flattened like that of the platypus, thus providing a good example of how different habits mould the appearance of closely related animals.

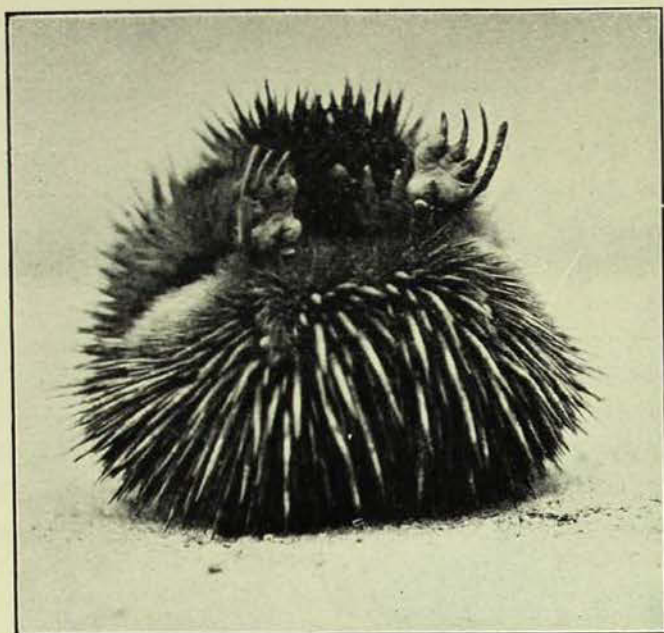
The spiny ant-eaters are not tunnellers and differ from the platypus in that the female carries its egg in a pouch which forms during the breeding season, wherein the egg hatches and the young one is carried until the spines become troublesome; it was once supposed that the parent placed the egg in the pouch, but Burrell points out the unsuitability of the paws for this action and suggests that the supple body enables the egg to be layed directly into the pouch, a possibility supported by the finding of excrement therein. Later on the young one is left in some hiding place, the mother returning to suckle it with milk, in a manner similar to that of the platypus.

As protecting burrows are not constructed, nature has provided this sluggish and otherwise defenceless creature with an armory of sharp spikes, like an animated pin-cushion, so that when curled up tightly the soft underparts are entirely protected. They also have a remarkable capability of clinging tightly to the ground and digging rapidly downward into the earth if the surface is suitable, providing an excellent means of avoiding enemies, with the spines for rearguard action. This ability to sink rapidly into the ground is protective and not for obtaining food, and is made possible by the greatly enlarged claws, and extraordinary rotary action of the powerful limbs.



A spiny Ant-eater about to burrow into the ground. Nature has arranged the longer quills in the most effective zones, and when the entire armature is erected there is complete protection from above.

[Photo.—G. C. Clutton.]



When curled up tightly by the powerful muscles, only the greatly enlarged hind claws, especially adapted to the rotary movement of burrowing downward, are exposed. Amongst the spines is a coat of coarse, typically mammalian hair.

[Photo.—K. C. McKeown.]

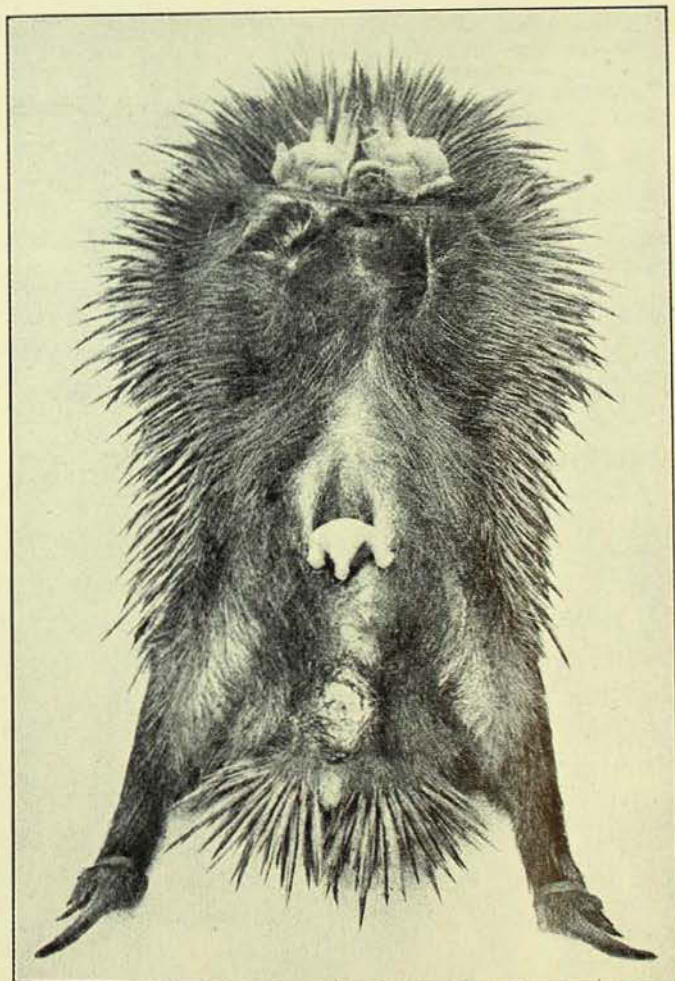
Unlike the platypus, which has juvenile teeth, ultimately replaced by horny plates, teeth are completely absent at all stages in the ant-eater, their place being taken by numerous horny serrations on the back part of the tongue which work against hard ridges on the roof of the mouth in breaking up food. Considerable dirt is taken up with the meal and aids the stomach, which has lost the suitable glands for digestive function, to act as a gizzard in further breaking up the food. Although the ant-eater is said to make a savoury dish when baked in coals (at least to aborigines), it seems to the author necessary first to cultivate the animal's indifference to formic acid. This opinion was formed after eating scones fried in its fat, one of the most bilious and trying experiences to which a collector can be subjected by an experimenting cook.

Excepting some remains of two extinct species of ant-eater, and some of the platypus, from the Post-Tertiary (Pleistocene) deposits of Australia, the monotremes are not certainly known as fossils in any part of the world. The discovery in 1888 of true teeth in the young platypus was expected to reveal ancestral links, but, although the two largest teeth in each jaw are said to be analogous to molars

in form, position, and function, the gaps appear to be so great between the dentition and that of any known mammalian type that there can be no presumption of real relationship until the discovery of closer points of comparison, or intermediate forms.

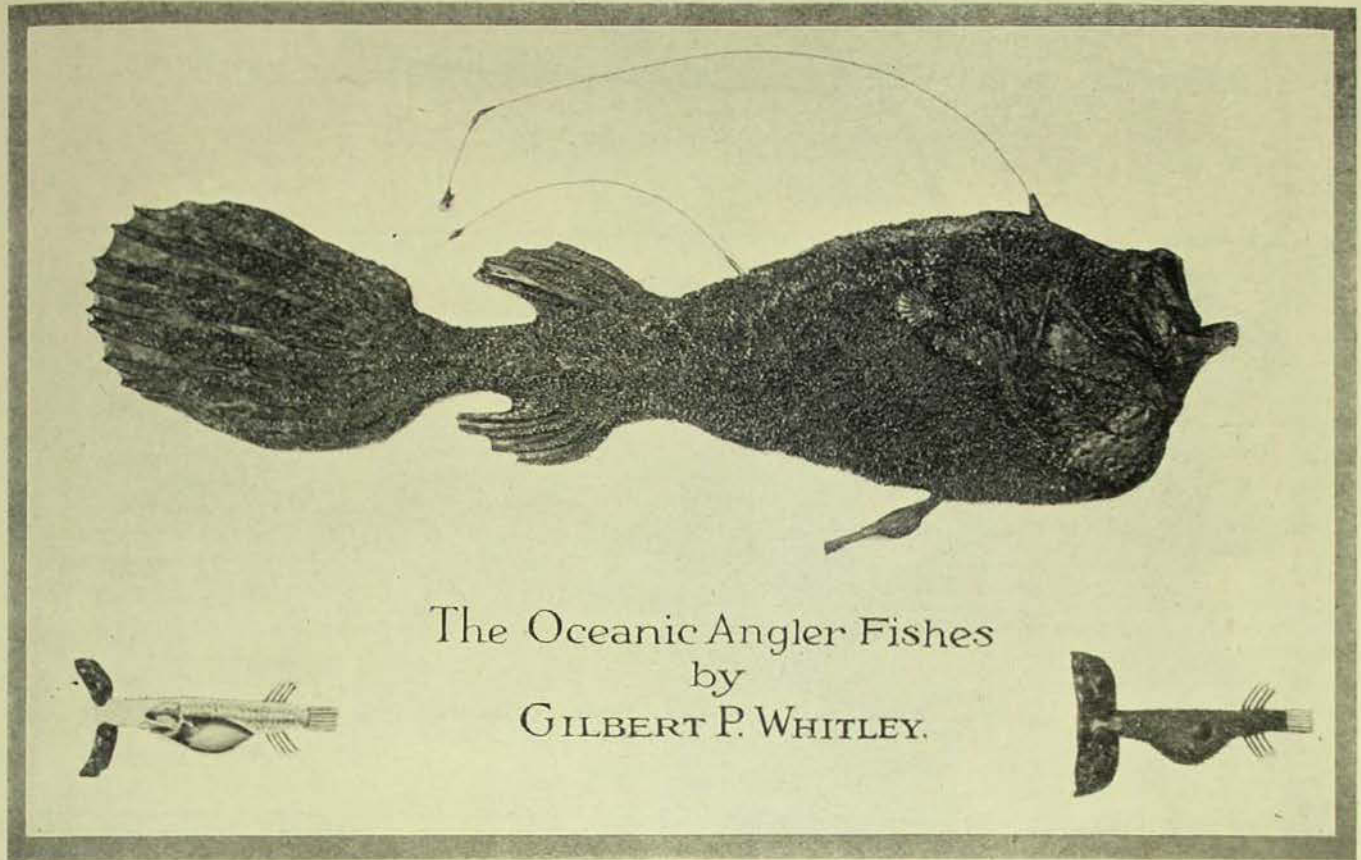
Whether or not the missing monotreme links are ever discovered, it is fortunate that total protection of the platypus, and the protective armament and lack of commercial value of the ant-eaters, seem to ensure the survival of these fascinating Australians for ages to come.

NOTE.—The author acknowledges his indebtedness to the work of Mr. Harry Burrell for the more recent and authoritative notes on habits. Readers are recommended to obtain his work, "The Platypus," for a full and splendidly illustrated account of the animals and their fascinating ways.



Showing the temporary pouch which develops in the breeding season, forming a living incubator for the egg, and perambulator for the youngster, until its spines become troublesome. Note the breadth of snout in the juvenile, which is adapted for suckling in the absence of normal mammalian teats in the parent.

[After Le Souef and Burrell.]



The Oceanic Angler Fishes  
by  
GILBERT P. WHITLEY.

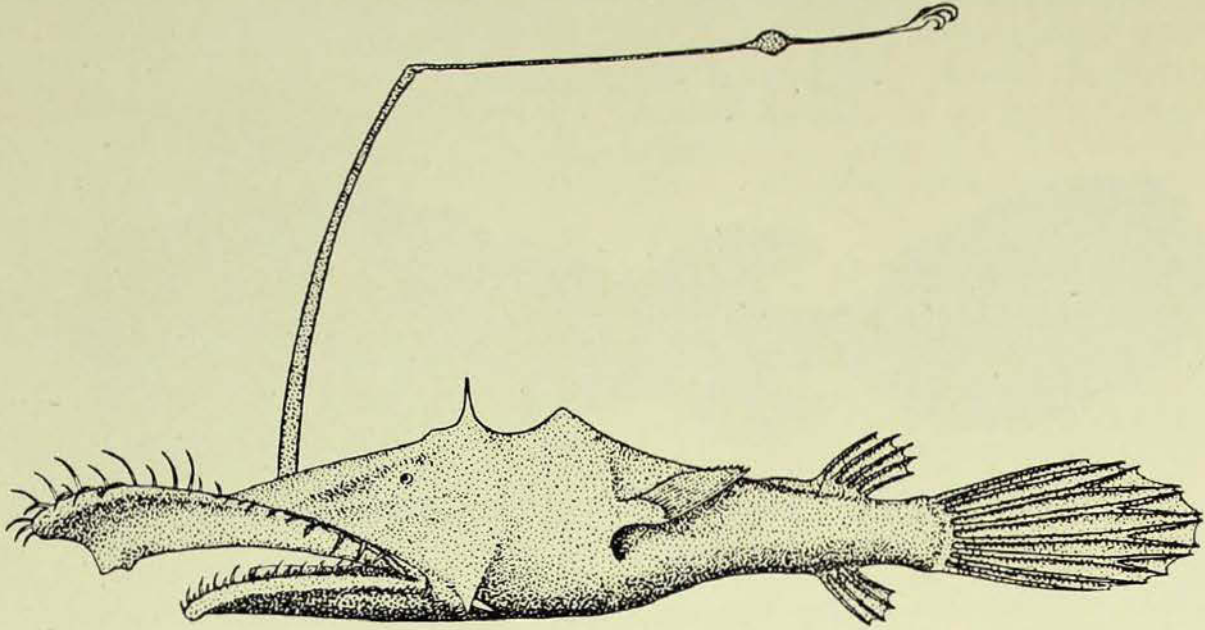
THE strangest fish story in the world, yet one which is perfectly true, is strikingly illustrated in the Oceanic Angler Fish group, the latest addition to the fish gallery of the Australian Museum.

Most people are familiar, from books if not by experience, with Angler Fishes,<sup>1</sup> which are distinguished from all other fishes by having the first spine of the dorsal fin placed on top of the head and modified into a kind of fishing-line and bait. Most of them live on the bottom in shallow or moderately deep water, and resemble in colour the ground on which they lie or the rocks and weeds amongst which they lurk; their bait is a flap or tassel at the end of the fishing-line, or filamentous first dorsal spine, and is flicked to and fro to attract their prey within reach of their jaws. In these inshore species, the males do not differ very much in external form from the females. The highly specialized Angler Fishes shown here, however, are inhabitants of the open ocean, where they live in water from about 200 to 1,000 fathoms below the surface, some distance from the bottom, but where it is cold and quite

dark. They are generally small in size, with tiny eyes and black bodies, and the bait at the end of their fishing-line is luminous. One species, aptly named the Compleat Angler, even has its line extending beyond the bait and armed with hooks. The teeth are usually large and movable and the stomach so distensible that it is actually possible for these abysmal Angler Fishes to swallow and digest fishes larger than themselves.

The most remarkable peculiarity of the Oceanic Anglers is that, whereas the females are fairly normal free-swimming fishes, the males are dwarfed and attached to them as parasites. The habits and conditions of life of these fishes, solitary, sluggish, floating about in the dark depths, indicate that difficulty in finding a mate might be encountered. This appears to have been overcome by the males, as soon as they are hatched, when they are relatively numerous, seeking the females and holding on to them, when found, for life. The males first attach themselves by the mouth, then the lips and tongue fuse with the skin of the female and the two fishes become so completely united that it is impossible to say where husband

<sup>1</sup> See THE AUSTRALIAN MUSEUM MAGAZINE, Vol. III, 1927, pp. 103-107.



**The Complanet Angler.** This extraordinary fish (*Lasiognathus saccostoma*) is provided with rod, line, bait and hooks.

[After Tate Regan.]

ends and wife begins. The undersized male, sightless, without fishing line or lure, with toothless mouth closed in front so that he merely breathes through slits at the sides, and with his alimentary canal reduced to a vestige, is nourished, like an unborn baby, by the blood of the female. His only duty is to ensure the continuance of the species when the time comes for the eggs to be laid. One or more of these "portable bridegrooms" may be attached, upside down or otherwise, to various parts of the head or body of the female. Betrothed in infancy when almost transparent, these fishes become blacker in colour as they grow up, doubtless as the result of pigment deposition replacing normal kidney functioning. Some ichthyological Katherine Mayo seems to be required to set things right amongst these dusky fishlings! There is hope for some of them. Renouncing marital ties, males who fail to attach themselves to a female develop into a peculiar type of their own

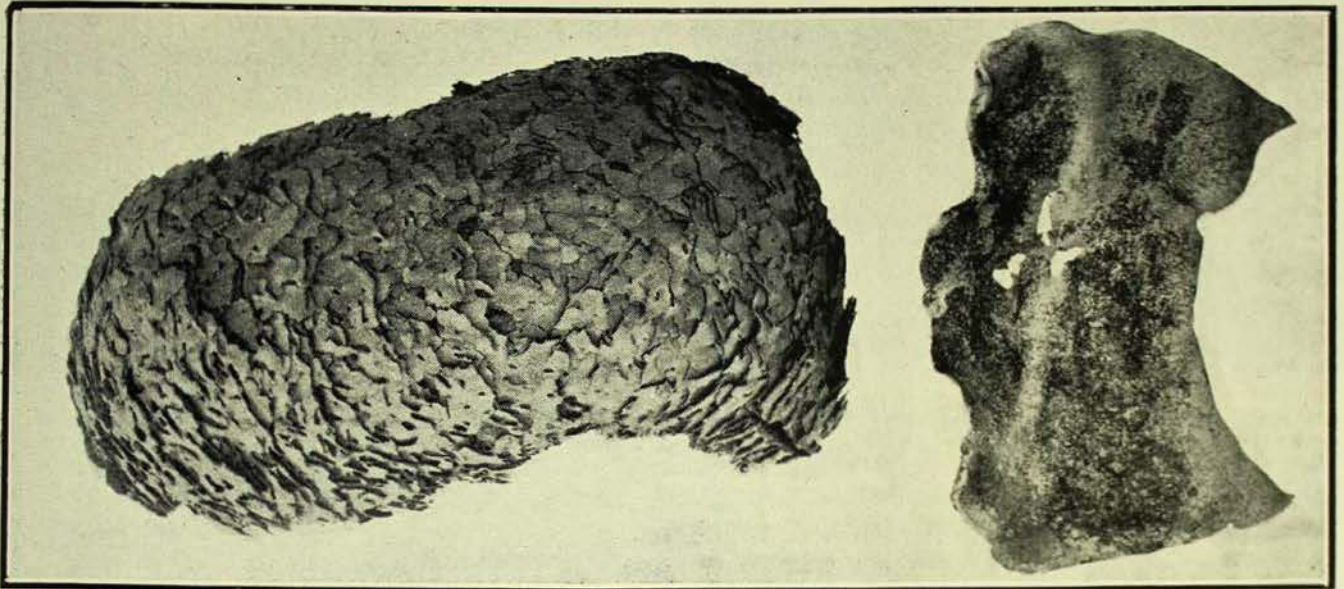
which has until recently been believed to represent a distinct family, the Aceratiidæ.

This extraordinary diversity of structure between male and female in one kind of animal is only comparable with that found in some of the lowliest sea-worms and barnacles. The deep-sea Angler Fishes are unique among backboned animals in having dwarfed parasitic males of this kind and unlike all other known creatures in having the males nourished externally from the blood-stream of the females.

In the group displayed at the Museum, and depicted at the head of this article, the largest exhibit is a life-size representation of an Arctic species, of which the dwarf male, a little over four inches in length, is attached to the body of a female ten times as long. The smaller exhibits show a dwarf male enlarged and sectioned to show its degenerate anatomy, which is fully explained on the labels accompanying them.

## Some Australian Wood-Destroying Insects

BY NANCY B. ADAMS.



Wood and lead damaged by "White Ants." The lead was eaten through to enable the termites to reach the timber framework.

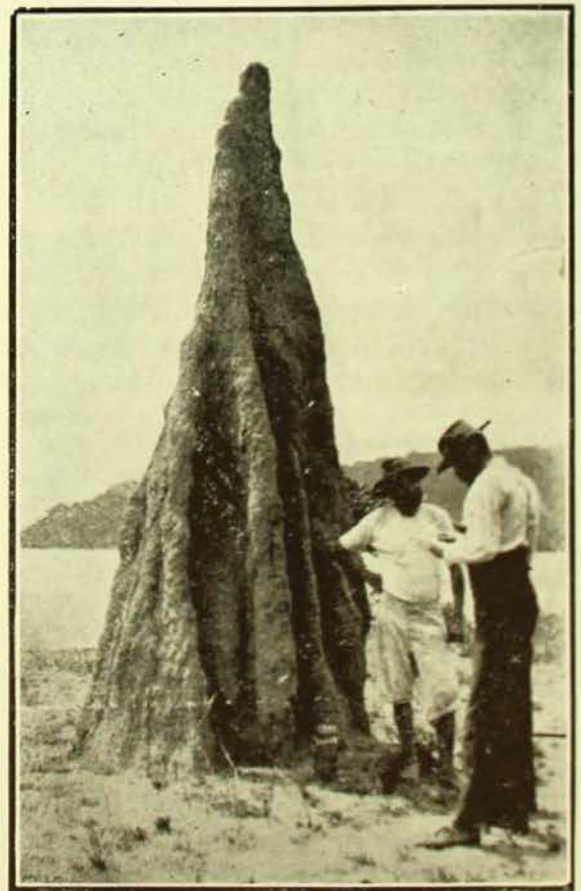
[Photo.—G. C. Clutton.]

THE subject of timber pests is of interest to every householder, as it is very often his lot to find some valued piece of furniture, or the woodwork of his home damaged by "white ants" or borers.

These little insects do not confine their attention to the seasoned wood found in buildings; some species are a continual source of anxiety to the timber merchant, since they attack living trees in the forest and green timber stacked for seasoning. The exigencies of space, however, will not permit of further reference to the latter section, and only those pests which concern the property owner will be described.

### TERMITES OR "WHITE ANTS."

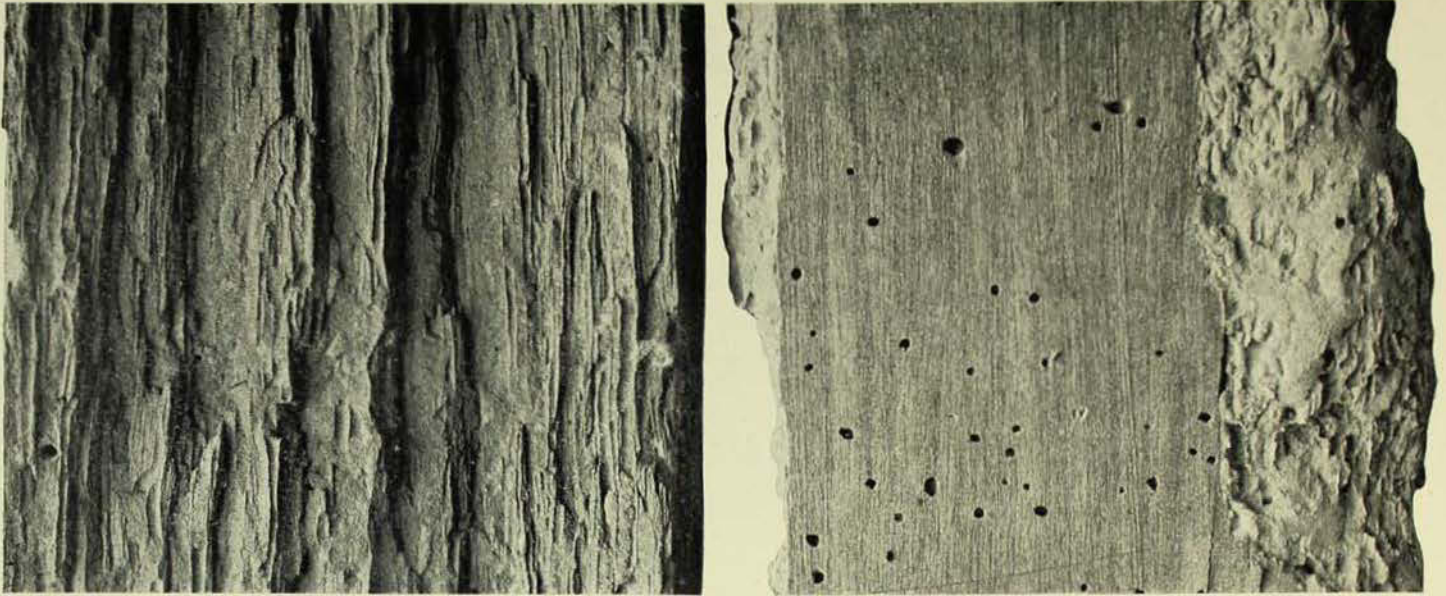
The most serious pests of timber are the Termites, popularly, but erroneously, known as "White Ants." The structure and habits of these remarkable insects have been described by Mr. A. Musgrave in a previous issue of the MAGAZINE,<sup>1</sup> and in this article it is proposed to deal only with their depredations.



Pyramidal Nest of *Eutermes pyriformis* at Cape York.

[Photo.—A. R. McCulloch.]

<sup>1</sup> Musgrave: AUSTRALIAN MUSEUM MAGAZINE, i, p. 11, 1921.



Wood damaged by the Powder Post Beetle (*Lyctus brunneus*). The left-hand section shows the crumbling interior; the right-hand one, the surface dotted with flight holes. [Photo.—G. C. Clutton.]

Termites may be divided roughly into two groups, Eutermes and Coptotermes. The former are bush termites and do considerable damage to railway sleepers, fences, and telegraph poles. Occasionally, usually in dry weather, they will attack living trees.

The members of the group *Coptotermes* are frequently found in buildings, where they destroy annually many thousands of pounds worth of valuable timber. These minute insects excavate beneath the surface of the wood wide flattened tunnels which run parallel to the wood fibres. There is no external trace of their ravages, and very often their presence is unsuspected until the thin outer shell of timber collapses.

Various preventive measures are now employed in the construction of buildings, the most important being the use of repellants and a resistant timber known as Cypress Pine.

Should an infestation be discovered, the following remedial measures may be carried out. First the nest or termitarium, from which covered passage-ways lead to the infected portion of the house, should be found; very often it is situated under the house or over an old tree stump. The nest should be destroyed and the soil near it saturated with coal tar creosote oil. In America termites' nests are sometimes located by placing thin pieces of

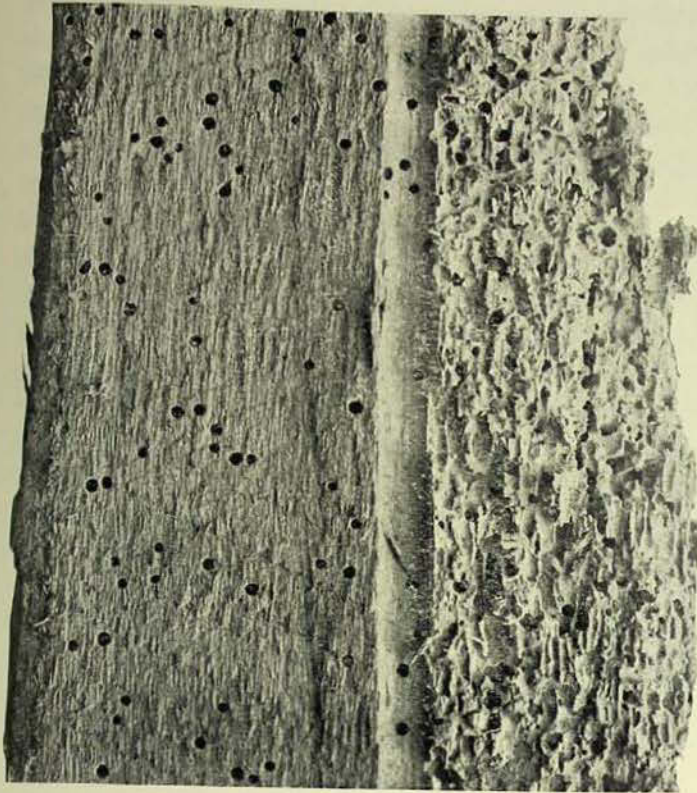
wood into the soil in several places. These sticks are pulled up and examined periodically for signs of termites. If the termitarium cannot be found the point at which the insects are entering the house should be located, and the soil and wood-work near the point of entry treated with creosote. Paris Green should be blown into the tunnels in the infested timber. If the damage is extensive the timber should be replaced either with Cypress Pine or treated wood.

#### THE POWDER-POST BEETLE.

Tiny circular perforations from which fine powder falls may often be seen on the surface of furniture and the wooden framework of houses. These holes are made by one of two equally destructive timber pests, the Powder-post Beetle (*Lyctus brunneus*), or the Furniture Beetle (*Anobium punctatum*).

The Powder-post Beetle, a cosmopolitan pest, is a slender reddish brown insect, which varies in length from one-eighth to one-fifth of an inch. The beetle deposits eggs in the pores of the wood, and, in a few days' time, from each egg a small grub or larva emerges and commences to feed. The larva constructs narrow tunnels, which run more or less parallel to the grain of the wood, and, as it bores its way through the timber, it leaves





Timber damaged by the Furniture Beetle (*Anobium punctatum*). Part of the surface has been removed from the right-hand side.  
[Photo.—G. C. Clutton.]

behind a mass of fine powder tightly packed in the tunnels.

The larva may carry on its work of destruction for several months before becoming full grown, when it burrows nearly to the surface and pupates. The pupal stage lasts for several weeks, at the end of which time the perfect beetle emerges from the pupal shell and bores its way to the exterior. The small circular perforations in the surface of infested timber are the emergence or flight holes of the adult beetles, and are the first indication of the presence of borers. These beetles may deposit eggs in the same timber or transfer their attention to sound woodwork. They die soon after emerging. Though the flight holes may be few in number the larvæ may have been working in the timber for a considerable time, leaving the interior a crumbling mass of powder concealed by a thin external shell.

The Powder-post Beetle confines its attention to the sapwood of Australian hardwoods used for furniture and the flooring and framework of houses. Owing to this fact little sapwood is now used in building construction. Rattan furniture

is often completely destroyed by the ravages of this pest, which is thought to have been introduced into Australia from the East in goods manufactured from this material.

If timber is badly infested it should be removed and replaced with resistant or treated wood. Usually, however, it is sufficient to treat the surface with creosote oil to prevent reinfestation; the oil may be applied with a spray or a brush. Small articles of polished or painted wood may be treated by injecting creosote into the flight holes with a small syringe. Though a very effective repellent agent, creosote stains light surfaces, so that, where discoloration is undesirable, a mixture of kerosene and creosote may be used. Kerosene or turpentine applied at frequent intervals will act as a deterrent. Paradichlor-benzene dissolved in kerosene is also advocated.

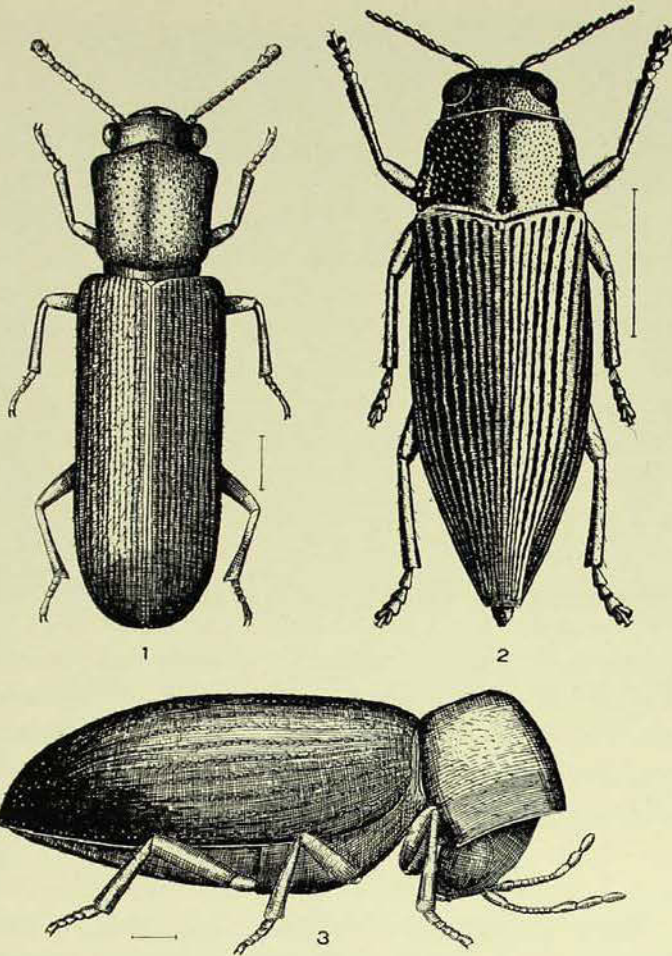
#### THE FURNITURE BEETLE.

The Furniture Beetle (*Anobium punctatum*) is a small dull brown insect about one-eighth of an inch in length, broader and more rounded in shape than the Powder-post Beetle. The prothorax or first body segment overlaps and hides the head in front and from the side looks like a little hood or bonnet.

The eggs are laid in cracks in the surface of timber and the larvæ burrow irregularly through the wood, riddling the interior with a network of tunnels. The adult beetles emerge from flight holes similar to those made by the Powder-post Beetle, and may be seen crawling or flying about the house from about October to January.

The Furniture Beetle has a decided preference for very dry well seasoned timber, and in England has destroyed many of the old and valuable wood carvings in churches and cathedrals. In Australia these beetles are often found in old houses and antique furniture. New Zealand white pine and other soft woods are also susceptible to attack, and articles of kitchen furniture are frequently seen riddled with little round holes.

The Death-watch Beetle (*Xestobium rufovillosum*), commonly met with in old houses in England, belongs to the same



1. The Powder Post Beetle (*Lyctus brunneus*). 2. The Hoop Pine Buprestid (*Prosphera moesta*). 3. The Furniture Beetle (*Anobium punctatum*).  
[N. B. Adams, del.]

family. These little beetles when burrowing through woodwork tap rapidly against the tunnel walls, making a distinct ticking sound. This call note, which is repeated at frequent intervals, has given rise to the curious superstition that the ticking precedes a death. The Death-watch Beetle is often found in the oak panelling of old houses. A few years ago the entire ceiling of Westminster Abbey had to be renewed owing to the depredations of this destructive insect. This species does not appear to have been introduced into Australia.

The remedial measures suggested for timber infested with Powder-post beetles will be equally effective for eradicating the Furniture beetle.

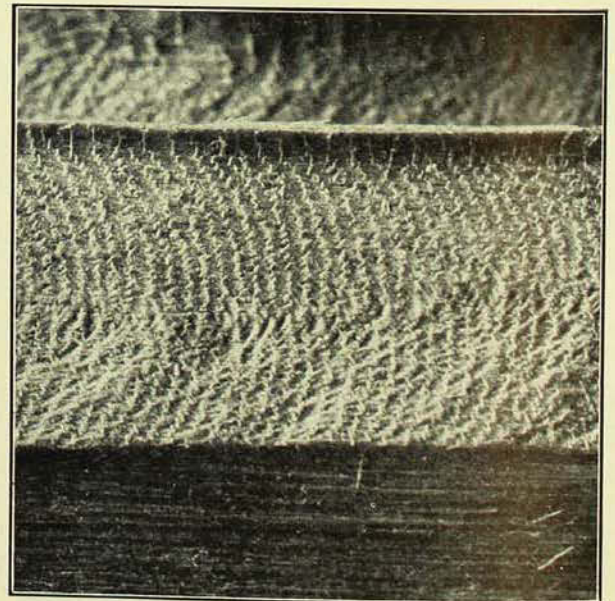
#### “SHOT-HOLE BORERS.”

“Shot-hole Borers” comprise several species of beetles belonging principally to the genera *Platypus* and *Xyleborus*. The commonest one, *Platypus omnivorus*, is a

small elongated cylindrical beetle, dark reddish brown in colour. These insects bore circular tunnels straight into recently felled trees or timber stacked for seasoning. Eggs are deposited in the burrows, and the adult beetles, as well as the larvæ, live on fermenting sap which forms a fungus on the walls of the tunnels. No actual weakening of the timber results, since the beetles leave the wood as soon as the sap dries out and the larvæ die in the burrows. When the pin holes made while the timber was seasoning appear in articles of furniture they are often mistaken for the emergence holes of wood borers, and cause unnecessary worry to the householder. The perforations made by “Shot-hole Borers” may be distinguished by the absence of powder, and often by a dark stain round the edge of each hole due to the presence of fungus.

#### OTHER TIMBER PESTS.

Borers which attack living trees cause great loss to the timber merchant but do not usually trouble the householder; Wood Moths and various species of beetles are the chief offenders. The adults deposit eggs in crevices in tree trunks, and from these eggs grubs or larvæ hatch and commence to tunnel through the living tissue. Some of these larvæ, particularly those of the Wood Moths, are large and



Section of a tunnel excavated by the larva of *Ambeodontus tristis* in New Zealand Rimu flooring (highly magnified).

[Photo.—G. C. Clutton.]

fleshy, and measure several inches in length. They may live for some years before changing respectively into the adult moths or beetles. Usually when the trees are felled the grubs die, but some species live for several years after the wood has been seasoned and used in the construction of buildings. An iridescent black Jewel Beetle, the Hoop Pine Buprestid (*Prospheres moesta*), has been known to emerge from large circular holes in the wall timber of houses. *Ambeodontus tristis*, a small long-horned beetle, was recently found crawling from the floor of a house. On removing the damaged timber the wood was found to contain several long tunnels the walls of which were marked

with delicate curved ridges gnawed by the larva. These occurrences are rare, the resulting damage is negligible, and the beetles will do no further harm.

For further details concerning these insects the reader is directed to the following articles :

C. French, junr., Furniture and Timber Boring Insects, *Journ. Dept. Agric., Vict.*, April, 1918; Charles J. Gahan, Furniture Beetles, *British Museum (Natural History) Economic Series No. 77* (Second Ed.), 1925; T. C. Roughley and M. B. Welch, Wood Borers Damaging Timber in Australia, *Technological Museum, Sydney, Bull. No. 8*, 1923; *Dept. Agric. N.S.W. Insect Pest Leaflets No. 17*, Gurney and Woodhill, White Ants; Wood Borers, *Dept. Agric. N.S.W. Insect Pest Leaflets No. 21*; W. W. Froggatt, Forest Insects of Australia; Forest Insects and Timber Borers.

## Notes and News

Dr. H. Lyman Clark, of the Museum of Comparative Zoology, Harvard University, Mass., arrived in Sydney on 22nd March to continue his researches on Australian echinoderms. On the 31st he sailed for Lord Howe Island, accompanied by Mr. A. A. Livingstone, of the Australian Museum staff. Dr. Clark regards Lord Howe Island as an important part of the Australian region, so far as the study of the Echinodermata and the marine fauna in general are concerned.

\* \* \* \*

Mr. Alan H. Coltard, M.A., of the Oxford School of Anthropology, visited the Museum in January and inspected the ethnological collections.

\* \* \* \*

In February, Dr. C. Anderson accompanied Mr. W. E. Schevill, of the Harvard Australian Expedition, to the Wellington Caves, where a representative series of the remains of the extinct marsupials found in the cave earth was made.

\* \* \* \*

Dr. J. S. MacKay, Honorary Conchologist, National Museum, Melbourne, who is specially interested in chitons, visited the Museum in March.

The President, Mr. F. S. Mance, and Professor W. J. Dakin, D.Sc., have been elected to represent the Museum on the Council of the Australian and New Zealand Association for the Advancement of Science at the meeting to be held in Sydney from August 17 to 24 of this year. Mr. E. le G. Troughton, of the Museum staff, who is Honorary Secretary of Section D (Zoology), will be glad to furnish information regarding the Section to anyone interested. During the meeting papers will be read and lectures delivered, and several interesting subjects for discussion have been suggested, such as "Biological Control of Pests," "Geographical Distribution of Plants and Animals," "The Evolution of Instincts," "Correlation of the Upper Palæozoic Floras and Faunas." Excursions to places of interest will be held during and after the meeting.

\* \* \* \*

Four lectures were recently delivered in the Museum to students of the Kindergarten Training College, namely, on "Fossils" and "Man's Ancestry," by Dr. C. Anderson, and on "The Australian Aborigines" and "Ancient Egypt," by Mr. W. W. Thorpe.

## Obituary

### ARTHUR MILLS LEA.

THE news of the death of Mr. Arthur Mills Lea, Entomologist of the South Australian Museum in Adelaide, came as a great shock to those who knew this energetic naturalist. For many years he has been an outstanding figure among workers in Australian Entomology, his colossal knowledge of the Coleoptera (Beetles) bringing him into touch with all collectors and workers of the group. To this great order, the largest of all the orders of insects, he devoted the labour of a lifetime, and long ago he eclipsed the record of the late Rev. Canon Thomas Blackburn, who had described 3,069 species of beetles. Mr. Lea, therefore, can be said to have described more Australian beetles than any man in the world.

He was born in Sydney, New South Wales, on August 10, 1868, and died in Adelaide on February 29, 1932, leaving a wife and three daughters to mourn him.

In 1892 he became Assistant Entomologist in the Department of Agriculture, Sydney. In 1896 he was appointed Government Entomologist to the Department of Agriculture, Western Australia, but in 1899 he resigned to become Government Entomologist in Tasmania. While filling these posts he was concerned principally with economic entomology, but on his taking over the position of Entomologist of the South Australian Museum, in 1911, his work became almost exclusively taxonomic. He was, however, Consulting Entomologist to the Depart-

ment of Agriculture, Adelaide, from 1911 till his death and, during 1924-25, he was on loan to the Fijian Government and carried out work on coconut palm pests. He had considerable experience as a collector in the field, and had collected in every State in Australia, as well as in Lord Howe Island, Norfolk Island, Fiji, Malay Peninsula, Java, Borneo, Celebes, and New Caledonia. It does not fall to the lot of every entomologist to have carried out so much varied work with such success in both economic and taxonomic entomology.

He was a good friend to all entomologists, ever ready to assist in the identification of specimens and liberal in the bestowal of duplicates, while the tyro in the field of entomology found in him a sympathetic listener to entomological sorrows. From all parts of the Commonwealth those interested in entomology sent to him representatives of those groups with which he has long identified his name, such as Weevils (*Circulionidæ*), Cockchafer Beetles (*Scarabæidæ*), and Ants' Nest Beetles of all kinds, and which he described in the journals of scientific societies. In truth one may select as epitomising his life, a few lines which he once wrote in the autograph album of the wife of an entomologist, *viz.* :

“Beetles are my only care,  
Beetles, beetles, everywhere.”

A.M.

Dr. J. R. M. Robertson, who had been a Trustee since 4th July, 1913, died on 12th April, at the advanced age of eighty-eight. A short obituary notice will appear in our next issue.

During Easter week twenty-five members of the Junior Farmers' Club paid a visit to the Museum, and were conducted round the galleries by members of the scientific staff.

# The Way of the Wasp

## PART I.

BY KEITH C. MCKEOWN.

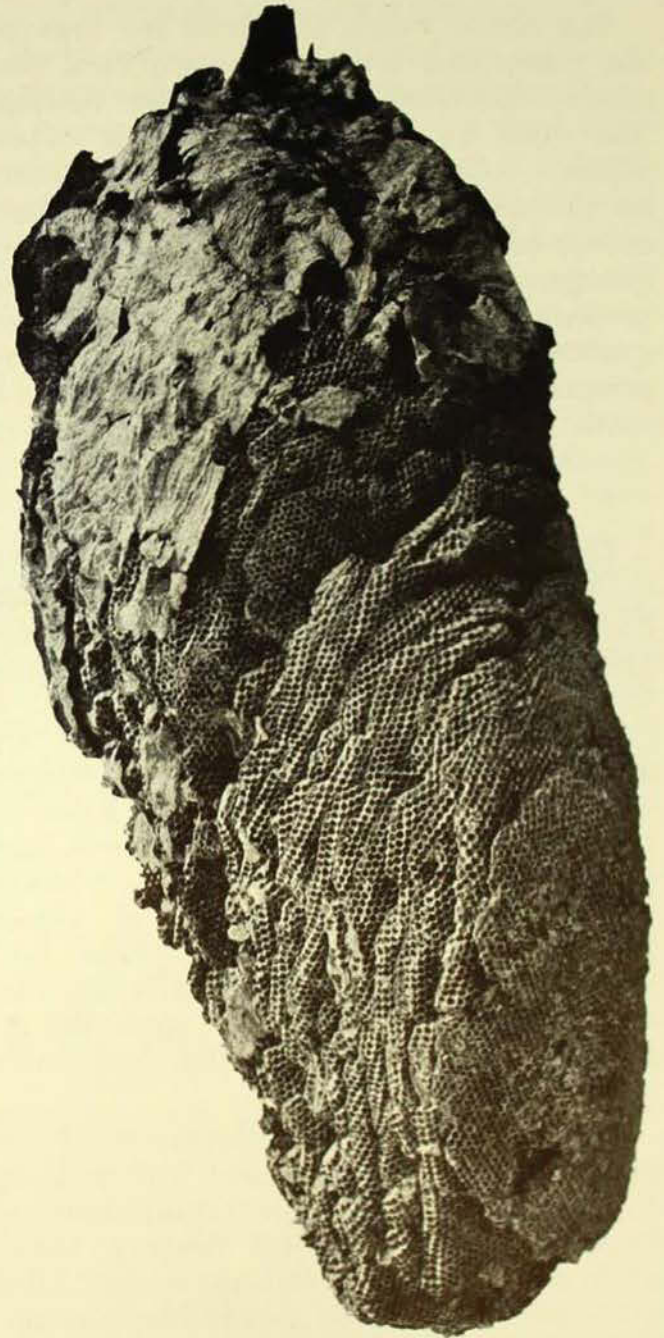
TO the average person wasps or hornets are only spiteful stinging creatures, to be avoided at all costs, but those who take the trouble to discover something of their ways will find themselves in a new and curious world, a world of strange life-histories and still queerer habits, a world bound to the wheel of routine, but in which one finds departures from that routine so unmistakably intelligent as to bewilder the imagination.

In spite of the interest of the study of the social and solitary wasps of Australia it is unfortunate that so much of the field is still unworked, and there are many species of which we know little or nothing regarding their life-histories and habits, and in no case is our knowledge as complete as in that of many exotic wasps. Australia still awaits its Professor G. W. and Mrs. Peckham, whose book *Wasps, Social and Solitary*, is a most fascinating record of the curious lives of many American species; there are few works of fiction that can compete with it for charm and interest. We also still await someone to follow in the footsteps of J. H. Fabre, who wrote so entrancingly of the wasps of France. Although many of his deductions are debatable, he stands unrivalled as an observer and recorder of the lives of insects.

In the present article it is proposed to describe briefly the habits of a few of our wasps, and to indicate, if ever so inadequately, the variety and strangeness of their behaviour.

### THE SOCIAL WASPS.

The true social wasps (Vespidæ) are represented in Australia by several species, all of which construct their nests of wasp-paper, a papier mâché of finely triturated wood-fibre mixed with saliva, which forms a stout but light building material; this is worked into a mass of hexagonal cells, and the completed nests range in size from



The large nest of the Gregarious Paper-Nest Wasp (*Rhopalidia cabeti*). Greatly reduced: the actual nest measures about two feet in length.

[Photo.—G. G. Clutton.]

about six inches in diameter in the case of *Polistes*, to a couple of feet in the communal homes of *Rhopalidia*.

In the nests of *Rhopalidia* we find large numbers of females throughout the year,

in contrast to the members of the genus *Polistes*, in which the nest is founded by one female, or queen, and in which the other females or males do not usually appear until autumn. In the first mentioned colonies the social life is considered to be in a more primitive state than in the latter.

The larval wasps are cared for first by the queen and later by the workers, and receive individual attention and feeding. The food is usually masticated caterpillars. After the foundation of the colony by the queen the construction of further cells is carried out by the workers as they emerge, and upon them also devolves the protection of the community—and well qualified they are for the task, as many persons can bear witness who have inadvertently disturbed one of the nests.

#### THE SOLITARY WASPS.

The solitary wasps are mainly members of the families Psammocharidæ, Eumenidæ, Exeiridæ, Nyssonidæ, Bembecidæ, and Sphecidæ. They are diverse in their nesting habits, some being workers in clay—the Mud-daubers—while others are miners, constructing tunnels and galleries in the sand. They store their galleries with the paralysed bodies of insects and spiders as food for their larvæ, their insect prey ranging over a variety of kinds, lepidopterous caterpillars, crickets and grasshoppers, and beetles, usually weevils, each species of wasp usually confining its attention to one family, and frequently to one species of victim.

The mud nests are masterpieces of the builder's art; here we have frail pottery objects, resembling ancient amphoræ, so fragile that a touch will destroy them, while others are stout lumps of clay filled with cells, so hard that it requires considerable effort to destroy them, but even in the roughest of these the wall of the cell is plastered smoothly so that no harm can come to the tender larva through contact with the masonry. The burrows are usually enlarged into chambers, but here the larvæ must lie upon the rough soil of the excavation. The clay nests are formed of mud, possibly mixed with saliva, and the workers are adapted to the handling

of wet clay, while in the case of the burrowing wasps their legs are stout and hairy and well suited to digging in the soil. As their name "Solitary Wasps" implies, each individual female has her own nest and carries on quite independently of any others of her kind which may be in the vicinity.

The prey of the solitary wasps is usually reduced to a paralysed or comatose condition by stinging. With some insects one sting is sufficient to induce paralysis, but in others, where the nerve centres are more widely separated, several stings may be necessary. The object of this stinging the prey appears to be mainly to render the victim immobile so that the young larva may not be injured in its struggles, but also to ensure a supply of fresh meat to the growing wasp grub. It is considered that the venom injected by the wasp has a preservative quality, for it has been found that where insects have been stung, perhaps more severely than usual, and death supervenes, decomposition does not set in for many days. Other wasps do not sting their prey, but kill or induce paralysis by crushing the nerve centres with their jaws. This method appears to prevail where the food supply is renewed from day to day by the parent.

The egg is usually deposited upon the body of one of the victims, but with some species which store up caterpillars, sometimes imperfectly paralysed and liable to crush the young larva in their wriggling, the egg is suspended from the roof of the cell by a slender thread. The Peckhams describing such an egg write: "When the larva comes out the thread lengthens until the tiny jaws reach the food supply. Startle it ever so slightly and the waspling retreats by way of its web, descending only when everything is quiet. For twenty-four hours it retains this path to safety, and then growing bold, it drops down and feeds at its ease."

#### SENSE OF LOCALITY.

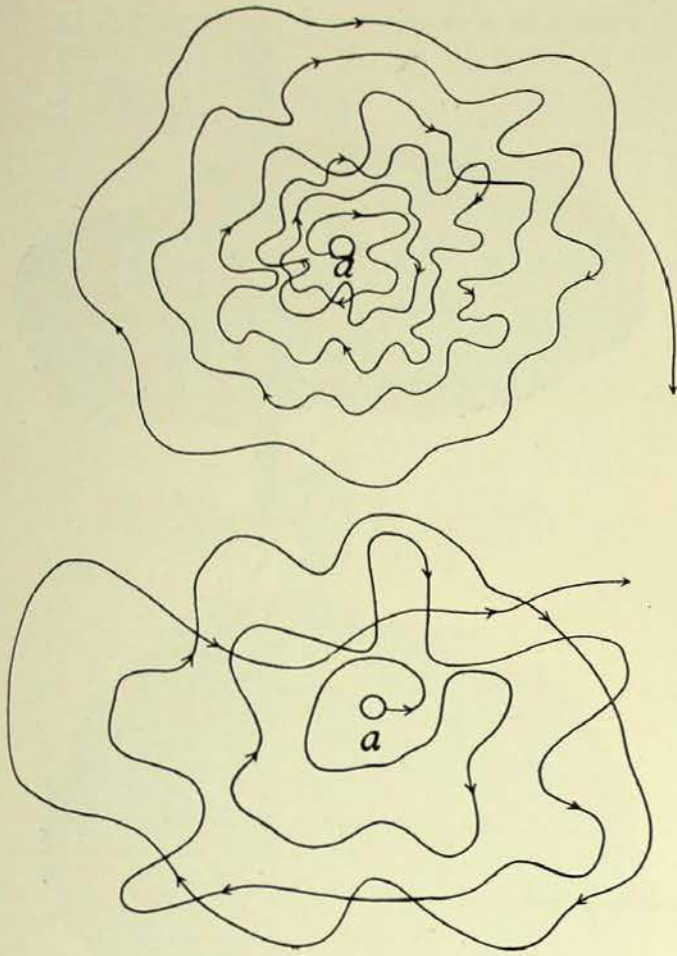
It was for long considered that wasps were possessed of some mysterious guiding sense which enabled them to find their nests unerringly, but careful observation shows that when she constructs a nest, be

found that the wasps went to it without hesitation and searched vainly for the nest entrance. This proves conclusively that wasps retain a memory of the surroundings of the nest and become confused immediately should they be altered to any great extent.

INSTINCT AND INTELLIGENCE.

A hard and fast distinction between instinct and intelligence would appear to be impossible; on the border line they merge into one another so that it is hard to say where one begins and the other ends.

Instinct in wasps appears to be a somewhat mechanical process, the insect going through a set series of actions in rotation, and should it by any means be thrown out of its regular routine it appears to be quite incapable of retracing its steps, but must continue from the point where it left off, however useless circumstances may have rendered that action; for example, if a mud-dauber wasp, which has constructed its nest and filled it with provisions, arrives back to find it empty of its contents, which have been removed in its absence, it will not re-stock the cell, but will deposit its egg in the ravished larder and meticulously close the entrance with a plug of clay as though everything were in order, before going on to construct the next cell in the nest. G. R. Dutt, who studied the habits of *Sceliphron madraspatanum* at Pusa, in India, once removed the cells of a nearly completed nest which only required covering with mud; the wasp had made two cells and had commenced bringing mud to plaster all over them



Locality studies made by a wasp (*Sphex ichneumonidea*). Upper: a thorough study. Lower: a hasty study. a indicates site of nest.

[After Peckham.]

it clay cell or burrow, the female makes a very careful survey of the locality, flying round and round in close circles until all landmarks are impressed on the memory. The importance of landmarks to the wasp has been proved by removing prominent weeds, stones, or other objects from the vicinity of the nest, and when they have been replaced some distance away from, but in the neighbourhood of the burrow, the wasp will carry on the search for the lost nest in their vicinity.

Experiments have also been carried out by placing sheets of coloured paper, with a hole in the centre so as not to obstruct the passage of the insects, over the entrance to a wasp's burrow: the wasps will at first become demoralized, but as soon as they have found the nest and become used to the paper, business will be carried on as usual. When the colour was changed confusion again ruled, and by placing the original coloured paper some distance away from the nest it was



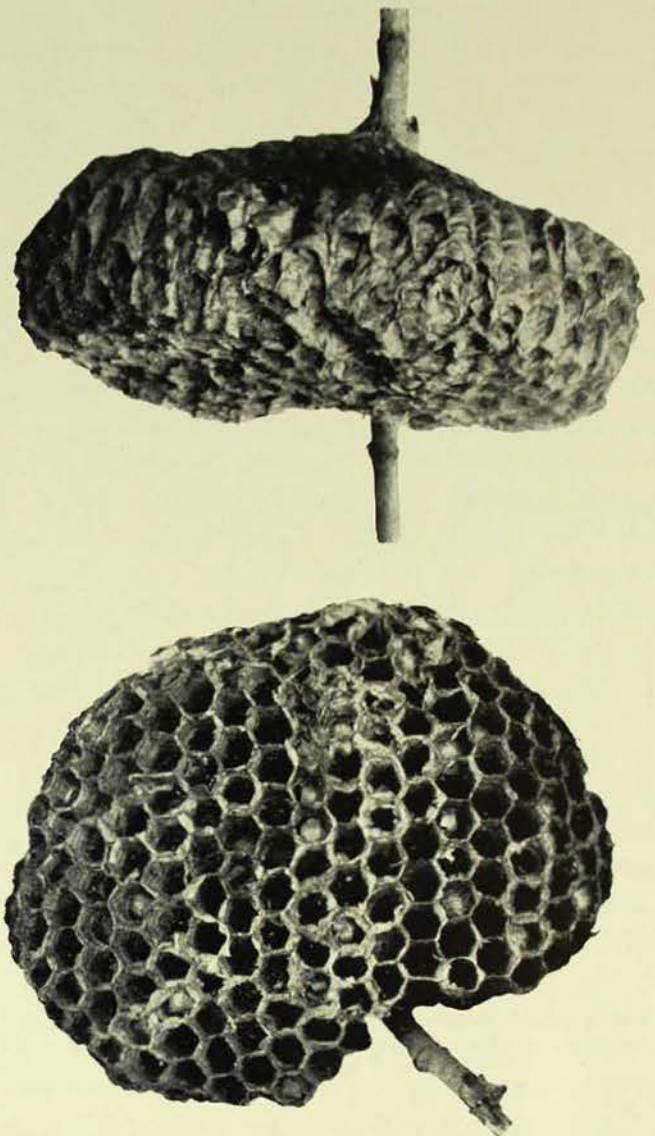
*Ammophila urnaria* using a stone to pound down the earth over her nest. Enlarged. [After Peckham.]

when this was done. She however continued to bring mud and to plaster it over the marks left on the wall until she had produced the same appearance as she would have had the cells still been there, apparently unaware that they had been removed.

Instances of what can only be interpreted as intelligence occur, however; the Peckhams describe and figure an *Ammophila*, a sand wasp, using a stone to pound down the earth over the entrance to its nest. Their description is worth quoting in full.

"In filling up the nest she put her head down into it and bit away the loose earth from the sides, letting it fall to the bottom of the burrow, and then, after a quantity had accumulated, jammed it down with her head. Earth was then brought from the outside and pressed in, and then more bitten from the sides. When, at last, the filling was level with the ground she brought a quantity of fine grains of dirt to the spot, and picking up a small pebble in her mandibles, used it as a hammer in pounding them down with rapid strokes, thus making this spot as hard and as firm as the surrounding surface. Before we could recover from our astonishment at this performance she dropped her stone and was bringing more earth. We then threw ourselves down on the ground that not a motion might be lost, and in a moment we saw her pick up the pebble and again pound the earth into place with it, hammering now here now there until all was level. Once more the whole process was repeated, and then the little creature, all unconscious of the commotion she had aroused in our minds—unconscious, indeed, of our very existence, and intent only on doing her work and doing it well—gave one final, comprehensive glance around, and flew away." This curious action has also been observed and recorded by other eye-witnesses.

Perkins, quoted by Sharp, says that in West Africa cockroaches are stung by an *Ampulex* and placed in confinement in some such spot as a key-hole and in one case the victim was apparently prevented from afterwards escaping by the wasp carrying some heavy nails into the key-hole.



Nests of Paper-Nest Wasp (*Polistes variabilis*). Above: side view showing method of attachment. Lower: View from underneath showing cells. Reduced: the actual nest measures about six inches in diameter.

[Photo.—G. C. Clutton.

These two examples only, selected from many, prove that a wasp is capable of deviating from its usual routine and making use of what can only be regarded as intelligence.

#### THE PAPER-NEST WASPS.

The paper-nest wasps are perhaps the best known of the Australian members of the family, probably from the fact that by their aggressiveness and the potency of their sting, they force themselves upon one's notice.

The commonest of these wasps are *Polistes variabilis* and *P. humilis*, both yellowish-brown species distributed throughout Australia. They both construct an umbrella or mushroom-shaped





Paper-Nest Wasps (*Polistes variabilis*).  
Enlarged.

[Photo.—G. C. Clutton.

nest suspended from its support by a thin stem. The female or queen wasp overwinters in some sheltered position, such as a crevice in the hollow trunk of a tree, and when awakened from her sleep by the warmth of spring, this sleeping beauty builds a nest consisting of a few cells only, of material which she scrapes from the weathered surfaces of fence posts or tree trunks with her strong jaws, and, mixing these wood fragments with saliva, forms a tough cardboard-like papier mâché which is ideal for her purpose. In each of the hexagonal cells she deposits an egg, and when these hatch the mother's work really commences, for the larvæ have to be fed with the masticated bodies of caterpillars or spiders, with perhaps a little honey or other regurgitated food. When fully fed the larvæ spin a silken cap over the mouth of the cell and pupate. When fully developed, wasps emerge, and from this time forward the queen's duties resolve themselves into egg laying, for the newly emerged workers now attend to the work of the nest, feeding the young and the construction of new cells. As the colony expands new cells are added to the edge of the old nest, until, in the case

of large colonies, it may measure up to six inches in diameter. The population of a wasp nest consists of the queen and numerous workers, and, later in the season, males and females which will pair in the autumn, the males then dying and the fertile females hibernating, as their mother did before them, to found fresh colonies in the following spring.

These wasps are excessively pugnacious and, should one approach the nest, every wasp will face in the direction of the intrusion, and stand upon tip-toes, as it were, ready to attack on the slightest provocation—or sometimes without it! Owing to their pugnacity their study offers considerable difficulty, unless the nest happens to be favourably situated outside a window, where the observer has a pane of glass or a gauze fly-screen between himself and the wasps; under these conditions their study becomes a fascinating one.

Another curious paper-nest wasp is *Rhopalidia gregaria*, a small black and yellow species which constructs long slender, cock's-comb- or finger-like nests attached to the support by a slender stem at the widest part, from which the nest gradually tapers; these nests may attain a length of up to six inches. A closely allied species is *Rhopalidia cabeti*, which makes great masses of combs, each parallel to the other, and suspended from the roofs of caves or from the stems of trees. Such colonies must contain enormous numbers of individual insects; the colonies are perennial, and contain a large proportion of females, and there is no special individual which could be designated as the queen. This stage of development of society in these nests is considered to be primitive.



The small Gregarious Paper-Nest Wasp (*Rhopalidia cabeti*). Enlarged.

[Photo.—G. C. Clutton.

## In the Haunt of the White Hawk

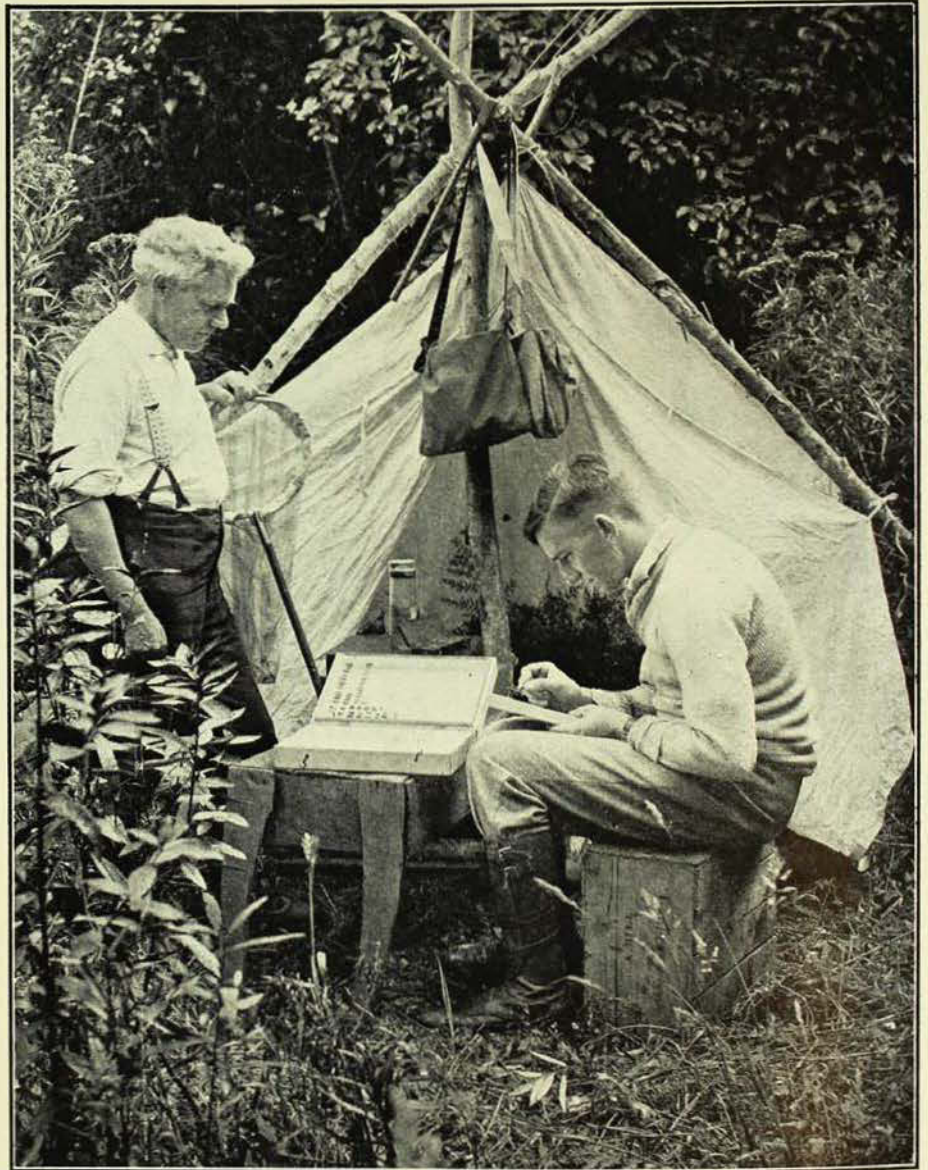
WILD NATURE OF THE OTWAY FOREST.

By CHARLES BARRETT, C.M.Z.S.

UNEXPLORED country in Victoria is hard to find, but there are areas that are almost unknown zoologically. We went to the Otway Forest country, whose fine roads are familiar to thousands of tourists, with great expectations that were realized. For a large portion of the Otway is forest reserve, and from Turton Pass, a favourite way for motorists, one looks down into gullies which remain today as they were when the first tree was felled in this wild region.

Every day we left the open road to ramble or break a trail through tracts of "undiscovered" country. We went where the tourist never goes, and penetrated into nooks and corners that belong so exclusively to wild nature that man is an utter stranger among their age-old ferns and still more ancient beeches.

This Otway country is a home of the White Hawk, a bird of prey which looks too beautiful ever to tinge its beak or claws with blood. A glorious form, moulded in snow and given life and wings, it might be the spirit of the Otway wilds, as it goes swiftly high across a gully or hovers between the sky's unclouded blue and the green of a foliage sea far under. No memory of our excursion is more deeply etched than this, the White Hawk on the wing above some unspoilt gully.



"Setting." Mr. Pescott pinning his day's captures in a store box. The author, standing.  
[Photo.—John Clark.]

Some ornithologists regard this bird as a sub-species, but it may be only an albino. There are two forms of the Grey Goshawk (*Astur novæ-hollandiæ*), the one grey-plumaged, the other white—our snow-bird of the Otway. The range of the species is wide—from New Guinea to Tasmania; but, at least in its Victorian

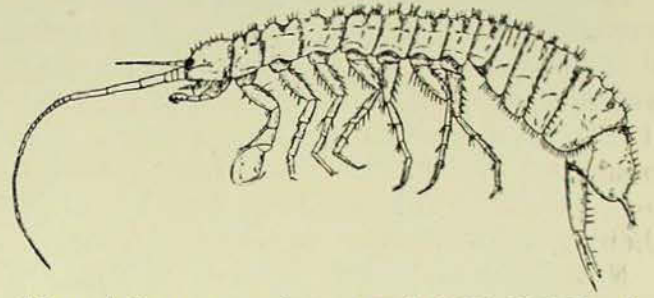
haunts, the white form is a rarity. A grey bird will mate with a white one; as happens, also, in the case of the dimorphic Reef Heron (*Demigretta sacra*), though the two forms, one blue and the other white, have been regarded by a few bird students as specifically distinct.

Our party was chiefly entomological, the trip to the Forest having originally been planned for one man only. The Director of the National Museum (Mr. D. J. Mahony) was sending Mr. John Clark, entomologist, into the Otway wilds to collect insects and other "small deer" for the Museum. Mr. R. T. M. Pescott (Entomologist, Department of Agriculture), took advantage of a good opportunity, as also, at Mr. Clark's invitation, did Mr. F. E. Wilson, the well-known Melbourne naturalist, and the writer of this article. Mr. Mahony himself joined us later, and spent a week in the wilds.

Our headquarters was a picturesque old hut, belonging to the Forestry Commission. Within cooee of a fairly busy highway, it yet was secluded. We might have been at the heart of the Unknown, in "Tiger Snake Camp." But fancy could deceive only at night and while there was no traffic on Turton's Pass during the daytime. Yes, we were justified in calling ourselves zoological explorers, since we collected in many spots where no naturalist had been before us. Results are the proof of this claim. The Museum has been enriched by thousands of specimens, and among them will be many types when the collections have all been worked out.

#### ANTS NEW TO SCIENCE.

John Clark is the recognized authority on Australian ants, and I have been in the field with no keener entomologist devoted to a specialty. My friend has a genius for finding new species. While I discovered one novelty, among the emmets, or ants, his record was nearly a score! Perhaps the Otway has been his richest field of discovery in eastern Australia; in the west he found a host of new ants. Besides their interest as undescribed forms, these Otway ants are intriguing—some, not all—by reason of their close relation-



**Phreatoicus**, a curious crustacean restricted to southern Australia, Tasmania and New Zealand.

[After Geoffrey Smith.]

ship to certain New Zealand species. Mr. Clark's theory, which makes the Dominion's invertebrate fauna a relic of the ancient Australian fauna, receives support from his gleanings among the ants in the Otway Ranges and their neighbour lowlands. These ant-links between Australia and New Zealand, too, are in favour of Wegener's drifting continents hypothesis. But I am getting beyond a field naturalist's depth!

Still another link must be mentioned. It is in the form of an ugly, fascinating, crustacean, of which I was lucky enough to find three specimens on the evening of our arrival in camp. Going to the creek to fill the billy, I overturned a rotting log. The billy was dropped, and down on my knees in the damp I went, with a call to Clark: "Come at the double." Three plump, dirty-white creatures, not unlike, in the faint light of evening in the gully, the grubs of a giant cockchafer, were the first fruits of our "expedition."

*Phreatoicus*! I knew them at once, because I have browsed over the fresh-water crustacean field, and had the privilege of visiting the haunts of rare Victorian species with Professor G. E. Nicholls, of the University of Perth, Western Australia, a leading authority on the Syncarida and other groups. In Australia, we have two families of fresh-water crustaceans which, to quote Dr. Nicholls, are peculiarly interesting—the Phreatoicidæ and the Janiridæ. With the latter, small isopods, I am not at present concerned, though the quaint little *Janirilla pusilla* is found in association with *Phreatoicoides*, an inhabitant of the Otway region.

*Phreatoicus*, like some other freshwater forms, is a "living fossil," a survivor of "the ancient crustacean fauna once widespread in the southern hemisphere." It was almost thrilling to look upon these creatures, so unlovely in themselves, to see them in what has been the haunts of their race for, maybe, millions of years!

New Zealand has three species of *Phreatoicus*, all being blind, subterranean animals. In Tasmania the genus, represented by several species, is commonly found associated with still more primitive forms—Syncaerids. In the year when the Great War began, a species of *Phreatoicus* was found in South Africa, upon the summit of Table Mountain. Our odd-looking friend, whose first appearance caused a billy full of water to be spilled, has an assortment of allies, you see, in several countries, and is notable in more ways than one.

In deep, moist Otway gullies and also in the fairly hard and dry ground on the spurs of the range, we collected many examples of *Phreatoicus*. It lurked, too, among filmy ferns, moss, and hepatics. A burrowing creature, it has, at least in many cases, little pools at the bottom of shafts in the soil. We had to dig for some of our specimens.

*Peripatus* was reported to be plentiful in the Otway, but though searched for every day, was not discovered until we had been in its haunts for a week. Then, the "bag" consisted of three specimens only. This wonder animal, which might be mistaken for a caterpillar by the uninitiated, is among the most elusive of living things. Where it really is not rare, the collector may obtain very few specimens, search how he will. This is my experience in Victoria, and may not apply, for instance, in Western Australia. *Peripatus* is puzzling. It was regarded by Guilding, who established the genus, over a century ago, as a mollusc, and its antennæ are rather slug-like. But what of the animal's many "legs"? It is liberally provided with paired appendages, each with its pair of claws, and all as alike as two peas. The jaw-claws, by the way, in their essential points, are similar to those of the feet. But a whole page would be needed for a detailed description of

this anomalous, lowly-organized creature, sluggish and beautiful, with velvety skin and eyes which are gems. A girl might envy *Peripatus* its "complexion"! There's a lovely bloom on the skin of this Arthropod, which has features unique among the Arthropoda and claims thereby inclusion in another group—the Worms. *Peripatus*, as Sedgwick expressed it, "stands absolutely alone as a kind of half-way animal between the Arthropoda and Annelida."

Can you wonder that we devoted long hours to the quest for a creature so distinguished? My first *Peripatus* was discovered by chance. It tumbled from a handful of golden-green moss which I was sieving for minute land shells and ants and fairy beetles of the sorts that frequent moss. Its skin was delightful to see and to touch, softer and more beautiful than velvet. No other creature in the world has a skin of finer texture than that of the lowly link between two groups of the animal kingdom.

#### LURE OF THE LAMP.

At night, the big white sheet of canvas was outspread, in the forest, on the highway, or on the upper slope of a gully. A 300 candle-power lamp was placed on the sheet, and around this lure the entomologists crouched. Pill boxes and phials by the dozen lay handy to each insect hunter; but, on most evenings a few would have sufficed.

If insects were plentiful in the shadows, they resisted the lure of the light, all but a sprinkling of small moths and beetles, lacewings and the like. This night collecting was a failure, until camp was moved down into the settled lower country. But, as a mere observer, I enjoyed it, where the roadway winds through Beech-land and the Country of Tree-ferns, nearly ten times taller than a man. The beauty and mystery of the gullies was enhanced by a square of canvas and an oil-burning lamp! Commonplace objects may act as a wand, and open a window on romance. Late travelling motorists were mystified when they saw us on the roadside one night. What could five hatless men in camp garb be after, kneeling or squatting

around a lamp on a sheet; all intent on—nothing? Perchance we were regarded as holiday folk at a foolish prank, or devotees of some new religion! That we excited wonder is certain. There are still hosts of people quite ignorant of entomological collecting methods; still many who haven't a notion why insects should be collected at all.

Some men are so lacking in appreciation of Wild Nature that they destroy life for "sport" or for "fun." That glorious white hawk is in danger whenever it comes into view from the roadway or any place frequented much by man. It is likely to be shot. I have seen the snow-plumaged form suspended from a branch, or lying, red-stained and crumpled, on the ground. Gaoi should be the price of such "sport"; but the vandals are too wary or too lucky to be caught in the act.



**Lure of the Light.** A posed picture showing method of luring insects at night. The lamp is 300-candle power. [Photo.—Chas. Barrett.]

#### LIGHTS OF FAIRYLAND.

"Did you see the glow-worms down at Turton's?" a farmer asked me one morning, when I went to the "Post office" for our mail. "There's heaps of them along the roadside." Well, not until we had been in the district for over a week did the glow-worms favour us with a performance of their only play, "The Lights of Fairyland." The stage setting was delightful. Where a tink creek flows from the gloom of musk-trees and beeches and ferns, to splash down a rock face three feet high and spread through a miniature frog-marsh, at the place where tourists rest and boil the billy, we saw, towards midnight, the fairy lamps gleaming amid filmy ferns and moss.

The effect was enchanting. I have seen fireflies in the tropics and among the palms of northern river brushes in New South Wales. The glow-worms of the Otway gave a display not less beautiful than those produced by firefly beetles (species of *Atyphella* and *Luciola*). Many specimens were taken, and Mr. Wilson hopes to breed out flies from the larvæ which shone their lights at the "Billy Creek" on Turton's Pass. The full life history of few species is known, I believe.

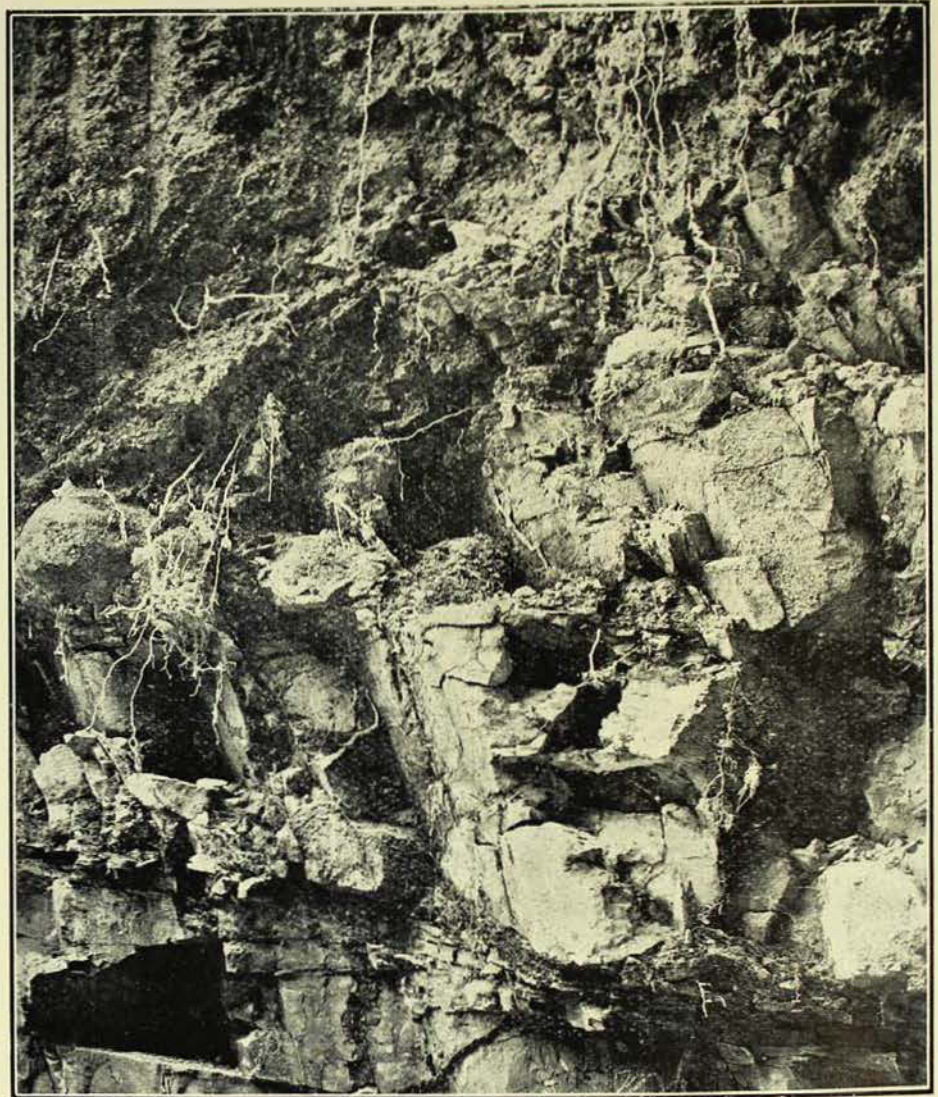
Our glow-worms, "grown-up," are dainty two-winged flies, members of a small group of the family Mycetophilidæ (the fungus-gnats and shade-midges). There are, according to Dr. Tillyard, one hundred Australian species and two

hundred and twenty-five forms in New Zealand, of these gnats. The glow-worm species are included in the *Diadocidinae* group. The Otway species probably is undescribed. The "worms" are slender and elongate, but very small. They spin webs, which gleam with beads of moisture—perhaps spray drops from the falls near their "stage." Webs, over the moss or in little crevices of the damp rock, to which the larvæ are attached, and where they make agile movements and glow! It is one of the prettiest sights in the bush. Did it not impress even a matter-of-fact potato farmer?

We were not the only tenants of the old hut, originally built by timbercutters. It is seldom used nowadays by the Forestry people, but has animal visitors or permanent tenants of many kinds. On the first night, I was wakened by a gliding movement beneath my bed of bracken on the floor. A snake or a large lizard, possibly the former, for we had reason to name our headquarters "Tiger Snake Camp." Copperheads as well as Tiger Snakes are plentiful in the Otway country.

Next, Wilson was aroused by a small animal pattering across his forehead. Nightly we heard little noises and had glimpses of a rodent's head, peering at us from nooks and corners over the fireplace and along the upper walls. Finally our fellow lodger was captured, and proved to be an allied rat (*Rattus assimilis*). There was a family in the hut; we heard the queer, almost musical squeaking of the baby rats when they were being fed.

Thoreau, at Walden Hut, had more kinds of wild animal callers and tenants, but none more interesting than ours at the Otway camp. Among the birds was



Where the Glow-worms give their fairy-lamp display.

[Photo.—Chas. Barrett.]

the Olive Thickhead or Whistler (*Pachycephala olivacea*), whose song was everyday music. It is rare to meet with many of these birds, at least in Victoria. There were scores of them around the hut.

Balanced on the mid-rib of a tree-fern frond, swaying gently in the gloom of a gully, was the daintiest bird home imaginable. A pair of Pink-breasted Robins (*Petroica rodinogaster*) had selected this site for their nest, a cup of green moss "cemented" with spider's-web and snugly lined with fern-frond down. Externally it was ornamented with silvery-green and blue-grey lichens. This is the second recent record of a Pink Robin's nest in Victoria. The species is rather rare, and confined to Victoria and Tasmania. Though loving the wild fern gullies, unvisited by man the year round, these robins leave the Forest when winter comes, to live in lightly-timbered country. Many make

Geelong district their winter quarters, and may often be seen in the larger city gardens. This was the case, some years ago, and Geelong may still be favoured.

Where the glow-worms spin their webs, we found, on a shelf of the rock, a nest of the Flame Robin (*Petroica phænicea*), a species which ranges from New South Wales to Tasmania. This nest, formed of soft bark, and decorated with spider's-web and moss, from the logs round about, was only five feet above the marshy ground. In Tasmania, I have found many Flame Robin nests in somewhat similar places and along high-banked roadways.

We came here at night, to the billy-boiling spot, in quest of frogs, which were plentiful. I noted four species, among them being the quaint little *Crinia signifera*, one of the commonest frogs in Victoria, and familiar, also, around Sydney. In the deep gullies very few frogs were discovered. I had faintly hoped for a new species, in this (zoologically) little-known part of the State, but was disappointed. We did, however, obtain specimens of that typical Tasmanian froglet *C. laevis*, or rather, one of its varieties.

Professor F. Wood Jones, of the University of Melbourne, is at present making a study of Australian frogs, and has many live ones under observation, including the splendid green Tree-frog (*Hyla carulea*), not uncommon in garden ponds, in Sydney. Our specimens were captured for the Professor, and so were kept alive. Tobacco and jam tins served well as temporary prisons.

As food for the captive frogs, I coveted some of Wilson's crane-flies, but the entomologist was careful of his "Daddies"!

Since I sent a small collection of crane-flies to the great American authority, Dr. C. P. Alexander, some years ago, interest in these insects has been shown by several Australian entomologists. Foremost in collecting and studying the group is Mr. F. E. Wilson. He has the finest collection in the Commonwealth, including many types. He has discovered over a hundred new species, and worked out the life histories of several.

In the Otway Ranges, Wilson col-

lected about forty species of "Daddies," some being undescribed.

Many of the Otway Tipulids are very interesting, but numbers are similar to forms common in the eastern ranges of the State. Individually, the insects are very abundant, but the species are less numerous than anticipated in such a district as the Otway, with its heavy rainfall. However, we were collecting during an exceptional period of dryness—a month without rain in those ranges is almost a record.

Of the four hundred (approximately) described species, the life histories of barely half a dozen Australian crane-flies are known. In an almost impenetrable gully, where one of the Otway streams rises, Mr. Wilson found the larvæ and pupæ of *Austrolimnophila munifica*, one of our larger crane-flies a handsome insect with black blotches on its transparent wings. The larva lives in, and feeds upon, the bark and rotting wood of stumps or logs. The pupal cases were found clinging to a log. The life history of the species is now recorded, for the first time.

Among beetles new to science in the Otway collection is a longicorn. It is probable that at least ten beetles, including several tiny weevils, will prove to be undescribed.

As botanist of the "expedition" (I was cook, too, on occasions) I devoted attention mainly to mosses and liverworts, lichens and ferns. In Otway gullies grow several of the rarer ferns. The Black Tree-fern (*Cyathea medullaris*), a monarch of fernland, has been recorded from the Otway Ranges, but one is lucky indeed to find it there, and will not see it elsewhere in Victoria. In New Zealand, of course, it is a familiar species, attaining a height of more than sixty feet, and bearing fronds over thirty-six feet in length. Its range embraces New South Wales and Tasmania, Asia and Polynesia.

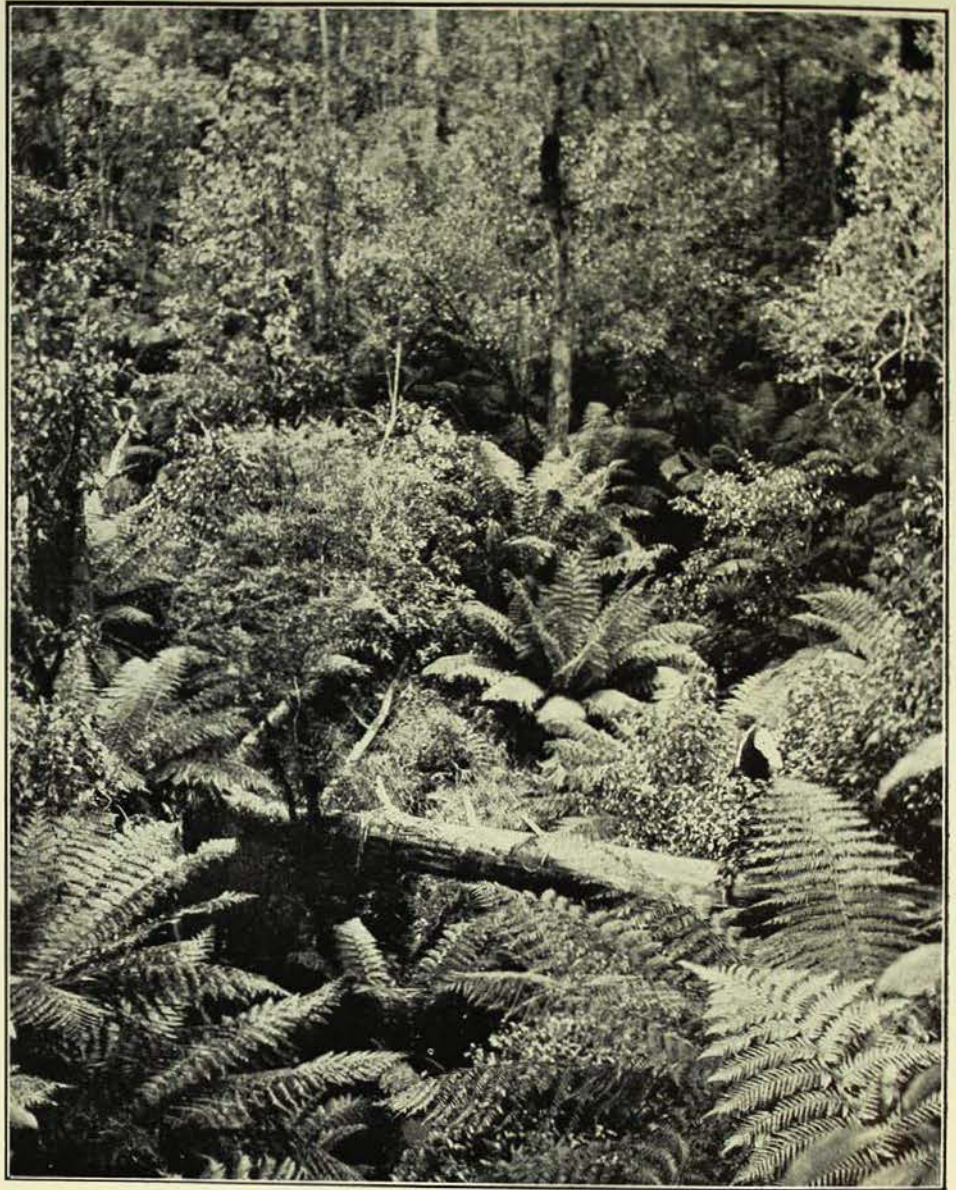
Of the Slender Tree-fern (*C. cunninghamii*) we saw numbers, during our rambles and scrambles in the gullies. Some examples were over forty feet in height, yet their stems were barely four inches in diameter. The Slender Tree-fern deserves its popular name. In New Zealand, where

it often is termed the "Maori" Fern, this species is common; it grows abundantly, also, in Tasmania. In Victoria it is classed among the rarer ferns.

Among the midgets I found the Rare Filmy Fern (*Hymenophyllum rarum*), growing on tree-fern trunks. It is a lovely thing, with pendant fronds, on capillary stalks. This dainty species is associated with the Baron von Mueller, prince of Australian botanists, who collected specimens at Apollo Bay (now a favourite holiday resort, which attracts thousands of city folk to the Otway country). In the Baron's day a trip through these ranges was an adventure.

Victoria's haunt of the White Hawk has a lesson for unwise governments to learn—if a government is ever teachable as regards forest conservation when the land is desired for closer settlement. Many years ago large areas of the Otway Forest were thrown open for selection, and magnificent stands of timber, chiefly Mountain Ash (*Eucalyptus regnans*) were destroyed. A heritage was wasted. Today, hills and valleys are desolate. Bracken has conquered where noble trees, for centuries, owned the soil. Settlers were ruined—after they had ruined the forest.

While agriculture flourishes over wide areas, and more settlement in the Otways is advocated by the Lands Department, forestry officers deplore the effects of an early Government's policy, and are keen to hold what they have in this region and to enlarge the reserves. Naturalists are with the Forestry people, and every attempt to encroach on the forest areas produces vigorous protests. Surely timber is of more value than crops of potatoes,



An unspoilt gully of the Otway. Man has not marred this Masterpiece of Nature.

[Photo.—Chas. Barrett.]

in a realm of our noblest tree. Happily, apart from the forest reserves, there is one of over 3,000 acres, known as Mount Sabine Reserve, which is safe from spoliation. The Turton's Pass runs through it, and in its glorious fern and beech tree gullies we did much of our natural history work. This is the part of the Otways that visitors from other States should see. It is easily accessible by motor-car from Melbourne, or by rail to Beech Forest and a short road journey from that township to Turton's Pass. I commend the Otway Ranges for an ideal holiday. No place in southern Australia has more of interest and beauty to show a nature lover than this haunt of the wild White Hawk.



## Snails

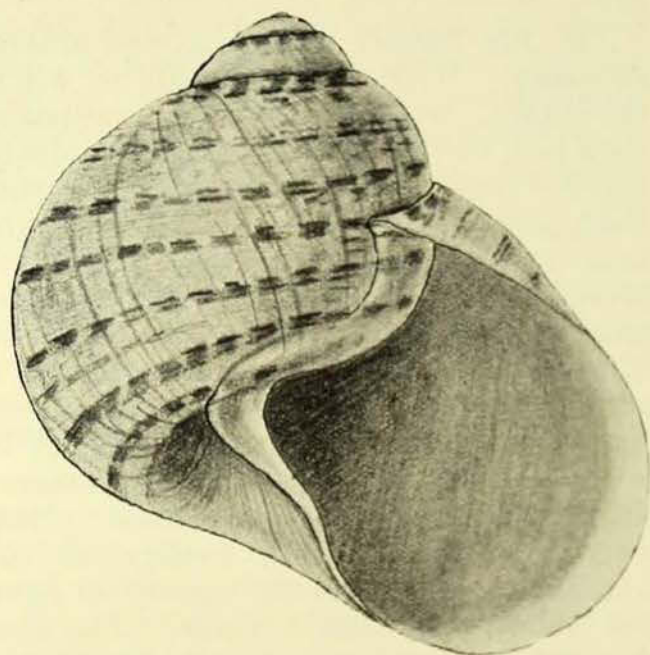
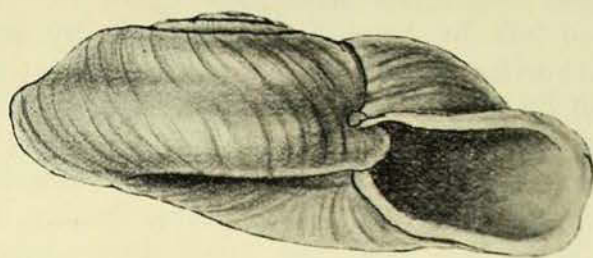
BY JOYCE K. ALLAN.

Snail is a worm of slime, and breedeth of slime, and is therefore always foul and unclean; and is a manner snake, and is an horned worm, and such worms be gendered principally in corrupt air and rain.—Bartholomew (1535).

FROM the above quotation, it is seen that snails were not regarded as shells by the earlier writers; on the other hand, for a time some even considered them insects. However, we now know that they belong to the molluscan kingdom, although differing from the sea-shells in that they are terrestrial air-breathers.

They are distributed all over the world, and in common with most molluscs are larger and more brightly coloured when living in the tropics. The handsomest of the tropical ones live on trees, those patronizing the ground being usually drab and lacking lustre. Two of the largest land-snails in the world are found in northern New South Wales and southern Queensland. One of these, the Giant Snail, a typical snail in shape, over three inches high, usually hides away in dry weather in nooks at the base of giant fig trees; the Scrub Turkey is its greatest enemy. The other, a solid, very flattened, almost circular shell, is found under dead leaves and stones or buried in clusters in the earth. It may be as much as three inches broad, yet its corresponding height is only one inch. The aborigines round Port Curtis use the sharp edges of the broken shell of this snail to polish their spears, boomerangs and waddies.

Almost similar in habits and life history, the different species do not vary to the great extent that many in other families do. If one kind is studied, it gives a very good idea of the history of all the other land snails, and a few remarks on their habits and life cycle generally will not be amiss. Snails have the sexes united, are vegetable feeders, though they do not refuse animal substance when necessary, and are found in woods and gardens, old walls and wood-work, on mountain sides, by fresh water,



Two of the largest land-snails in the world are found in Eastern Australia. Above, a circular flattened species (*Pedinogyra cunninghami*) with one of its eggs, and below the Giant Snail (*Hedleyella falconeri*). Slightly reduced.

[Joyce K. Allan, del.]

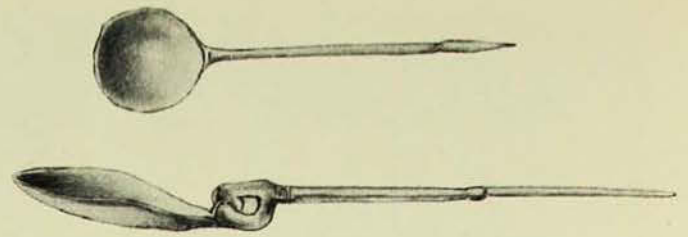
and even on open plains. Usually they are nocturnal in habit, but they do emerge and wander about in moist weather, during rain, or when it is about to fall.

The snail animal is large and slug-like, drab in colour with a tough and granulated skin, and locomotion is performed by gliding along on a foot, broad anteriorly, tapering to a tail posteriorly. A long pair of very sensitive tentacles bearing

eyes on their apex is carried anteriorly, with an inferior pair of tentacles below them. The whole body is covered with an exudant slime, and given off from the mantle of the animal is a filmy substance which seals the mouth of the shell, excluding an over-abundance of air, and thereby preventing unnecessary evaporation. The slimy appearance of the snail probably protects it from the attacks of birds and small mammals who feed upon it. The trail left by them is considered by some authorities to indicate a homing instinct, and by its means the snail is able to forage far and wide for food, returning to its sheltered abode after the hunt. Whether this is true or not I am unable to say, but it is certain that the snail does show a more advanced state of intelligence than most molluscs. A spiral shell, within which it can completely withdraw, protects it.

The life history shows a well-ordered existence. With the first colds of winter the snails, which have been preparing for a long fast by feeding copiously, cluster together, become sluggish and cease eating. Each one then burrows down into a suitable hole dug by itself and lined with dead leaves and slime, and closes the upturned mouth of the shell with a calcareous lid. Thus protected until the warm weather of spring, the snail performs no further body functions. It then comes to life, the lid is thrown off, and growth recommences. Eggs are laid in early summer. These vary in number, from twenty to one hundred according to the species of snail, but about fifty is an average. The snail digs a hole with its foot, and the whitish eggs about the size of a pea, are laid in clusters in it. Each is enclosed in a chalky shell, upon which the baby snail is supposed to make its first meal when hatched, between twenty to thirty days later. The shell covering the baby snail, whose growth at this stage is very rapid, is at first transparent, delicate, and horn-coloured, but soon hardens in the air. By autumn it is quite large and well-nourished, and after a year or two reaches maturity.

As far as is known, snails live for about eight years, but conditions under which they live may lengthen their life. It is



**Roman silver spoons (Cochleares) found in England. The spoons were made of bone, silver or other material and were sharpened at one end to pick the snail out of the shell.**

[Joyce K. Allan, *del.*, after Taylor.]

known, however, that as far back as 1774, some "white snails" after being in the cabinet of an Irish collector for at least fifteen years, came out of their shells when put in warm water, and in 1850, after a long sleep of four years in the British Museum, an Egyptian Desert Snail "re-lived." An experiment after this was tried with other snails imported to that institution from Egypt, and they awoke after six years sleep.

Where the English and European winters are so severe, the hibernating of snails is a great safeguard against the cold. In the tropics, where the seasons are divided into practically dry and wet, the snails are liable to reverse their period of activity and inactivity, and hibernate in the summer and wake in the winter, as any sign of moisture or rain will bring them out, or when any rainy season is about.

Though practically all snails are edible, some are more suitable than others, and it is about these and the common garden snail that this article is mainly written.

The Roman or White Snail, on account of its large size and suitability, has from the earliest times been the most popular. It is eaten in all European countries, particularly France, where the greatest numbers are consumed annually, in America and in England. Previously inhabiting the area round the Mediterranean, the snails were first used as food by the Romans over two thousand years ago, before the time of the wars between Pompey and Cæsar. When fresh countries were conquered by the Cæsars, the soldiers introduced their cultivation and a taste for them, into Switzerland and provinces round the Danube. The Romans reared the snails, gathered from the Mediterranean districts, in enormous quantities in moist

gardens or enclosures called "Cochlearia" or snail-farms. They fed them on growing vegetation and bran soaked in wine and other rich food, which not only fattened and enlarged them but improved their flavour.

The culture of snails was in the middle ages intensively carried on round Ulm, in the Province of Württemberg, and from this place millions were sent annually down the river to Vienna and Austrian convents, where they were eaten as fish during the Lenten season, as meat was forbidden. For this reason they are even now eaten in large quantities in that season, particularly in Catholic countries, and snaileries are established adjoining many monasteries and convents.

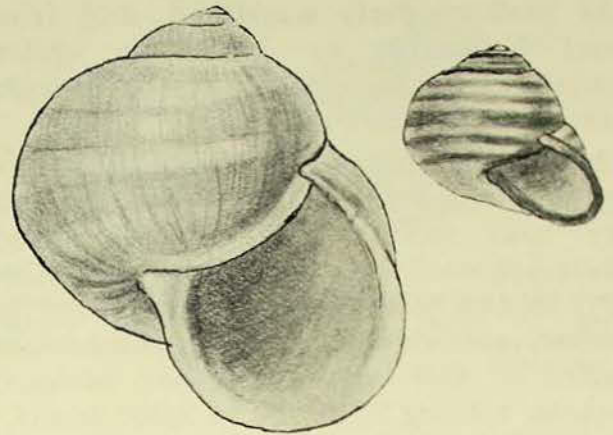
Snail diet was introduced into Paris in the 18th century, and since then snail-farming has been extensively carried on in that country. Wine merchants making yearly buying trips to Burgundy for wine, were obliged to stop at inns on the way where snails, gathered from the neighbouring vineyards, figured on the menus. Impressed with the tasty dishes, they returned home and aroused interest in them there, until a coach journeying between Auxerre and Paris was commissioned to bring the first baskets of snails to the latter place. Railways increased the demand for Burgundy snails, as they were called, and markets sprang up in Italy, France and Spain, where snail-farms became as common as in many of the Danube Provinces.

France appears now to have the monopoly of this trade, and millions of snails are reared there annually for home consumption and for export.

#### SNAIL FARMS.

They are grown in snail-farms or "Escargotières," selected plots of damp calcareous ground enclosed with smooth boards about a foot high, which penetrate the soil for some distance and have a shoulder to prevent the snails burrowing out. About 10,000 snails fill an area of 25-30 square feet.

Walks are made in the snailery, these being essential to scatter food, and clean the pens, as bits of food and moss become covered with slime and other things and



**The Roman or White Snail (*Helix pomatia*) has from the time of the early Romans been the most popular as food. The small brown-lipped wood-snail (*Helix nemoralis*) is considered by some to have a nicer flavour than other species.**

[Joyce K. Allan, del.]

may cause disease amongst the snails. During the hot weather they are sprinkled several times a day with water. They are fed at sunset, their strongly developed sense of smell enabling them to find the food at night when they are foraging. The arrangements of a snailery may vary, but the fundamental ideas are the same. Wire and wire-netting are sometimes used instead of boards.

The snails are gathered by local people in early spring in neighbouring woods, when they receive about 48-80 cents a 1,000, according to the condition of the shell. It will be seen, to them at least, it is not a very profitable business, and is one more suitable for children. They are placed in one half of the snail-farm, and about three months later are transferred to the other half, which has been divided into moss-covered squares, by boards a foot high. Their food is cabbage, lettuce, grass, herbs, fruit, potatoes and bran mash, and after three months of this diet they become very fat, large, and greenish in colour. They burrow from sight into the moss in the early autumn, with their mouth facing upwards and covered with a hard lid. It is in this state they are exported as they will keep alive and fresh for a considerable time. The closed snails bring a higher price (about 17 francs a 1,000), than the open, which have to be used at once. The slack season is between May and June, the best season commences in September, as by that time the snails

have been properly nourished, and from about November to April the under-nourished ones are sold mostly by grocers, wine- and pushcart-merchants.

About two hundred million snails are disposed of in Paris during a season, about fifty tons daily. They are sometimes taken out early in the season, stored on trays in cool warehouses, until wanted for market, and shipped in a dormant state, packed in well ventilated cases, sacks, or baskets, holding from 500 to 2,000 snails.

On account of their glutinous nature, snails are easily digested and are very nourishing, and for this reason rival the oyster, which they somewhat resemble in flavour. Like the oyster they are not eaten at every meal, but as an entrée to a dinner or as a single meal. In a good restaurant in Paris a plate of snails costs between 30 and 40 cents, and about 12,000 of the cheaper variety are eaten in a café during twenty-four hours.

Before being sent to market, some snails undergo preparation. Those from Burgundy are washed in flowing water, and 10,000 cooked at a time in salted water. The meat is removed, reduced to paste seasoned with finely chopped parsley, herbs, salt, pepper and anchovies, placed between thin slices of unsalted butter, and stuffed into the clean dried shells. The "Burgundy Snails" are then ready for market. Numbers ranging to 200 are shipped to private consumers and to 2,000 or more in wooden boxes to restaurants. All that is necessary when needed, is to heat them over a hot fire and the snail-meat is then picked from the shell with a two-pronged fork. They are never eaten without the addition of condiments, and a light wine usually is drunk with them.

In modern Rome snails are now hawked from door to door, and in other Mediterranean towns they are boiled with herbs in large iron cauldrons, in the main thoroughfares, where they are sold to the poorer classes. A large number are sent away annually from snail-farms in Tyrol.

Though the day is past when they could be expected to have this same popularity in England, they are nevertheless eaten in large quantities by the poor people, and a country lass was heard to remark :

"We hooks them out the wall in winter time not summer; and we roasts them, and when they are done spitting they be adone, and I loves them dearly." The small brown-lipped wood snail is the favourite in that country, and is considered more tasty than others.

In America the taste for snails has spread also, but although large quantities are eaten daily, the sale is restricted to the poorer and more crowded areas, and foreigners are the main purchasers.

Snails are at their best for eating during the winter, and before preparing should be freed of all slime. A few modern French methods of serving snails are here given.

*Snails à la Parisienne.*—Mix some finely chopped parsley and garlic with good butter. After removing the gut of the snail, replace it in the shell and fill the opening with the mixture. Cook for a short time in the oven, being careful not to allow the snails to turn over and allow the butter to roll out. Serve very hot. The gut is sometimes left in for flavouring.

*Fried Snails.*—Leave snails in boiling water for about ten minutes, until they can be easily removed from the shell. Let them stand in a mixture of equal parts of water and vinegar, flavoured with minced parsley, garlic, onion and shallot, cloves, thyme, and a bay-leaf. Drain, dry on a cloth, and fry in hot fat. Serve with garnish of fried parsley after draining on soft paper.

There are many other methods, varied by the addition of cream, yolk of eggs, red or white wine, or portions of veal and chicken, and imitation snail-meat is sometimes put on the market in old shells, when snails are out of season.

From earliest times, snails have been credited with excellent medicinal qualities, particularly in the treatment of consumption and various pulmonary disorders. A famous physician of Queen Elizabeth's time says that for the straitness of the lungs and cold cough, snails broken from the shell and sodden in white wine with oil and sugar are very wholesome. Another says, "for consumptive, take a spoonful of snail-sirup with everything imbibed." Snails are collected in the south of England for making a kind of soup for tourists for

this purpose. They are supposed to build up anemic and sickly people and in some countries are prescribed for ailments such as asthma, eye-trouble, rheumatism, eczema and for soothing the stings of insects. An old recipe says: "Snails which be in shell beat together with bay salt and mallows, and laid to the bottomes of your feet and to the wristes of your hands, before the fit cometh, appeaseth the ague."

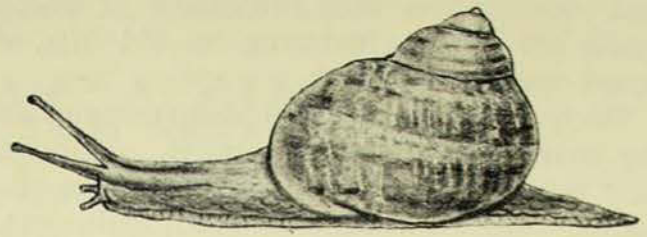
Lupton, in "Notable Things" [1595] says: "Snails without their shells, or otherwise with their shells stamped and mixed sometimes with cheeselope or rennet, do draw out thorns, or any other thing out of the flesh, though never so deep, if they be applied to the place."

The Roman Snail is used as bait for eels in France, and the slimy matter left in the shell after the animal is extracted, mixed with quicklime, makes a cement capable of resisting heat and humidity.

Though the market for the edible snails is so great, the rearing of them is not very profitable. The demand for the Roman Snail became so large, that the authorities in 1908 were obliged to enact a special close season in France, to prevent its becoming extinct.

#### THE COMMON GARDEN SNAIL.

Though almost as popular as the Roman Snail for food, the common Garden Snail is considered a foe rather than a friend by man. It is hard to forgive them for the way they work havoc in gardens and fern-houses, devouring the young plants and tender shoots. They are aided in this destructive work by a large oblong tongue carrying an enormous number of saw-like rasping teeth, sometimes as many as 20,000 teeth on a tongue. Smaller than the Roman Snail, the animal and its shell is so well known that a description is not necessary. From being an European species, this snail has spread, either accidentally or purposely, till it has now become almost world-wide, and, being highly organized wherever introduced, it has not only survived, but maintained a strong footing and increased enormously, until the combined efforts of man, birds, and other predators have been unable to



Regarded with much disfavour because of its ravages in gardens, the common Garden Snail (*Helix aspersa*) is eaten by the Belgians in preference to the Roman snail. [Joyce K. Allan, del.]

exterminate it. They live mostly in cultivated areas round dwellings, generally in gardens, and are very partial to old walls, creepers, roots of trees, and old fence palings. Excavations in the Carboniferous Limestone rocks in North Wales, have a striking likeness to the shape of this snail, which is credited with making them.

The Garden Snail is very strong, and it has been known to drag a load fifty times its own weight. The mucus track left in its progress is very pronounced and is made up of small patches instead of being a smooth line of slime. The homing spirit is well developed; it will journey a long distance, climbing high walls to search for food and will return by the same way to its settled home.

It is eaten in large quantities in France, Spain, and South West of England, and in Belgium is preferred to other species.

Years ago, slips of paper upon which this snail had crawled were sold for a penny each in London as a healing plaster for wounds, and in Yorkshire numbers were collected to manufacture a greenish ointment for curing corns. Necklaces are made by stringing them together, and these are sold in some English towns.

In Australia we can see how susceptible this snail is to drought and rain, and therefore it is difficult to form any definite opinion as to when they hibernate, as a sharp shower of rain will often bring them out, however dead to outside agencies they may appear. Mr. H. S. Grant, of this Museum, a keen gardener, tells me he notices that towards the end of summer and early autumn they are more numerous

and destructive, and numbers of baby snails are found clustering on old bits of board and palings.

There are many patent destructives on the market, which cause relief, although only temporary, if used in time before the rasping tongues commence their onslaught. A tame magpie round the garden is a great help, as practically all birds are enemies to snails, but a really good

exterminator is a Blue-tongued Lizard. These can be bought for a few shillings in the city, make excellent pets and are particularly fond of a snail diet, being able to root round and find both snails and eggs. An eye must be kept on them occasionally though, as like the pet tortoise they are inclined to journey into neighbouring gardens and re-appear streets away.

## Notes and News

During Bridge Week an exhibition was held in Science House, to which the Australian Museum, in conjunction with the Sydney Harbour Trust, contributed an exhibit illustrating the ravages of marine boring organisms. A report on the destructive work of molluscan and crustacean borers in Port Jackson, and suggested means of combating their attacks, has been prepared by Messrs. T. Iredale and F. A. McNeill of the Museum staff, in co-operation with Mr. R. A. Johnson of the Harbour Trust staff, and is now in course of publication. This report is the fruit of several years' observation and research by these officers, and already considerable benefit has been derived from suggestions made as a result of this work.

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During the Royal Agricultural Society's Show an exhibit of venomous snakes and spiders was arranged by Mr. J. R. Kinghorn of the Museum staff; country visitors to the Show were greatly interested in the exhibit.

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A case containing Birds of Paradise has been added to the Museum exhibits. This case has a background of black velvet, against which the brilliant colours of these beautiful birds appear to great advantage.

\* \* \* \*

Brigadier-General W. H. Evans, late of the Indian Army, a keen student of and high authority on the Hesperiidæ or

Skippers, a large and important family of butterflies, has been working at the Museum in co-operation with Dr. G. A. Waterhouse, Honorary Entomologist. They have been able to clear up many obscurities and difficulties which have impeded a clear understanding of this family, which is largely represented in Australia. On his return to England Brigadier-General Evans will work at the British Museum.

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The craze for goldfish and other aquarium fishes is now at its height, and some beautiful examples of fishes, water-plants and animals and aquaria were seen recently at the second annual exhibition of the Aquarium Society of New South Wales. Appropriately enough, the Technological Museum, Sydney, has just published "The Goldfish in the Home," by Mr. T. C. Roughley, an excellent and well produced brochure for which there is a great demand. The price is only one shilling, and it should be in the possession of every aquarist.

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Mr. J. S. Falkinder, Falmouth, Tasmania, who is keenly interested in Tasmanian and Australian stone implements, has been on a lengthy visit to Sydney, and has spent some time at the Museum examining the collections. From Mr. Falkinder we have at various times received valuable examples of Tasmanian stone implements.