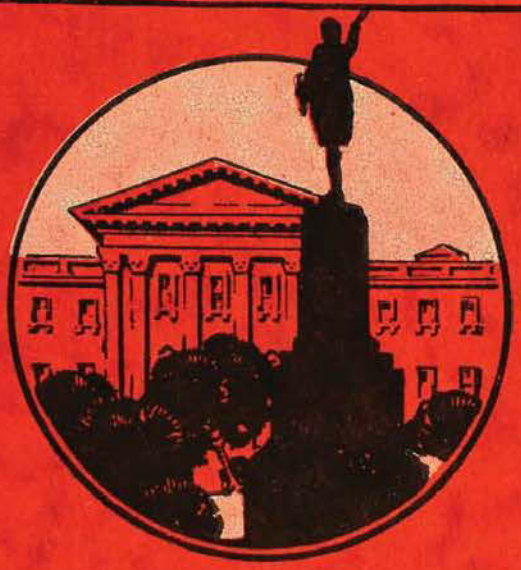
The AUSTRALIAN MUSEUM MAGAZINE

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



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A native of Wonar village, North-eastern Division of Papua, chewing the betel-mixture. He is using a plain wooden spatula, and his supply of Areca nuts is kept in a netted bag. His head-dress is very elaborate, his arms and legs are decorated with plaited grass bands, a Conus shell is on each arm, strings of Nassa shells encircle his neck, and a Melo shell is suspended on a string of Red-lipped Strombus round his neck. A bamboo pipe lies at his side. (*See* **"Areca, Betel and Lime", page 7.**)

[Photo.—*Captain Frank Hurley.*

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VOL. V, No. 1. January-March, 1933.

Our Native Slug

By Joyce K. Allan.

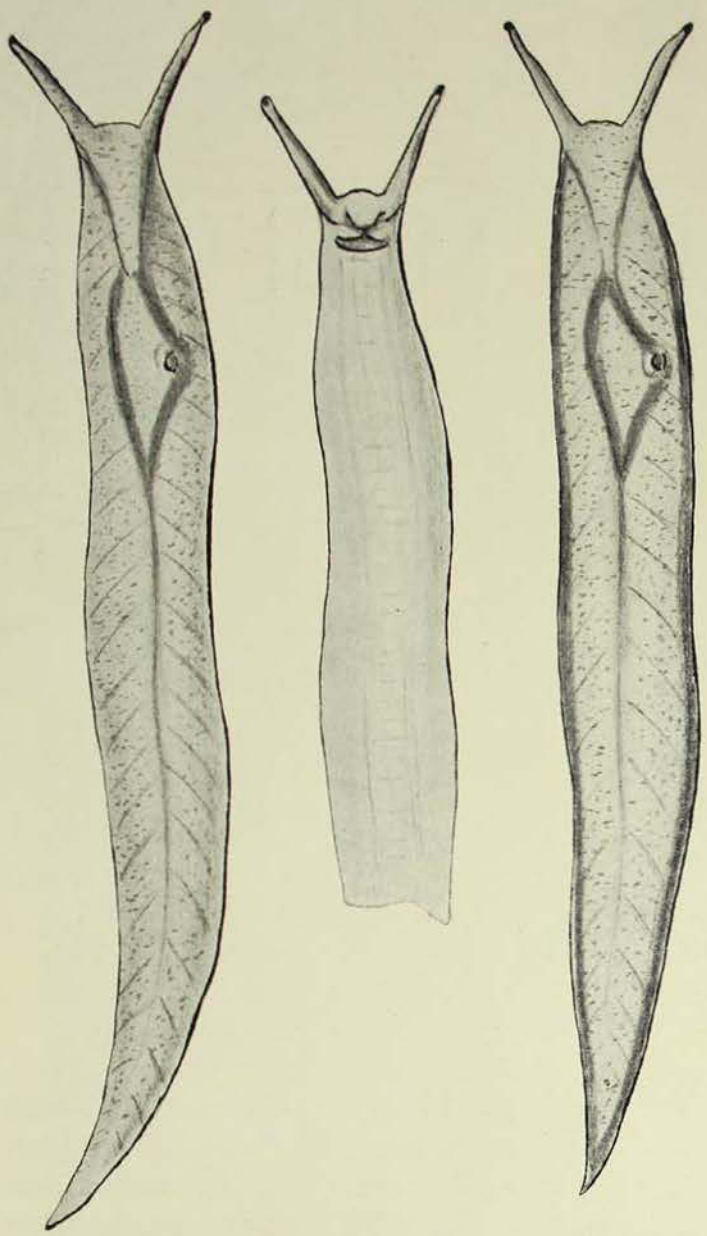
WHEN an enquiry concerning an unusual animal is made to the Conchological Department of the Museum, on observation the specimen is generally found to be either the Hammer-headed Oyster or the native slug of Australia.

This strange land-dwelling slug belongs to a group which contains the most curious forms found in the molluscan kingdom. Unlike any other land slug, it has only a single pair of tentacles, bearing eyes, no trace of the smaller pair being present, and for this reason it and its allies are generally known as Bitentaculate Slugs.

Little is known about the habits of these slugs and still less about their life history. They were first observed in the southern hemisphere as far back as 1827 by the two French naturalists, Quoy and Gaimard, who saw specimens on leaves of trees while their vessel, the *Astrolabe*, was anchored in Tasman's Bay, New Zealand. They instantly recognized by the single pair of tentacles that they were different from any other slugs, and took a specimen back to Paris with them, where it was examined and caused much excitement. Later other specimens were sent abroad from New Zealand and the Admiralty Archipelago; these were named, and now it is known that several different species of bitentaculate slugs occur in these localities.

In 1856, Dr. Macdonald, having found a form in New Hebrides which he recognized as quite different from the New Zealand one, wrote an account of it in the *Annals and Magazine of Natural History*, adding that he had just heard of the existence of an undescribed Australian slug which undoubtedly belonged to the same genus as his species. The New Hebrides slug was later named after him, *Aneitea macdonaldi*, by Grey, who also named some specimens from New Caledonia.

The first specimens of bitentaculate slugs to reach Europe from Australia arrived there a few years after the New Hebrides forms were named. These had been collected at Wollongong, a coastal



Two of the commoner forms of the native slug (Aneitea græffei). The general colour is brownish or yellowish green, with the triangular dorsal shield margined with bright red, as is the edge of the animal in the right hand specimen. The undersurface is shown in the centre figure.
[Joyce K. Allan, *del.*

town of New South Wales. They were called *græffei*, and this is the one now commonly occurring in New South Wales and supposed to be the same as the one found abundantly in Queensland.

It is not intended to discuss fully the anatomy of the Australian slug in this article. Superficially its most conspicuous features are the single pair of long, wide apart, retractile, eye-bearing tentacles and a well-defined triangular-shaped shield on the dorsal surface. The animal is typically slug-like, and assumes many different positions and shapes. When resting, it is usually flat, rounded in shape and about two inches long, with the tentacles either completely or almost retracted, but it is able to stretch to a great length, as much as five inches, when crawling, with tentacles well exserted and tail attenuated.

On the right side of the dorsal shield at the junction of the two slightly shorter sides is an opening, the pulmonary orifice, capable of considerable expansion. Through this orifice air enters the lung, which can be seen when the opening is fully extended. A well-defined median line runs from the base of the shield to the tail tip, becoming fainter as it approaches the end. The slimy wet appearance of the slug is due to abundance of transparent mucus, given off from the edge of the shield.

A groove arises on each side of the mouth at the anterior end of the slug, and passes round the base of the tentacles; these grooves gradually approach and meet each other, enclosing a facial area anterior to and equal in size to the dorsal shield. The grooves then separate and completely encircle the shield. Peculiar markings exactly like the veinings of a leaf cover the dorsal surface; as these creatures are so often found amongst leaves this marking may have a protective effect.

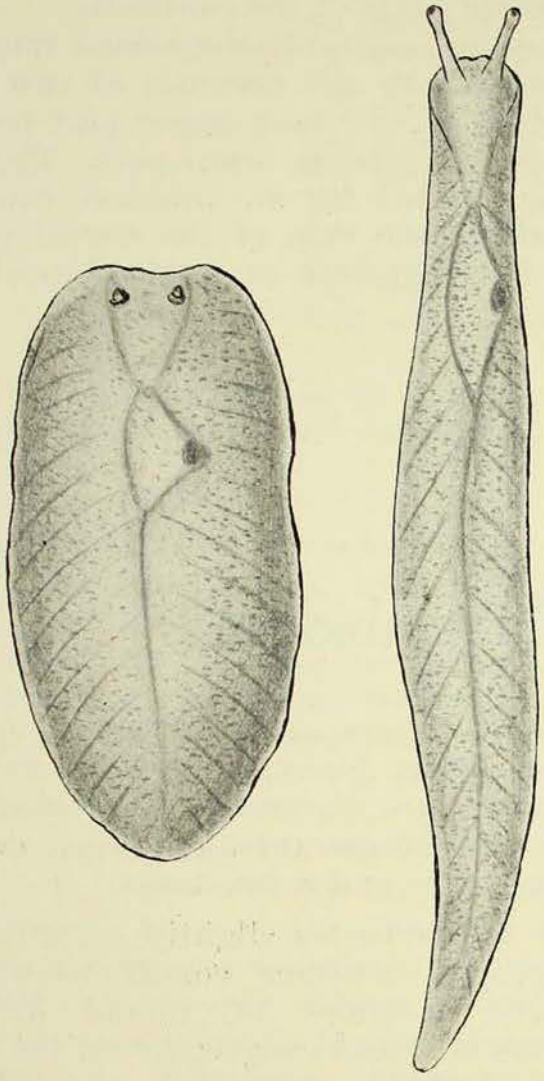
A shell is represented only by a few white calcareous fragments beneath the anterior end of the shield; there is no external shell as in the snail, and no complete internal shell. The slug has a very strong jaw imbedded in the mouth opening and a long ribbon-like tongue.

The colour seems to vary considerably in the Australian specimens, and it is doubtful whether we have a number of distinct species or only colour varieties. The typical form found round Sydney and suburbs and New South Wales generally, *Aneitea græffei*, varies from yellowish-brown to greenish-grey. The under surface is lighter yellow. A blood-red border outlines the dorsal shield.

I have seen specimens of this colour, but with a bold red border outlining the whole animal. As far back as 1865 this variety was considered to be a distinct species, and was known as *Aneitea kreffti*,

but at present this differentiation is ignored and both are generally placed in the one species, *græffei*.

However, a fresh difficulty has arisen now which suggests there may be, after all, several different species of these bitentaculate slugs in Australia, and that they are not all colour varieties of the one species.



The resting and crawling stage of a particularly beautiful melon-pink coloured slug (Aneitea sp.) from Mount Kaputar, Narrabri, New South Wales.
[Joyce K. Allan, *del.*

In the last week of November of last year, a beautiful live specimen of a bright melon-pink coloured slug was forwarded to the Museum by Mrs. A. J. Park. This was only one of hundreds found crawling about amongst rocks and leaves and in dark places right at the summit of Mt. Kaputar (5,008 ft.), near Narrabri, New South Wales.

They appeared after heavy rain, and when not crawling extended, were flattened out resembling dying red gum leaves. The specimen at the present time is still alive in the tin in which it was sent, but if it feeds on the leaves and grasses it cannot be obtaining much nourishment from them, as they are now dry and shrivelled. It is the same colour all over, the tentacles alone having bluish stalks and yellow apices. When extended normally, the animal reaches a length of about four and a half inches, and its broadest measurement is three-quarters of an inch, but it could probably elongate much more. In dry weather none of these slugs were seen at this locality.

In 1892 the late Charles Hedley recorded from the summit of Bellenden-Ker Mountain and the Proserpine River, north Queensland, a melon-pink slug which he considered to be different from the typical yellowish-green form, and he therefore named it *Aneitea rosea*. Whether this species from Queensland is the same as the ones from Mt. Kaputar remains to be seen, as there is no specimen of the former in this Museum, and, even if there were, preservation would make comparison difficult. It would be necessary to study live specimens from both localities to settle this point, for after being in preservative they naturally lose their colour and become somewhat wrinkled.

Mr. A. J. Thackway, a keen conchologist, says he has seen hundreds of the yellowish-brown ones on the banks of Mihi Creek, near Armidale, New South Wales, after heavy rain, and that the crayfish in the creek eat them.

It is always during wet weather that these slugs appear, crawling over grass and leaves, or up trees. As there is no sign of them in the dry weather, their wanderings are probably nocturnal, and in very droughty weather it is possible that they become dormant like the snail. Hedley found them only under logs and stones in dense scrub, a dozen or more clustered together, showing their gregarious habits; one specimen found under a log had about half a dozen globular

Areca, Betel and Lime---A Primitive Narcotic

BY FREDERICK D. MCCARTHY,
Assistant in Ethnology, Australian Museum.

Pluck wild areca nut, ha! ha! ha!
Hot wild areca nut, ha! ha! ha!
An old woman plucked it, ha! ha! ha!
By the side of the stream, ha! ha! ha!
She bit it on trial, ha! ha! ha!
She turned giddy and fell over, ha! ha! ha!
Into a bull-ants' nest, ha! ha! ha!
She ran away and left her stick behind, ha! ha! ha!
The stream washed it down, ha! ha! ha!
And then the boys
Netting prawns found it, ha! ha! ha!
And broke it in two, ha! ha! ha!
With shouts and yells, ha! ha! ha!

This is a lullaby crooned by a mother to her child about the wild areca nut, as recorded by Ivens from the south-east Solomon Islands, and suggests probably as a warning to the child its effects when first experienced.

CHEWING of the betel mixture is an ancient custom, and is practised in south India, Siam, China, Malaysia, the Philippine Islands, New Guinea, and north-west Melanesia. It is with the two last mentioned areas that this article will deal. Its southern limits in Melanesia are Tikopia (inhabited by Polynesians) and the Santa Cruz group, where it is in everyday use, and in these two places kava is also indulged in, but only on religious occasions, and is probably the older habit. Rivers has suggested that these two habits in New Guinea and north-west Melanesia characterize two peoples, whom he calls the "betel-people" and the "kava-people", who have mingled with another but earlier indigenous people, so that a complex blending of cultures took place. Hence he thinks betel mixture was introduced into this region as a fully developed custom. However, the origin of these peoples and of their various cultures is enshrined in mystery. Many such customs have been introduced into north-west New Guinea by contact with the Malays, and possibly by migrants, and thence have spread through the island.

INGREDIENTS.

There are three principal constituents of the betel mixture. The nuts of the Areca Palm (*Areca catechu*), the leaves, fruit and stem of the betel vine or *pàn* (*Chavica betle* Miq.), and lime. Other ingredients may be added, and in western Papua a large bean-shaped fruit is also chewed, which allows the mixture to be formed into a solid ball in the mouth, where it is kept day and night. Tobacco is also chewed with it.

The Areca Palm is a native of Malaysia, and has been diffused throughout a wide area from this region, and many closely allied species are also found in New Guinea and Melanesia. *Areca catechu* is a very beautiful palm, reaching a height of about fifty feet, and a circumference of up to eighteen inches. It has a crown of nine long pinnate fronds, and is cultivated in the villages by the natives. It occurs in North Queensland, but is not used by the aborigines.

The groves of these graceful palms around and in the villages add greatly to their beauty. The palm bears bunches of fruit, each single one of which is about

Side view of the introduced English slug (Agriolimax lævis) often found feeding upon young cabbages and other vegetables in gardens. The additional pair of tentacles are seen below the long eye-bearing pair.
[Joyce K. Allan, *del.*

gelatinous eggs, about one-quarter of an inch in diameter, lying alongside it in a hole in the ground.

A close study has yet to be made whereby we may find what these interesting slugs feed upon, whether they are edible, how long they live, how many eggs they lay, and many other interesting facts not yet known.

The native slug of Australia must not be confused with the different species of the introduced English slug, about five species of which are now widely distributed throughout Australia. These introduced slugs have probably been brought into this country with plants, and are now common in gardens, where they are most destructive to the young vegetables, especially cabbages; they are also found in remote parts of the continent.

They are easily distinguished from the native slug by the presence of two pairs of tentacles, one long upper pair bearing eyes and an inferior lower pair. The shell is represented by an internal complete one under the skin of the dorsal shield, and not fragments as in the latter slug.

Collecting on the Murrumbidgee

The field party consisting of Messrs. J. R. Kinghorn, Zoologist, K. C. McKeown, Assistant Entomologist, and W. Barnes, Assistant Preparator, spent an interesting and profitable five weeks on the Murrumbidgee Irrigation Area during September and October. The Water Conservation and Irrigation Commission generously placed a light truck at their disposal, and the principal of the Yanco Agricultural High School provided accommodation and every facility for carrying on the work of collecting.

The fauna, particularly the birds and insects, is interesting because of its variety and distribution. Twenty years ago this area was but sparsely inhabited by animals of any kind, but today, with its miles of canals, its acres of rice fields, and its large permanent swamps, it is rich in bird and insect life. The birds are widely distributed, for there is abundance of food and water. Among the small timber on the river flats parrots and honeyeaters abound, with a sprinkling of larger birds, and on the swamps and lakes are thousands of ducks, ibis, spoonbills, cormorants, dotterels, various wading birds and a few terns.

The fauna varies slightly according to the general weather conditions of the State. In times of inland drought millions of ducks congregate on the area, while brolgas may be counted in thousands, and even emus may be seen seeking food and water.

Specimens secured include a number of the smaller mammals, birds belonging to sixty species, snakes, many lizards, numerous frogs and toads, thousands of insects and arachnids, besides fishes, molluscs, and crustaceans.

It is hoped that in a future issue a more detailed account of the fauna will appear, with illustrations of some of the more interesting species and their habitats.

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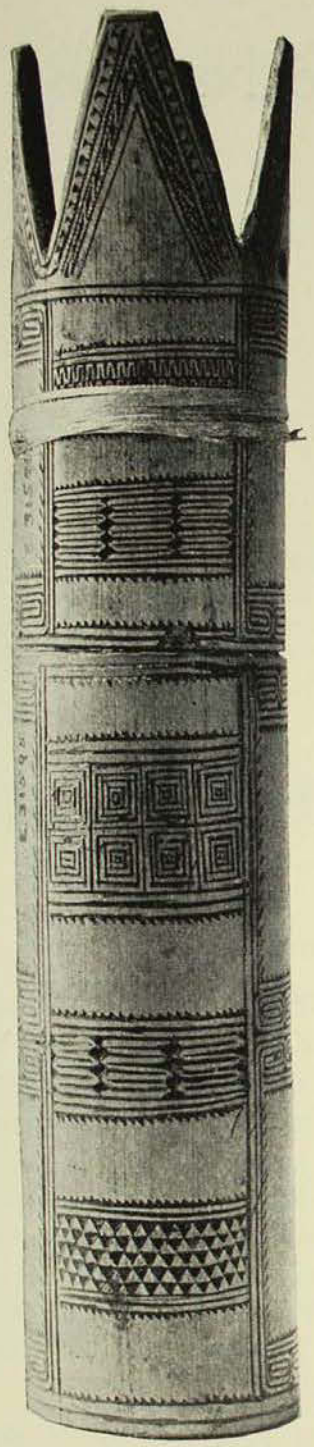


Bamboo lime box from the Solomon Islands, with an attractive geometrical pattern in rectangular panels. The top is neatly shaped. Australian Museum Collection.
[Photo.—*G. C. Clutton.*

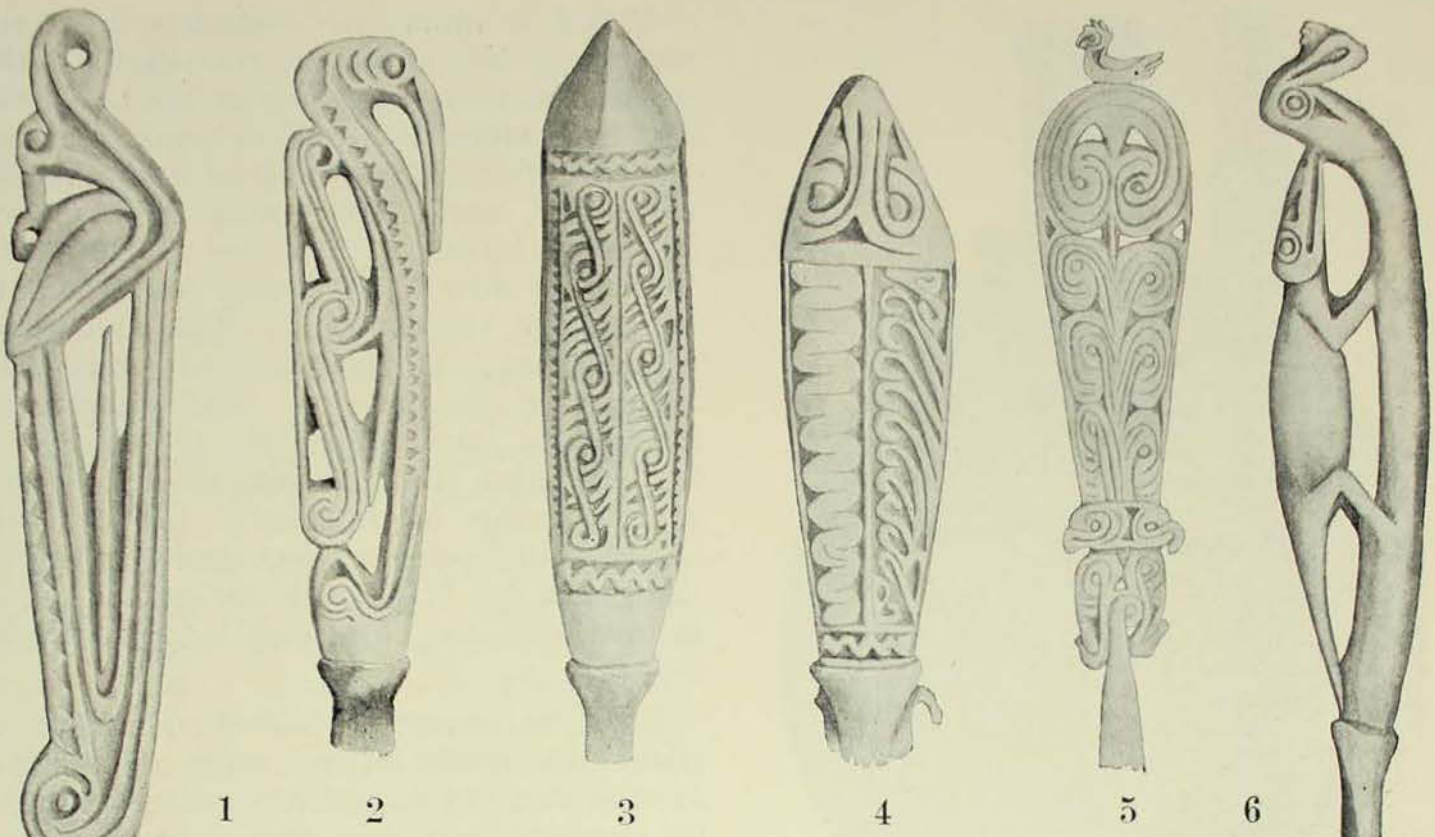
the size of a nutmeg, and has a yellow fibrous husk when ripe. There is a single seed in each nut, which is very hard and heavy, and in section is grey, mottled with red and brown. According to MacPherson, it contains about 14% fixed oil and the same amount of tannin. There are three alkaloids: arecoline, which causes vomiting if taken internally, increases the saliva, and, if taken in large doses, may cause death from arrest of respiration: arecaine is neutral and not so active and its salts are acid; the third one is unimportant. The seeds have been used in treatment for tapeworm in man and dogs, and are astringent and stimulant. The nuts are used at different stages of growths, the younger ones being preferred, and are carried about in beautifully made netted bags. The name betel refers to the pepper plant, and is wrongly used when applied to the Areca nut, as it commonly is.

The betel vine or *pàn*, which is closely allied to the black pepper, is cultivated and also grows wild in the forest, where the natives may climb the trees to get it or use long hooked poles to tear it down. The leaves, fruit, and stem are all made use of. The fruit is about two inches in length and half an inch thick, and has a peppery but not unpleasant flavour.

The lime is procured from different sources, the marine shells being the commonest. The Orokaiva of the north-east division of Papua construct a small pyre by placing trays about three feet square, made of sago palm fronds, on which the shells are spread, one upon the other, to a height of three or four feet; it is lighted from the top. The shells retain their shape and are transferred to a banana leaf tray and broken down, the native muttering the while "ere, ere" (get up, hurry up). Water is sprinkled over the mass and it is left close to a fire, a very soft powder being produced in this way. At Ulawa, in the Solomons, branching coral is used, but owing to the difficulty of obtaining it, it is frequently dispensed with. Mushroom coral is also used, but is considered too strong. The coral is burnt, slaked, dried in the sun, and is kept in short sections of bamboo, which are exchanged for a porpoise tooth. Another method is to crush coral limestone, and the Mafulu of New Guinea use the limestone occurring in their territory.

The lime liberates the essences of the other ingredients during mastication, and causes a free flow of saliva. It is used in the Solomons to free the juices in the same way from a plant (*Morinda citrifolia*) in the making of a red dye. As the betel mixture is chewed

A beautifully carved lime spatula from the Massim area. The elongated face, prominent nose, with dot enclosed in circle for eye, are typical of New Guinea. The figure is holding a drum. Australian Museum Collection.
[Photo.—*G. C. Clutton.*



1 2 3 4 5 6

A series of Massim lime spatulas in which the conventionalization of the motifs is well displayed. Nos. 1 and 2 are a combination of crocodile head, in profile, with single eye and straight slender tongue, and the frigate bird. No. 2 is a particularly fine carving of the frigate bird head and the double scrolls derived from it, and in Nos. 3 and 4 these scrolls are only a single line; in No. 3 the design, in two panels, is a very pleasing one. Nos. 3 and 4 are of the clapper type, in which the handle is split down the middle, and is hit against the legs to make a clapping noise. The motif in No. 5 is that of the human face, and this is also seen at the apex of No. 4. The animal in No. 6 could be the cuscus, dog, or boar, and is combined with a bird head, probably the hornbill. The scroll might be termed the key element in Massim art. Australian Museum Collection.

[Nancy B. Adams, *del.*

the saliva turns red, staining the lips, tongue, and teeth. It preserves the latter and forms a coating over them which may become black and so thick from constant indulgence as to protrude from the mouth, as in Santa Cruz. This, however, wears off after a period of abstention from the habit. The discoloration of the teeth is greatly admired by the women.

The lime is usually kept in a gourd or calabash, the shell of a fruit. They vary widely in shape—spheroidal, pear, and hour-glass. The stem is detached, the inside cleaned out, and a stopper made of strips of leaves rolled into a disk and sewn at the marginal edge may be inserted. The Orokaiva use a disk made from a jungle creeper, but for the old and respected the gourd is fitted with a mouthpiece of shell, in which are set scarlet jequirity seeds and fragments of white shell. A bone spatula accompanies it. This gourd is termed *kananga*, and may be given as a ceremonial gift, but a young man would not use it, his pattern of behaviour not allowing him to do so.

Sections of bamboo are also used as lime receptacles, as are coconuts, and suitable leaves are also utilized to make containers. They are often carried about in a netted bag, or in a sling.

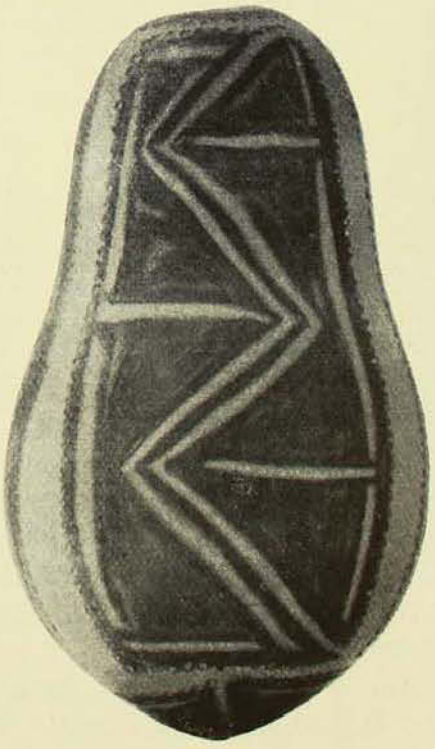
Spheroidal lime gourd from the Trobriand Islands. The curvilinear design harmonizes with the shape; a strip of plaited yellow and black grass encloses the stopper. Australian Museum Collection.
[Photo.—*G. C. Clutton.*

PREPARATION AND CHEWING.

There are various methods of preparing and mixing the ingredients. The Papuans of the western side of the Gulf of Papua skewer the Areca nuts on a cassowary bone or bamboo needle, and the chewer is constantly husking them with a cockle shell (*Cardium* sp.). Bone spatulas are used as well as wooden ones, to which beads and dog's teeth are attached. In the Trobriands the spatula is sometimes made of the bone of a deceased relative. The Purari delta people import *Areca catechu* nuts from the Motu on the eastern side of the Gulf of Papua with whom they trade, as the native species is small. When used, it is dried over the fire until shrivelled and brown. The nuts are chewed, but the old men who have lost their teeth carry small wooden mortars and pestles, often elaborately carved, to break up the nuts.

When a sufficient quantity of Areca nut is in the mouth a few dips of lime are added, then a portion of the betel vine, and then more lime. The chewer moistens the end of the spatula, dips it in the lime container, and then sucks the lime off. He may, however, dip the nut into the lime as in New Britain and the Solomons, or employ the fingers. The spatula is often rattled in the gourd to express the feelings of the chewer. Everywhere the indulgents are generous to their colleagues, and it is politeness and a sign of friendship to distribute to them any of the ingredients required; even the chewed quid is passed around a group. Before speaking it is polite to empty the mouth.

Betel mixture is partaken of at all times during the day; always after meals, as it is thought to aid digestion, generally by the initiated men and old women. A man may not be allowed to partake of it until he has killed a man as at Maccleur's Gulf. In some cases even the young children are confirmed betel-chewers. It is usually one of the things upon which a

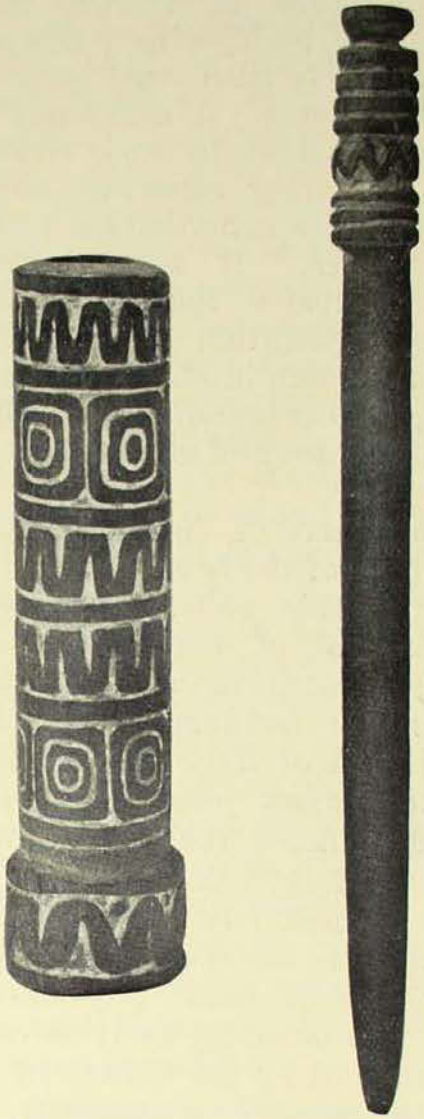


Pear-shaped lime gourd from Central Papua. The design is burnt in, and is in three zones, of which a zigzag is the main feature. Australian Museum Collection.
[Photo.—*G. C. Clutton.*

tabu is placed prior to a feast, but the Mafulu of New Guinea are allowed to use it when other food has been made tabu. This is its principal use with these people, and, contrary to the general practice, they spit it out after chewing.

EFFECTS.

There are many claims as to its value made by the natives. It is said to make a man active, to ward off hunger, prevent foulness of breath, to increase stamina, make life pleasanter, and engender friendship. However, cases of cancer (epithelioma) of the inside of the cheek have been reported to be due to its use. An observer states that it is difficult to hold the attention of an adherent when under its influence. It has a drowsy effect, but at the same time tends mildly to excite the chewer. Guppy partook of Areca nuts, and his impressions are as follows: "I once was tempted by curiosity to chew a betel nut, which I afterwards swallowed in order to experience its full effect. Very shortly afterwards my head began to feel heavy, and I had an inclination to lie down, whilst my sight was sensibly dimmed. These effects passed away in about twenty minutes. In my cabin I tried the effect on my circulation of chewing a single nut. Five minutes afterwards I found my pulse had increased in force and in frequency from 62 to 92 beats per minute. There was a sensation of fulness in the head and temples, but no perceptible effect on the vision. The pulse retained this frequency for another five minutes; but it did not resume its previous rate until more than half an hour had elapsed since the beginning of the experiment. Subsequently I tried the effect of chewing two betel nuts. The first increased the pulse by twenty beats per minute, and gave rise to restlessness and a feeling of fulness in the head. The second sustained, but did not increase, the frequency of the pulse. On account of nausea I chewed the second nut with difficulty. No effect was produced on locomotion by these two nuts; but my sight was sensibly dimmed. On turning-in for the night soon afterwards, I experienced during the first hour rather vivid dreams characterized by rapid shifting of the scene and change in the *dramatis personæ*. Some of the crew, who, at my desire, tried the effect of chewing a single nut, informed me that it affected them much the same as a glass of spirit would. The natives themselves are usually content with chewing one nut at a time; two nuts, as they told me, produced unpleasant symptoms, and a bad head. The betel nut, in truth, possesses far greater stimulating properties than I had previously suspected. . . . I believe that the extent of its intoxicating qualities is not generally known."



Pestle and mortar from the Trobriand Islands, used by old men for crushing the Areca nuts. The dot enclosed by circles is a typical representation of the eye in New Guinea. Australian Museum Collection.
[Photo.—*G. C. Clutton.*

Betel mixture is known to be a stimulant and tonic, with astringent properties, and has been used as a prophylactic for malaria. A deficiency of lime in the diet is known to cause rickets, skin disease, and other ailments, so that it forms a valuable contribution to the food of the natives. It is undoubtedly a beneficial custom of the natives, and is a means of relaxation after the day's activities. It aids in strengthening social ties and group cohesion, and is offered as a symbol of peace and goodwill to visiting parties.

In some parts of New Guinea where the essentials of the betel mixture are not easily procurable, substitutes are found. The Wakatami of Dutch New Guinea make a very potent drink from the Sugar Palm (*Arenga saccharifera*). This tree bears a bunch of dark green fruit. To secure the viscous juice a cut is made below the stalk of the fruit, and as it trickles out it is collected in a coconut shell and immediately drunk. It causes intoxication and has a deteriorating effect upon its users, both physically and morally. The *gamada*, as it is called, is also partaken of by the Girara of the Fly River delta, but only occasionally, as they are daily users of the betel mixture.

RITUAL.

There is not the ritual importance of the kava-bowl of Polynesia attached to the betel mixture in Melanesia. This is rather strange in view of the useful part it plays in the everyday life of the natives and the esteem in which it is held. It is possibly due to the different social organizations, and to the method of the use of each, betel-chewing being essentially individualistic, and kava communal. There are, however, some ritual uses of the betel mixture, and no doubt many others not recorded.

In the Trobriands the betel is used as a spell to induce a person to become a *kula* or trading partner and a tabu is placed upon it during trading. A spell may be chanted over Areca nuts to kindle generosity in a partner's heart. Williams gives an account of an Orokaiva medicine-man, or *bara*, who chewed some Areca nut together with his medicine, and then sucked at his patient's leg. He spat out the mass, and found in it a small piece of wallaby bone. It was assumed that as the patient had eaten wallaby flesh some time before this was the cause of the sickness.

According to Ivens, there are many such uses in the south-east Solomons. Areca nuts are used in propitiatory offerings to the gods, and also in two religious ceremonies. It is necessary for the priests who have eaten sacred food at a feast ritually to tap the Areca nut and free themselves and the people from the restriction placed upon it. The nuts are used in a ceremony called the Maidens of the Ha'u (bonito), and as an emblem of peace when visiting. Sometimes before feasts the Areca palms are ceremonially washed and a magical spell chanted over them to ensure a prolific crop. In this locality the palms are destroyed at the death of a chief, together with his other property. The owner of a lime box may dedicate it to a certain ghost, and, if he lends it, only those who are likewise in that class can use it. Such is the case also with Areca palms and betel vines. In Tikopia mourners have to abstain from betel-chewing for about two months.

CONNECTION WITH SORCERY.

The discarded skins of Areca nuts may be the means of encompassing the death of the person who used them, in common with the widespread practice in Melanesia of contagious magic, in which spells and rites performed over such things as hair, nail trimmings, and food leavings cause death. Great care, however, is taken to dispose of these properly to prevent such usage.

There is a widespread myth in Melanesia in which communication with the sky people is obtained by climbing an Areca palm which stretches skywards. The Purari delta people have myths telling of the securing by one Biai of the Areca palm while walking on the seashore, and of how two women, Au and

Apura, were the first to make lime by burning shell-fish.

ART AND THE BETEL HABIT.

Art as applied to gourds, mortars, and spatulas is ornamental and symbolic, and reaches its highest development with the Massim people. They occupy the extreme eastern end of New Guinea, and the archipelago including the Trobriands to the north and the Louisiades to the east.

Haddon has shown that with the adzes of this region there has been a development from the utilitarian to the artistic, from realism to pure decoration, and from a useful implement to a useless one, with a relatively enormous thin and beautifully polished stone blade, and an unwieldy handle, ornately carved. Such is part of the wealth of the owner, and the more time and work expended on its making the more highly is it valued. So with the lime spatulas and wooden mortars, which are a symbol of wealth, of personal pride and vanity, and the elegant and complex carvings are an outlet for the ability of the individual. They are made of a dark, heavy, ebony-like wood, and the designs are infilled with lime so that the intaglio portions form a pleasing contrast.

The carving was originally done with stone adzes, but is now generally done with steel implements secured from white traders, and suffers by comparison. The work is poorer, and the lessening interest in native ritual and sacred life, replaced by missionary teachings, is having a degrading influence on the art.

The motifs of the designs have been stylized to a degree usual in primitive art. For instance, the bird's head (frigate bird) can be traced from a realistic representation to scrolls serially interlocked, to a twisted figure-of-eight, to a guilloche, and even to a zigzag line; the eye may or may not be represented. Very often the bird's head is combined with the crocodile's head, the mouth of the latter open, as if about to seize the bird, with a slender tongue, and the eye invariably present. Other zoomorphs used are the boar, dog, cuscus, lizard and mantis, and all are of economic or totemic significance. All totem species, however, are not used in art, only the ones, it seems, that have an additional importance. Thus the frigate bird is featured in mythology and is emblematic of the Western Pacific. It is sacred, and in Florida in the Solomons it has a ghost. It is used as a motif in Solomon Island art. It is closely connected with the bonito, and is also sacred in Polynesia. The crocodile is a feared and dangerous reptile wherever it occurs, and the claws and teeth of the cuscus are used to a great extent in the making of personal ornaments, as are the tusks of the boar, whose flesh, in addition, may be sacred to chiefs and priests.

Carvings of human figures on the spatulas are made in many parts of New Guinea and Melanesia. They are symbolic of ancestor worship.

The designs on the gourds are burnt in, and strips of coconut leaf sheath, or the edge of the coconut shell, may be used for this purpose. The points are put in the fire and the design incised. The patterns are pleasing, each being typical of a certain locality. Some are geometric, but bird, animal, and even human motifs are common. On some of the bamboo lime boxes these patterns are cut out. Owing, however, to the widespread trading carried out by the Papuans and Melanesians it is often very difficult to assign a definite locality to an object, which though procured from a certain tribe, is not necessarily made or decorated by them.

Aquatic Insects*

By KEITH C. MCKEOWN.

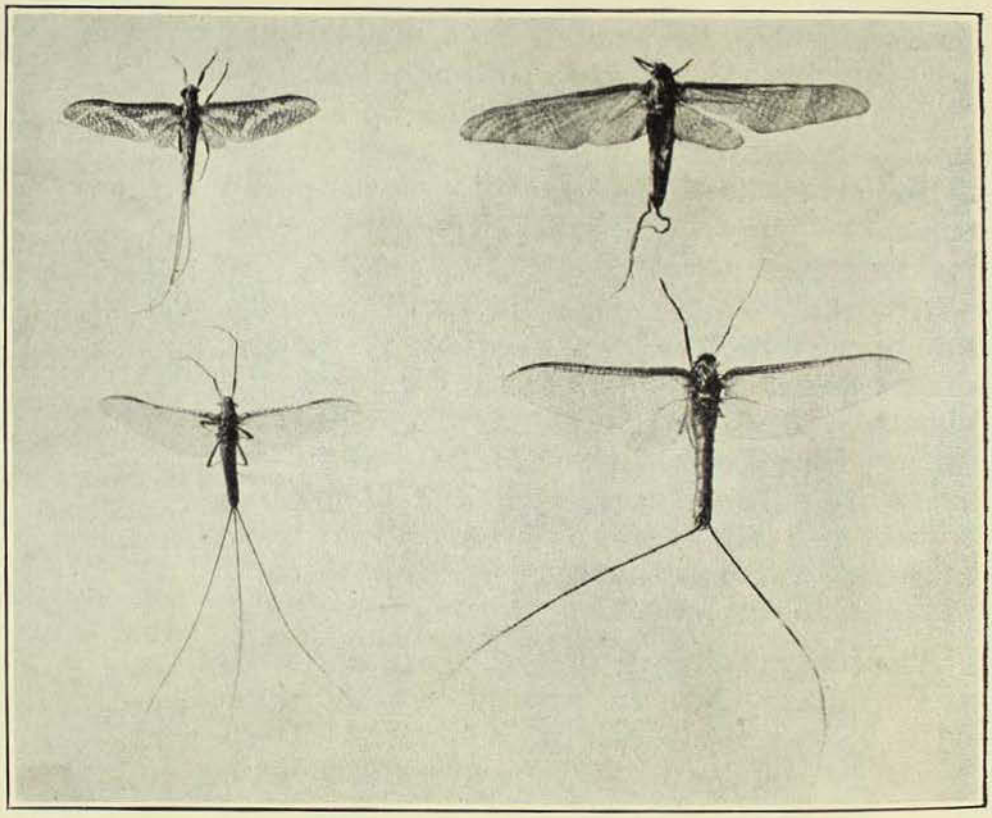
DURING recent years aquaria, ranging in size from the small glass tank, costing a few shillings, to the pretentious rock pool worth as many pounds, have become a feature of many homes. Their acquisition has stimulated an interest in forms of life other than fish, and the following notes, it is hoped, will afford some information to those possessing an entomological bent.

Large numbers of insects, belonging to several orders, have taken to life in the water, and it would appear that, although the original ancestors of insects were aquatic, their modern representatives were originally terrestrial, for the forms which now exist are undoubtedly modified terrestrial insects adapted to an under-water life; and as comparatively few are so well adjusted to the new conditions that they can breathe the dissolved air in the water, most of them have to rise to the surface to renew their air supply, and many are aquatic for a portion only of their lives. Only one insect, so far known, is wholly aquatic, and that is a fly which lives in the sea at Samoa, and spends its whole life in the water.

Many of their ancestors, known to us as fossils, grew to an immense size, and one of the dragonflies of the Carboniferous period attained a measurement of twenty-seven inches and more across the wings, while may-flies and other insects attained a proportionately great size.

*This article is the substance of a lecture delivered to members of the Aquarium Society of New South Wales.

Aquatic insects obtain their air supply by three different methods: (1) by communication with the free air at the surface, as in the case of the water beetles and mosquito larvæ; (2) by utilizing by means of gills the air dissolved in the water, as dragonfly and caddis larvæ; (3) by piercing the stems of aquatic plants and securing the air contained in the cells, as in the case of a mosquito pupa (*Tæniorhynchus*) and a Chrysomelid beetle. Some indications of the adaptations to the aquatic life will be touched upon in dealing with the individual insects.



Examples of the delicate, gauzy-winged aquatic insects popularly known as May-Flies.
[Photo.—*G. C. Clutton.*

MAY-FLIES.

I propose to deal with the insects in their generally recognized natural order. First come the may-flies, which belong to the Order Plecoptera or Ephemeroptera.

Little work has been done on the members of this order in Australia, so that here is an almost virgin field for anyone who desires to investigate the life histories and habits of these most fascinating creatures.

The eggs are deposited in the water, usually in two masses, and the larvæ hatch in a couple of days. Each egg is provided with a bunch of filaments at the end, which become entangled with the weeds and serve as an anchor to prevent the egg being carried away and buried in the mud. The larvæ of may-flies are active creatures and are supplied with branched gills along the sides of the body. The adult insects after emerging from the pupa are unique in possessing a sub-imago which lasts a few days in some species, a few minutes in others, and from this issues the mature insect, leaving behind it a cast skin, complete in every detail, even to the covering of wings, legs, and antennæ. The adult insect is a delicate gauzy-winged creature with three long tail filaments. May-flies[1] live only from a few hours to a couple of days. They sometimes appear in vast numbers, and these swarms may be seen rising and falling in the air above the surface of the water; these are the mating assemblies. Both in their larval and adult stages may-flies are among the most important fish foods, and are especially relished by trout, which devour them in immense numbers. The artificial flies of the rod fisherman are based upon the appearance of the various species of may-flies.

DRAGONFLIES.

In our survey of the aquatic insects we now come to the Odonata or dragonflies. These are too well known to require description. They are commonly known as "horse-stingers", although they are not in any way harmful and have no sting. "Devil's-darning-needles" is the popular name for them in America. The slender Zygopterid dragonflies are usually known as "Damsel-flies".[2]

Dragonfly larvæ are veritable tigers of the under-water world; they relish almost anything they can catch, but more particularly smaller specimens of their own or other species. Dr. Tillyard records that the larva of one species swallowed sixty mosquito larvæ in ten minutes. When young, they relish Protozoa, and later water fleas and other small Crustacea form a large part of their food. Tadpoles and small fish are attacked, although they seldom eat more than a small portion of these animals.

WATER BUGS.

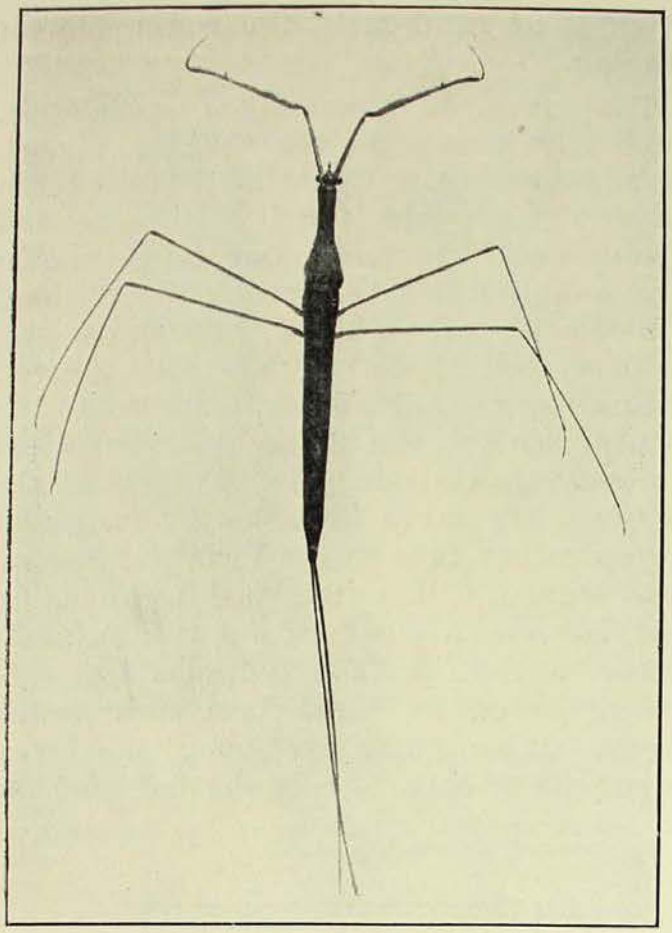
Several of the Bugs (Order Hemiptera, Suborder Heteroptera) have adopted aquatic habits in all their stages, but in the adult state they are capable of performing long flights from pond to pond.[3] The Great Water Bug or Fish Killer (*Lethocerus indicum*) attains a length of several inches and is very rapacious, destroying not only many of the larger water insects, but also quite large fish and frogs and sucking up their blood by means of the sharp-pointed beak or rostrum. These bugs are sometimes attracted in large numbers to the electric lights in the city, and can inflict a painful stab with the sharp beak if carelessly handled.

The Water Boatmen (Family Corixidæ) are familiar objects in ponds as they propel themselves through the water with their long oar-like hind legs. They carry a copious supply of air under water, and they are capable of remaining submerged for astonishingly long periods. They usually feed upon mosquito larvæ, and their food is captured with the anterior pair of legs, which hold the prey securely while they extract the nutriment. The Indian *Micronecta striata* (*Corixa ovivora* Westw.) is reported to feed on the eggs

[1] *See* Musgrave, A., "The H. M. Stephen Collection of May-Flies", AUSTRALIAN MUSEUM MAGAZINE, iv, 7, July-September, 1931, p. 248.

[2] The life-history of the Dragonfly has been described by Dr. R. J. Tillyard in this MAGAZINE, Vol. iv, 9, 1932, p. 310.

[3] *See* article by T. G. Campbell, AUSTR. MUS. MAG., Vol. iii, 3, 1927, p. 90.

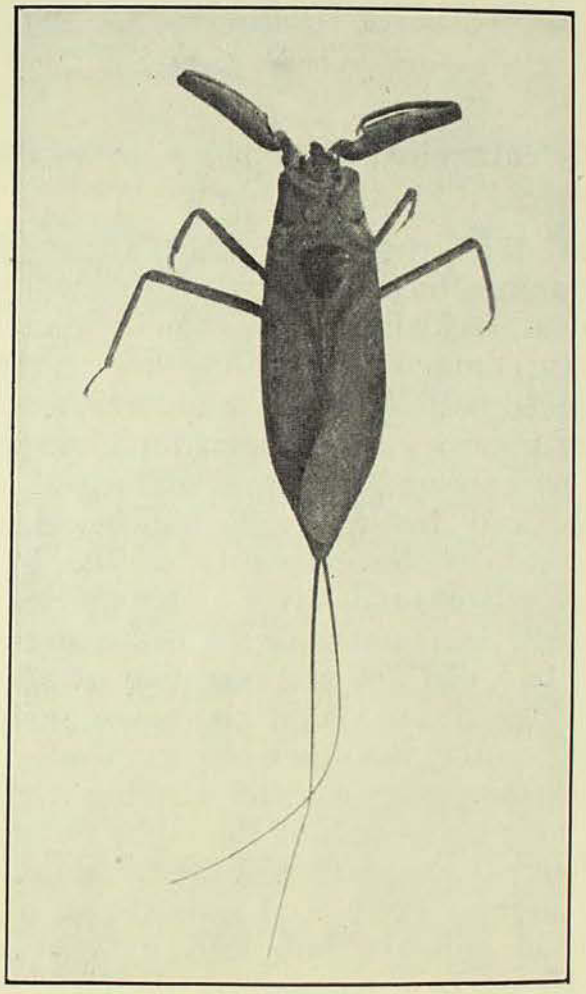


A typical "Toe-Biter" (Ranatra australiensis).
[Photo.—*G. C. Clutton.*

creature within their reach. They bear a remarkable superficial resemblance to the terrestrial Praying Mantids. They are sluggish in their habits and move little unless disturbed, although they are strong flyers, and make long flights from pond to pond. Water Scorpions are equipped with a long slender respiratory tube, by means of which they obtain their air supply from the surface. They are capable of destroying tadpoles, frogs and fish. Little is known about the habits and life histories of the Australian species; the eggs are believed to be embedded in the stems of aquatic vegetation. Three species are found in eastern Australia, *Laccotrephes tristis*, the broad, leaf-like form, and the slender species, *Ranatra australiensis* and *R. filiformis*.

Another aquatic bug which is worthy of mention is *Sphærodema rusticum*, on account of the curious habit of the female forcibly affixing her eggs upon the back of the unwilling male—the "Now, James, you go and wheel the perambulator" idea, as it were. Females have been seen struggling for hours to impose their will upon the males.

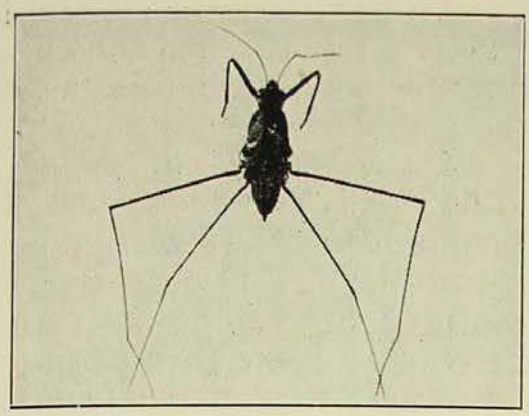
Bugs of the genera *Halobates* and *Gerris* run rapidly over the surface of the water, supported by the surface film, and members of the first-named genus have been captured far out at sea. In the Pacific Ocean their eggs have been found attached to floating feathers of sea birds. *Halobates whiteleggei* may be found upon tidal rivers in the vicinity of Sydney.



A "Water Scorpion" (Laccotrephes tristis).
[Photo.—*G. C. Clutton.*

WATER BEETLES.

Familiar creatures in almost any pond are the water beetles. These have not completely conquered the aquatic element, since they have to convey with them, when submerging, a supply of air sufficient to last them for some considerable time. This is effected by several methods, as by filling the cavity under the elytra with air,



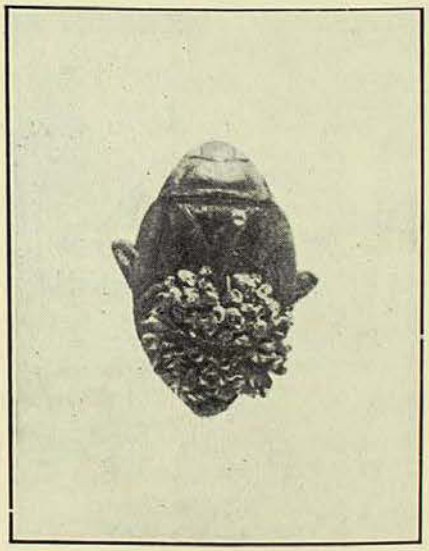
A Water Strider (Gerris australis) which glides over the surfaces of ponds and streams. Some of its relatives have been captured far out at sea. (Enlarged.)
[Photo.—*G. C. Clutton.*

or by entangling air bubbles in the body hairs.

On the surface of the water one encounters the Gyrinids, which swim in swarms, whirling over the water in erratic dances. Gyrinids are curious flattened beetles, which, when submerged, carry a supply of air upon the close felting of hair on the lower surface of the body, and frequently a bubble of air attached to the extremity of the body, which glistens like silver under the water. The eye is remarkable in being divided into two distinct sections, one of which is evidently for vision above the surface of the water, the other below. The larvæ of *Gyrinus* carry a series of fringed gills, one pair upon each of the eight foremost abdominal segments, and the terminal one two pairs. Their food consists of small aquatic animals and, failing these, the tender parts of submerged plants. There is also evidence of a taste for fish eggs. When full grown the larva pupates in a cocoon attached to water weeds. The two common species in eastern Australia are *Macrogyrus oblongus* and *M. striolatus*.

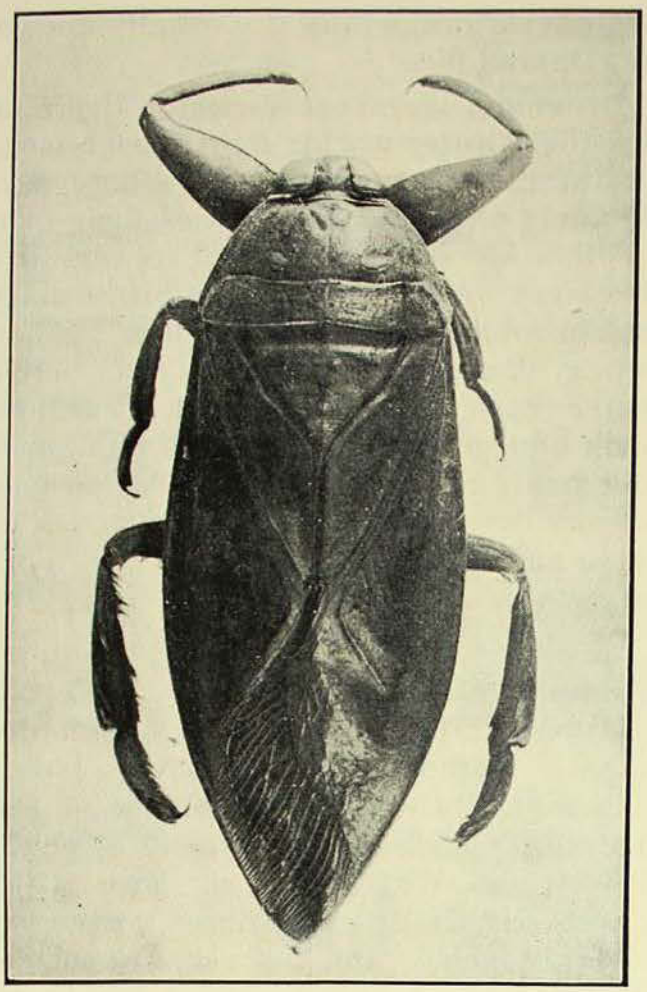
The large olive-green beetle with the yellow border to the elytra is *Homœdytes scutellaris*; it is carnivorous in both the larval and adult stages. The eggs are deposited in cavities cut in the stems of aquatic plants by the female, who uses her stout ovipositor for the purpose; eggs dropped at random in the water seldom develop.

The larva of *Homœdytes scutellaris*, popularly known as the "Water Tiger", is undoubtedly a veritable tiger of the under-water world, for it will seize and devour water animals many times its own size, hanging on like a miniature bulldog while sucking their blood through its long sickle-shaped jaws, which are pierced with a fine channel, from the point to the mouth, through which the blood is sucked while firmly embedded in the body of the victim. The larva breathes by means of a respiratory tube in the terminal abdominal segments, hanging tail upwards in the process. Almost all aquatic animals, snails, worms, insects, tadpoles and fish, are devoured by these insatiable beetle larvæ. When fully developed, the larvæ pupate in a clay cell in the bank of the pond. The adult beetle is wholly carnivorous, and lives upon much the same food as the larva.



Sphærodema rusticum, a bug widely distributed in eastern Australia. The illustration shows a male upon whose back the female has deposited a number of eggs. (Enlarged.)
[Photo.—*G. C. Clutton.*

In the male beetle the first pair of legs is provided with a remarkable cluster of suckers which are believed to assist the male in retaining his hold upon the female during courtship. So tenacious is the grip



The Great Water Bug or Fish Killer (Lethocerus indicum) which ranges from India to Australia.
[Photo.—*G. C. Clutton.*

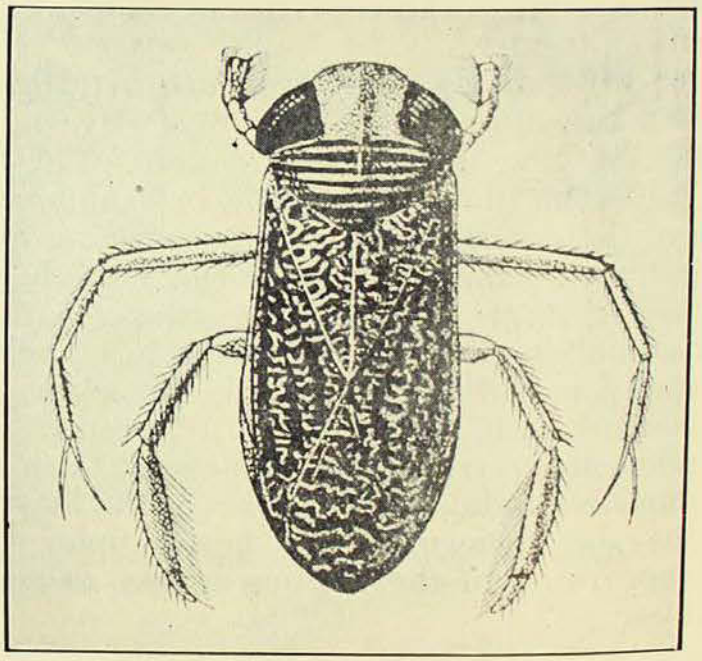
of fishes, and the Great Water Boatman of England feeds upon tadpoles, fish and frogs. There are no data yet available with regard to the presence or absence of this habit in any of the Australian species. The commonest species in New South Wales are *Porocorixa eurynome* and *Arctocorisa truncatipala*.

These bugs stridulate while under water, the sound being produced by the tarsal comb being moved rapidly across an area studded with pegs situated at the base of the opposite femur. The eggs are "peg-top" shaped, and are deposited in the thicker stems of water plants. The eggs of a Mexican species are collected by the natives from bundles of reeds placed in the water for this purpose, pressed into cakes and sold in the markets as food.

Another group of aquatic bugs are the Back-swimmers (Notonectidæ), which feed upon mosquito larvæ and other small aquatic creatures. They have wonderful adaptations to fit them for their aquatic life, the hind legs being perfect fringed oars, while the body has the perfect lines of a boat, the back, which is below as the insect swims, being keeled.

The eggs are inserted into plant stems and leaves in holes drilled by the ovipositor, usually in stems of medium thickness. *Enithares bergrothi* is found in eastern Australia, and is reported to have destroyed fish.

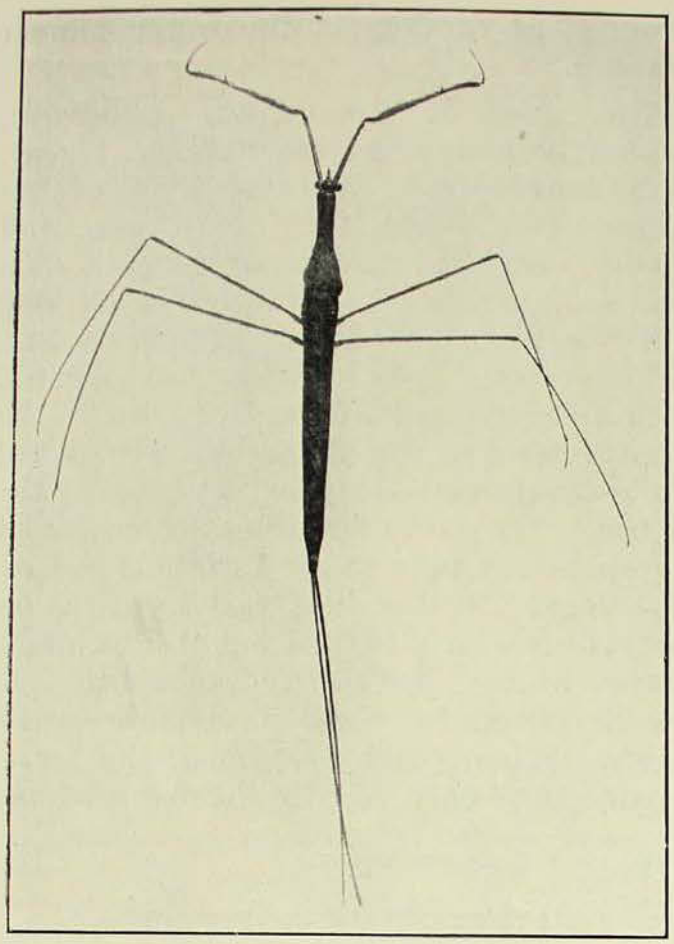
In 1847 the migration of an enormous swarm of a North American species was observed by Sir George Simpson, who states that the bugs were suddenly incapacitated through encountering a freezing stratum of air, and fell to the ground in countless numbers, covering a space of 25 to 30 miles in length and of



A typical Water Boatman (Arctocorisa truncatipala).
[*After* H. M. Hale.

unknown width. No swarms of great magnitude have been recorded from Australia.

The so-called Water Scorpions or "Toe-biters" are also bugs, and are usually to be found crawling about over the mud or weeds, with their raptorial forelegs always ready for the capture of any luckless



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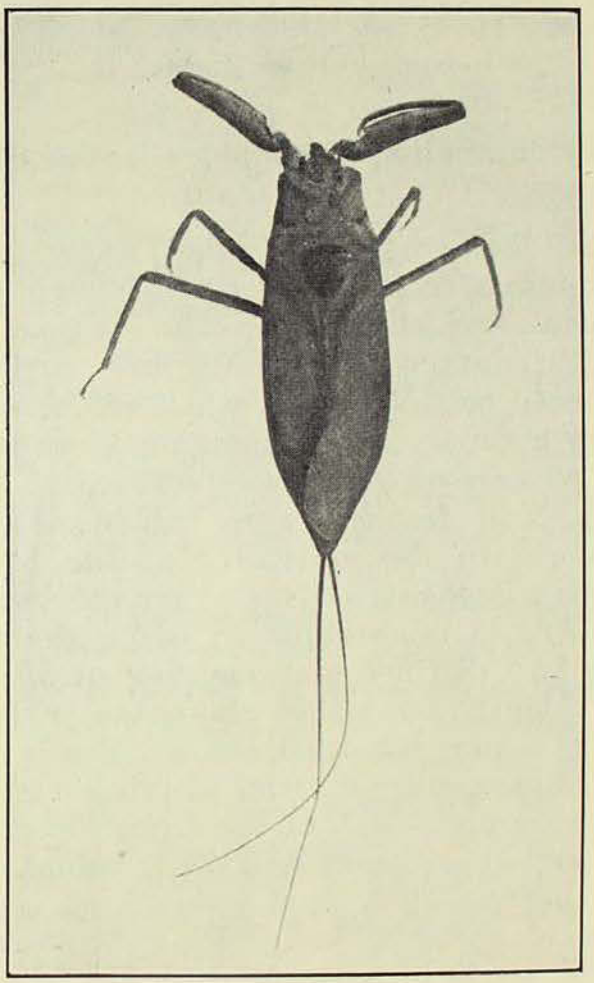

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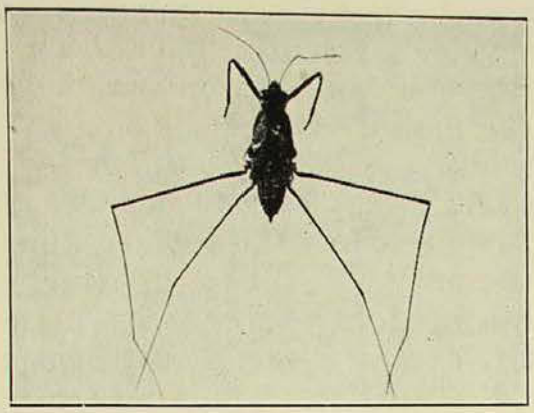

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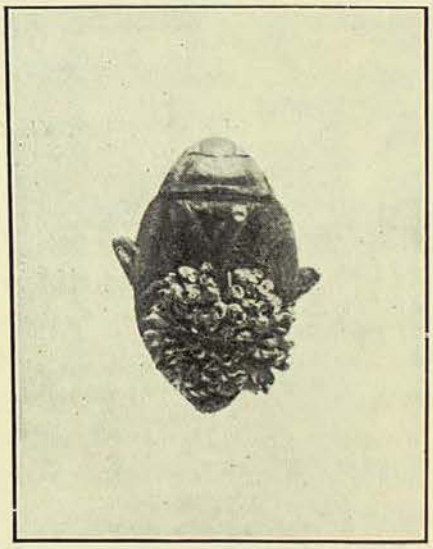
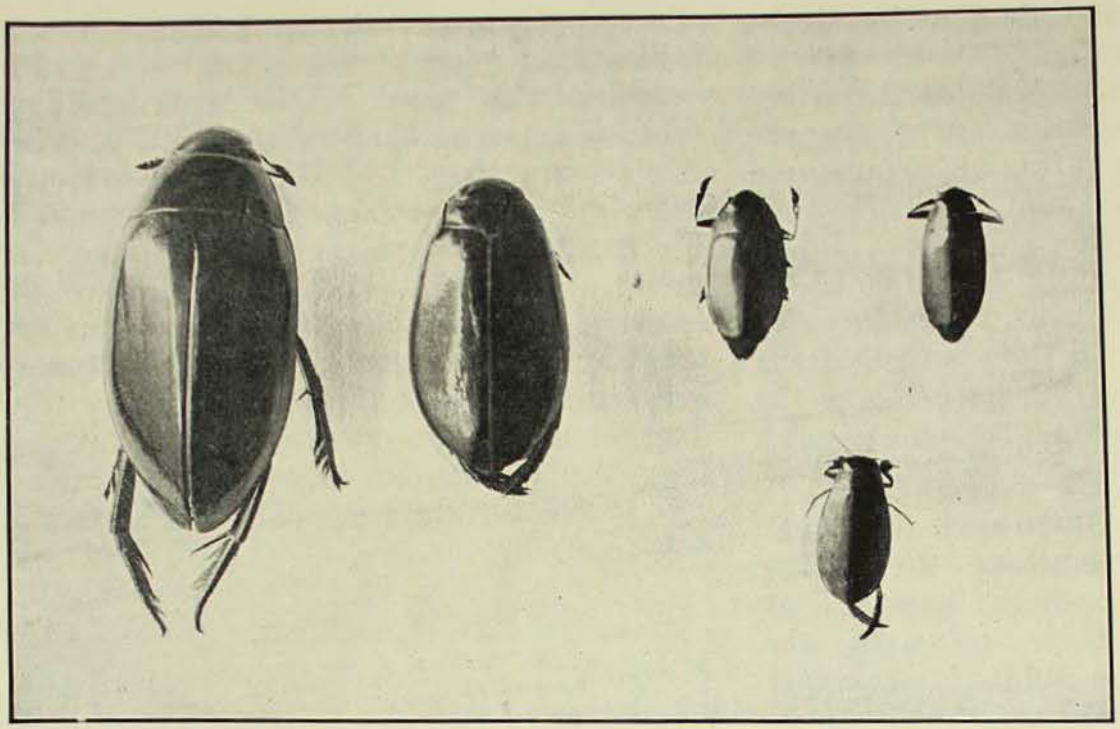
The large olive-green beetle with the yellow border to the elytra is *Homœdytes scutellaris*; it is carnivorous in both the larval and adult stages. The eggs are deposited in cavities cut in the stems of aquatic plants by the female, who uses her stout ovipositor for the purpose; eggs dropped at random in the water seldom develop.

The larva of *Homœdytes scutellaris*, popularly known as the "Water Tiger", is undoubtedly a veritable tiger of the under-water world, for it will seize and devour water animals many times its own size, hanging on like a miniature bulldog while sucking their blood through its long sickle-shaped jaws, which are pierced with a fine channel, from the point to the mouth, through which the blood is sucked while firmly embedded in the body of the victim. The larva breathes by means of a respiratory tube in the terminal abdominal segments, hanging tail upwards in the process. Almost all aquatic animals, snails, worms, insects, tadpoles and fish, are devoured by these insatiable beetle larvæ. When fully developed, the larvæ pupate in a clay cell in the bank of the pond. The adult beetle is wholly carnivorous, and lives upon much the same food as the larva.



Sphærodema rusticum, a bug widely distributed in eastern Australia. The illustration shows a male upon whose back the female has deposited a number of eggs. (Enlarged.)
[Photo.—*G. C. Clutton.*

In the male beetle the first pair of legs is provided with a remarkable cluster of suckers which are believed to assist the male in retaining his hold upon the female during courtship. So tenacious is the grip



From left to right: The Great Water Beetle (Hydrophilus latipalpus), largest of our aquatic beetles. Homœdytes scutellaris, whose larva is well known as the "Water Tiger". Two Gyrinids, Macrogyrus striolatus and M. oblongus. Lower figure is that of the common but little known Eretes australis.

[Photo.—*G. C. Clutton.*

of these suckers that female beetles have been secured with the cluster cups of the males still adhering to the thorax.

The supply of air is carried in the cavity under the elytra or wing covers where the spiracles are placed, instead of along the sides in the position normal in beetles; renewal is effected by raising the extremity of the body above the surface of the water and raising the tips of the elytra.

A small species, *Eretes australis,* is widely distributed throughout Australia; it is also carnivorous and attacks creatures larger than itself, but little is known regarding its life history.

The great Water Beetle (*Hydrophilus latipalpus*) is the largest of our aquatic beetles, and is a dark olive-green colour. The larva is very similar in appearance to the "Water Tiger", but heavier in build. It is carnivorous, but usually contents itself with smaller animals than the other species. The adult beetle is only partly carnivorous and has a preference for vegetable food. The eggs are deposited in a capsule or cocoon attached to the weeds; it is constructed with a projecting tail or mast, which is produced above the surface of the water, and appears to serve the purpose of admitting air to the eggs.

FLIES.

Our next group is that of the Diptera or Flies, many examples of which have adopted the aquatic life, notably the mosquitoes (Culicidæ).

Mosquitoes, both in their larval, or wriggler, and adult stages are too well known to require much description. Mosquito larvæ and pupæ form an important food for fish and other aquatic animals. Respiration is effected by means of an anal respiratory tube, which is brought in contact with the air through the surface film. In the pupæ the respiratory orifices are in the form of two curved tubes placed upon the thorax behind the head. This method of respiration makes available an effective means of mosquito control, for by placing a thin film of oil on the surface of the water access to the air is prevented and suffocation rapidly ensues. One species, *Tæniorhynchus,* has already been mentioned in connection with its habit of securing air from the stems of plants. It may be of interest to note that it is the female mosquito alone which bites, the male being incapable of taking other than honey and plant juices as nourishment. Mosquitoes are of the greatest importance medically as vectors of disease, and one need only mention the carrying of filariasis by *Culex,* malaria by *Anopheles,*

and yellow fever and dengue by *Aedes* (*Stegomyia*) *fasciata*.

The eggs of mosquitoes are deposited upon the surface of the water; in the case of Culicines in rafts, which are non-wettable, non-sinkable, and non-capsizable. The larvæ emerge from the lower end of the egg and immediately find themselves in the water. The eggs of *Anopheles* and *Aedes* are scattered on the surface of the water, frequently forming patterns as the result of surface tension. In some species the eggs are equipped with floats.

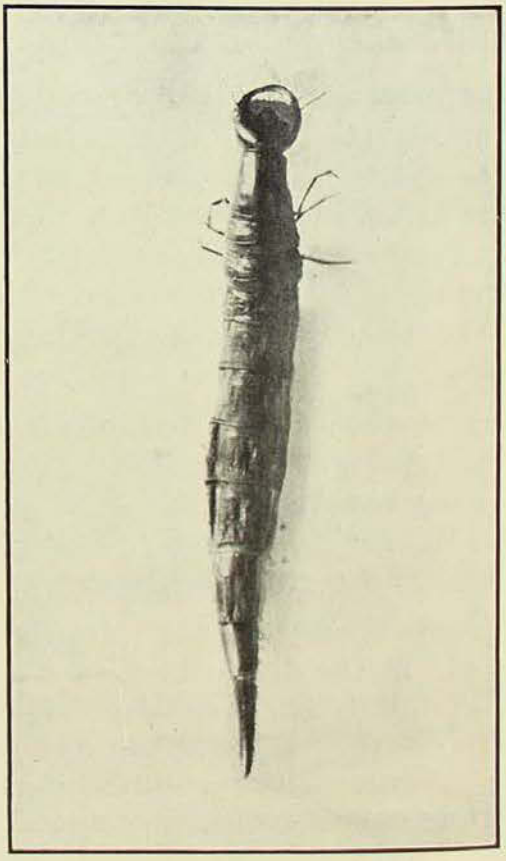
Insects frequently mistaken for mosquitoes by the laymen are the Chironomids or "Midges"; these insects bear a resemblance to their relatives the mosquitoes, but for rough and ready determination it may be said that a mosquito elevates the hind pair of legs while resting, while a Chironomid raises the front pair. The larvæ have been suspected of causing the death of fish, but they can be completely exonerated, for they are entirely vegetable feeders, living among the decaying vegetation at the bottom of ponds and water containers, where they construct slight cases of vegetable matter in which they shelter. While in the case, the larva maintains a constant undulatory movement, which serves to cause a current of water to flow through the case and over the gills, ensuring a constant supply of aerated water. The larvæ are popularly known as "bloodworms" on account of their red colour, which is due to the presence of hæmoglobin, the red colouring matter of mammalian blood, which has a great affinity for oxygen. In the possession of the hæmoglobin the Chironomid larvæ are almost unique in the insect world.

The egg masses, when first deposited, are covered with gelatinous matter, which expands in the water, forming a slimy transparent sausage, in which the eggs are arranged in a spiral chain close to the surface. The whole egg mass is anchored to the water weed or pond bank by means of a slender thread, which prevents it from being carried away by the water. The gelatinous covering serves to protect the eggs from enemies and against excessive evaporation.

In the rice fields of the Murrumbidgee irrigation areas these Chironomids breed in vast numbers, and about sunset I have seen immense swarms of them engaged in their nuptial dances, their numbers so great as to form dark clouds above the surface of the water. These swarms are attracted by the electric lights, and prove great nuisances in the houses, where they are generally thought to be mosquitoes; they are, however, incapable of biting. The larvæ form a very valuable source of fish food.

CADDIS-FLIES.

The Caddis-flies (Order Trichoptera) form a fascinating group for study from the habit of their larvæ of constructing portable cases which they cover with sticks, stones, shells and other natural objects. The cases of some species bear a very close resemblance to fresh-water snail shells. Caddis cases made of the



Larva of a Dytiscid beetle, probably Homœdytes latipalpus, popularly known as the Water Tiger.
[Photo.—*G. C. Clutton.*

more solid materials are so heavy that their occupants have great difficulty in moving them about from place to place. The larvæ are well provided with gills situated along the sides of the abdomen, and the insects keep up a constant undulatory motion to ensure a current of fresh water flowing over the gills. The anterior end, which protrudes from the case, bears strong slender legs, and is heavily chitinized, in marked contrast to the soft, white, abdominal segments which are concealed in the case. The terminal segment bears a pair of stout hooks which cling to the lining of the case and render the eviction of the insect a difficult matter. The eggs of Caddis-flies are deposited in rounded gelatinous masses, attached to stones and other submerged objects. When larvally mature, the insect spins a grating of silk over the end of the case, which, while protecting it from enemies, yet allows a free flow of water, and pupates.

Larvæ, pupæ, and more sparingly adults are greatly relished by fish. Trout especially devour the larvæ in large numbers, and these have been among the principal contents of trout stomachs I have examined. The fish swallow them, cases and all, with no apparent symptoms of indigestion, although the practice is rather like eating oysters with the shells intact.

The larvæ of Caddis-flies, except in one family, are vegetarian. They have, at times, caused considerable damage to rice crops on the Murrumbidgee irrigation areas. One family, the Hydropsychidæ, are carnivorous, constructing nets between stones and similar objects in running streams, and preying upon any luckless creature which may be swept into them. The adult Caddis-flies are active four-winged insects, somewhat resembling moths, with very long slender antennæ.

In closing, I would suggest that anyone who keeps aquatic insects in captivity will be well advised to keep the fullest notes on the habits of his captives, for he will find that he has entered a most fascinating field, as detailed observations and careful notes of the life histories are badly needed, for much remains to be learnt concerning the habits of even our commonest aquatic insects, and in some cases we know nothing at all of them.

Biographical Notice of Dr. T. Storie Dixson

THE late Dr. Thomas Storie Dixson, whose death took place on December 9, was one of the best-known medical men in New South Wales, who took an active part in hospital and ambulance work and was also prominent in scientific affairs. He had been a Trustee of the Australian Museum since 1898, was President of the Board from 1918 to 1925, and always displayed a keen interest in the activities and advancement of the institution.

He was the son of Hugh Dixson, founder of the firm of Dixson and Sons, tobacco manufacturers, and was born in 1854. For some time he attended the Sydney Grammar School, but, later, was educated privately by the Rev. Barzillai Quaife; he matriculated at the University of Sydney before reaching his sixteenth year. At the age of eighteen he entered on the study of medicine at the University of Edinburgh, where he came under the influence of Lister, the father of antiseptic surgery, to whose staff he was attached for three sessions as clinical clerk. He intended to graduate in science as well as medicine, but ill-health

prevented his attaining this ambition, although he distinguished himself in the geology class, which was then taught by Professor, afterwards Sir Archibald, Geikie. He graduated as M.B. in 1877, and subsequently studied special branches of medical science at Dublin, Berlin and Vienna.

On his return to Sydney he was appointed Lecturer in Materia Medica and Therapeutics in the newly established Medical School of Sydney University. Being granted two years' leave of absence, he spent most of that period at the celebrated Pharmacological Institute of Strassburg, where he made important researches and isolated the poisonous principle of the castor oil bean. Realizing the need of a text-book of pharmacology for use in British and American universities, he translated Schmiedeberg's *Pharmacologie*, which became the recognized text-book in English-speaking medical schools.

He was appointed Visiting Physician to the Sydney Hospital in 1888, and was later elected to a similar position in connection with the Infants' Hospital of the Benevolent Society of New South Wales, of which hospital he was the initiator. It was at his suggestion that the Eye, Ear and Throat Departments were established at the Sydney Hospital, and he was largely instrumental in forming the New South Wales Branch of the British Medical Association. He also acted as Honorary Consulting Physician to the Lady Edeline Hospital for Babies.

He took a very lively interest in ambulance work, especially in connection with the St. John Ambulance Brigade, of which he was Chief Commissioner for Australia; in recognition of his great services he was made a Knight of Grace of the Order of St. John of Jerusalem in England, a rare and coveted distinction.

The sad lot of afflicted children made a great appeal to Dr. Dixson, and he became Honorary Aurist and Oculist to the Institution for the Deaf, Dumb and the Blind, of which he was for some years President. At the time of his death he was also President of the New South Wales Medical Board, an office which he had held since 1919.

He never lost his interest in scientific matters, and was one of the oldest surviving members of the Linnean Society of New South Wales, which he joined in 1881; he served for fifty years on its Council and was President from 1903 to 1905. As a Trustee of the Australian Museum he was always looking forward, and was full of ideas for improvement in methods of preservation and display, in which branch of museum work he was able to make valuable suggestions based on experience gained in travel abroad. He was particularly impressed with what he saw in some of the large American museums, notably the American Museum of Natural History, New York, where he met and discussed museum methods with Professor A. Bickmore. Dr. Dixson was largely responsible for the initiation of a lecture course at the Museum; from small beginnings, these Museum lectures have grown in popularity and now form an important branch of the Museum's educational activities. He was a consistent advocate for the establishment of a children's room at the Museum, and it is hoped that some day a suitable room will be available so that this highly desirable addition to the usefulness of the Museum may be made.

Just before his lamented death Dr. Dixson presented to the Museum a valuable series of lantern slides, and also his microscope, a very fine instrument, with a large number of accessories for carrying out special work in microscopical research. These valuable and very welcome gifts were the outcome of his desire that the slides and the microscope might go to some institution where they would be of use.

Dr. Dixson was a man of wide sympathies and interests, who delighted in rendering unstinted service to charitable and other institutions. He led a full and useful life, unselfishly devoting his talents and training to alleviate human suffering and make this world a happier place for the afflicted.

C.A.

The Maternal Instinct in Insects

BY KEITH C. MCKEOWN.

AMONG the higher animals the maternal instinct is highly developed; the mammals suckle, care for, and guard their young from enemies until they are well grown and capable of fending for themselves. In the case of the birds, the eggs are brooded and the young fed by the parents, although there are a few curious exceptions, as in the case of the cuckoos, which foist their eggs upon some unsuspecting foster-parent, and the Mound-builders, which employ a heap of decaying vegetable matter as an incubator to relieve them of their family ties, the young birds being able to run and feed themselves immediately upon hatching.

When we come to consider the insects, we find that parental care of the young is rare; in fact, the mother is casual and her responsibility ends when her eggs are deposited upon a suitable food-plant or other situation where the food is readily accessible to the newly hatched insects. In contrast to the apparent callousness of the average insect, it is strange to find that cases of real maternal care do exist.

In the case of the well-known Paper-nest Wasp (*Polistes variabilis*), the queen wasp, after overwintering in some sheltered position, emerges from her shelter and constructs a small nest, consisting of a few cells only, in which she deposits her eggs, and guards them until they hatch; she then devotes her time to the capture of caterpillars; these she masticates and feeds to the young larvæ. When these worker wasps are fully developed the queen's activities in this direction cease, and the care of the young devolves upon the other members of the community. With the mud-wasps, of which a typical instance is *Sceliphron lætum*, the slender-waisted, black and yellow wasp that constructs its large clay nest on the rafters and walls of outhouses, the cells are stocked with spiders, first stung and paralysed in order to render them incapable of injuring the young wasp larvæ. When the cell is filled and an egg laid, the wasp closes the cell with an earthen plug, and leaves her offspring to their own devices.

The Carpenter Bee (*Lestis bombylans*) of the grass-trees excavates a tunnel in the flower stem of the Grass-tree (*Xanthorrhœa*), which is divided into cells, in each of which she places a ball of "bee-bread," and deposits an egg upon it. The larva, when the food supplies is consumed, pupates in the cell.

Colonies of ants, when first founded, are cared for by the queen until the first worker ants are mature and take over the whole of the work of the nest, when the queen devoted herself wholly to egg-laying.

The curious habit of a Sawfly (*Perga lewisi*) was first recorded in the *Transactions of the Entomological Society of London*, 1837, by R. H. Lewis, who observed the insects at Hobart, Tasmania; Mr. W. W. Froggatt has also written upon the habits of this insect, the larvæ of which feed upon the leaves of the Blood-wood. In his paper, "The Pear and Cherry Slug (*Eriocampa limacina* Retz.), generally known as *Selandria cerasi*, with Notes on Australian Sawflies" (*Agricultural Gazette of New South Wales*, 1901), he says: "The female makes a double slit on the upper surface of the leaf generally among the young growth, in which she inserts a double row of elongate eggs, which, as they swell, form a regular blister, but the most remarkable fact in the life history of this insect is the care she takes after laying her eggs. Nearly all insects after the eggs are laid leave them to their fate, but Lewis' Sawfly not

only stands guard over them until they are hatched, but further looks after the helpless little grubs for some time after they have commenced feeding. She straddles the eggs with her wings half opened, the tip of her abdomen turned up, and with her jaws open, makes a slight buzzing sound if meddled with: if you pick her up, she never attempts to fly, but crawls back to her post, reminding one of an old hen protecting her chicks."

Few of the beetles make more than the most casual provision for their young, but both the males and females of the Dung Beetles (Coprinæ), belonging to the genera *Onthophagus* and *Bolboceras*, co-operate in storing up a supply of food for their young.

Among the insects belonging to the Order Orthoptera, the Earwigs (Forficulidæ) and the Mole Crickets (Gryllotalpa) are noteworthy for the care of their young, since they both brood over the eggs, and when the larvæ hatch stand guard over them to protect them from their enemies. When disturbed, the immature insects crowd under the body of the mother, peeping out between her legs, and reminding one irresistably of chickens sheltering under the wings of the hen.

The well-known Cotton Stainer Bug (*Tectocoris diophthalmus*) provides a wonderful example of maternal solicitude, since she watches over her eggs until all are hatched, and the young bugs are capable of fending for themselves. Mr. F. P. Dodd has written an interesting account in the *Transactions of the Entomological Society of London* for 1904, in which he describes the curious habits of this bug. He writes: "Apparently the mothers never leave their eggs temporarily; any that I met with unprotected were quite abandoned. . . . It is absolutely certain that the 'broody' bugs remain foodless for the whole of the period of three weeks or more of 'sitting,' they occupy the same position always, and various investigations have failed to reveal any punctures in the twigs in front of them. . . . As already stated, the position of the insect never alters as she stands above the eggs—the forelegs are clasped about the twig in front of them, the third pair holds it just behind, and the middle pair clasps them about the centre, so that they are effectually shielded above: they are placed in rows all round the twig.

"In approaching a 'sitting' bug, or pushing any object near her, from the side, she inclines her body towards the threatening quarter, or exhibits much concern if the hands, say, are held near and moved about her: it is most absurd to watch her determined efforts to shield the precious eggs; she sidles to the right or left, as the case may be, to meet the supposed danger, but no menacing in front or behind will induce her to move." As the eggs hatch, the mother backs an inch or so away from the egg mass and stays there long after the last egg is hatched, when she departs, leaving the small bugs to take care of themselves.

It is curious to find these instances of maternal care in a group of animals, which, on the whole, appears to be practically devoid of what we consider the higher instincts, as from the human viewpoint. Although only a few of these cases are known to us, it is possible that when the life-histories of our native insects are more fully known, further instances of this care of their young by insects will be discovered.

Several collections of ethnological material were received during the quarter. Mrs. G. C. Lister presented a large number of specimens from Melanesia, and Mr. Wm. Dixson a series of Australian aboriginal weapons and implements. Mr. F. W. Hill presented a coffin containing a skeleton of a male aboriginal, which with two others was found in a rock-shelter on Vandyke Station, north of Springsure, in Queensland. This represents a very interesting type of native burial, and has been placed on exhibition in the gallery.

The Natural History of Rarotonga

by

G. P. WHITLEY.

Natives have surrounded a school of Unicorn Fish with a seine net, and are spearing them under water for their friends in the outrigger canoes.

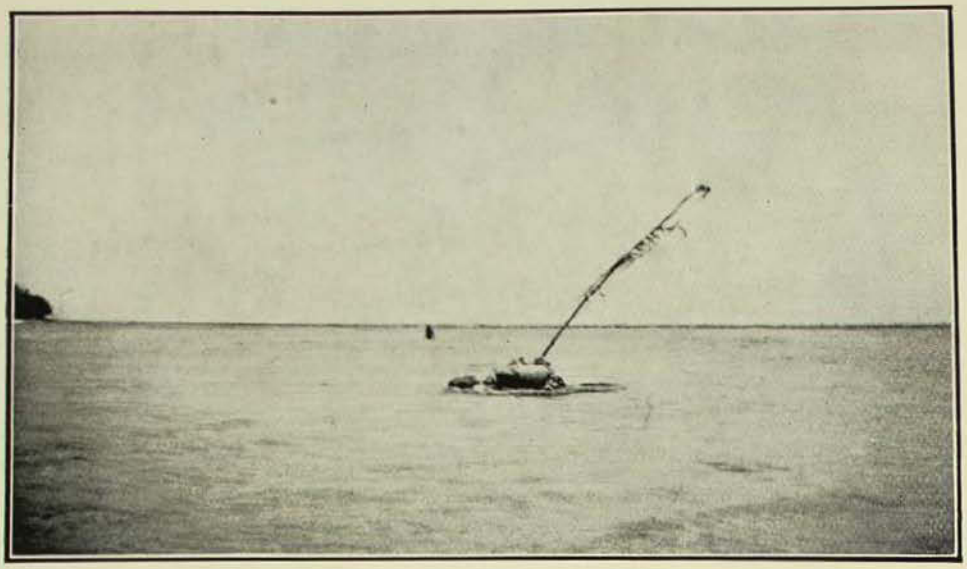
[Photo.—*G. P. Whitley.*

A NECKLACE of gem-like islands sweeps in a broad festoon over the bosom of the Pacific Ocean. Commencing in the north-west with the Marshall Group, the curve passes through the Gilbert, Ellice, Samoan, Cook, and other islands to the Low Archipelago. This region of Oceania is followed by a south-easterly oversea drift, the source of its distinct native fauna and flora, and may be named the Garrettian Province, after the late Andrew Garrett, an American naturalist who collected and painted the animals of the South Seas.

Ignoring introduced mammals, birds, insects, and plants, I was immediately struck by the conspicuous absence from Rarotonga, one of the Cook Islands, of animals well known in tropical Australia. This is not entirely due to the incessant search for food by the natives, for, in any case, the rich fauna of the continental areas of Australia, New Guinea, and the East Indies decreases as the Solomons, New Hebrides, and Fiji (themselves continental) are passed, until in the purely oceanic islands of the South Seas it has dwindled considerably.

MAMMALS.

Because of this distance from the continental land masses, there are only one or two mammals which may be regarded as truly Rarotongan. A species of Flying Fox, known as *mokirikiri*, is sometimes seen among coconut trees, but is regarded as a pest and is shot for a reward of threepence a head. Unfortunately, only one or two were seen during my visit, and I have so far been unable to secure a specimen. This bat is said to have been introduced from Mangaia, a neighbouring island, by the chiefs of old, who appreciated its flesh, but it may migrate from one island to another. The Pacific Rat (*Rattus exulans*) was almost exterminated by cats, introduced by the missionaries. At Mangaia, but not at Rarotonga, this rat was used as food. Anything edible is disposed of in an astonishingly short time, and when a whale came inshore only a mile from where I was stay-



"Fishing prohibited here" is the message conveyed by this wind-tattered coconut leaf erected by order of the king on a cairn in the lagoon.
[Photo.—*G. P. Whitley.*

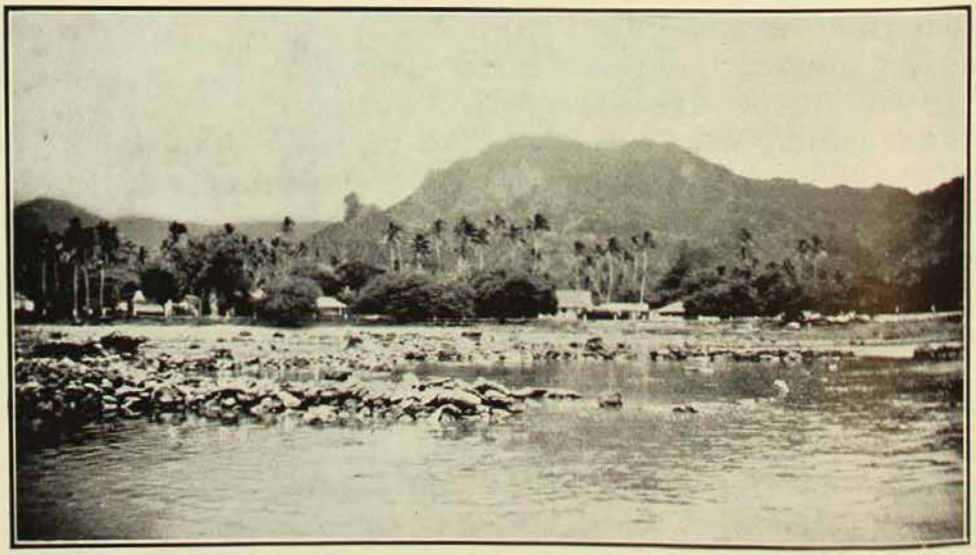
ing, it was cut up and taken away for *kai* before I could get to it to take photographs or measurements, only some gory water and pieces of blubber remaining. Whales were caught off Rarotonga over a century ago, and they still bring their confinement cases to the coral reefs there. The dugong does not occur so far out in the Pacific, but a seal (?), regarded by the natives as Satan himself, was once reported from Mangaia by the Rev. Wyatt Gill.

Introduced mammals are legion: dogs, cats, horses, sheep, cows, pigs, rats, and even guinea pigs. The horses are undersized, perhaps through lack of hard feed, whilst cows and sheep die prematurely. The introduction of rabbits is wisely prohibited. To our list of mammals perhaps should be added the introduced white man and brown.

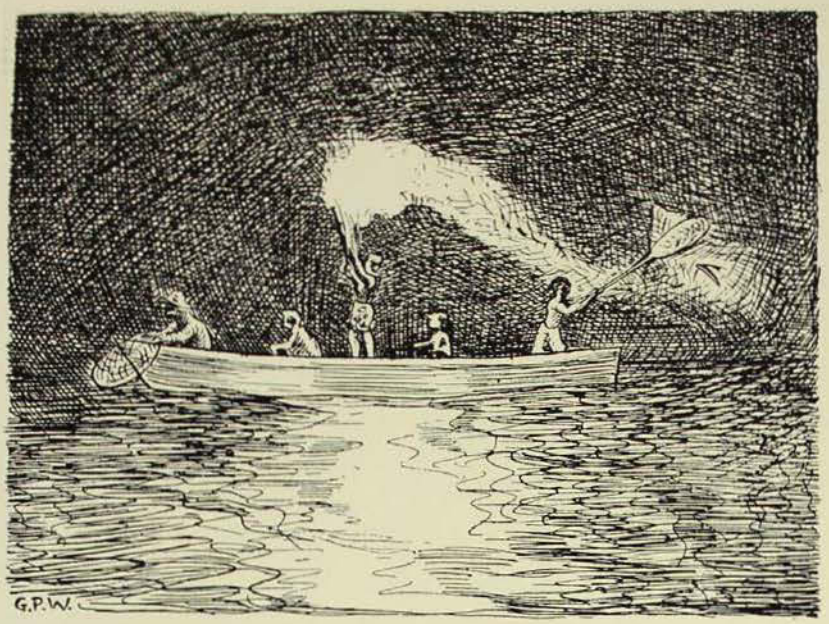
BIRDS.

There are no sparrows at Rarotonga, but their place is taken in the villages by the Indian Mynahs, imported to cope with the large introduced wasps. A plan was afoot to bring kookaburras from Australia to kill the rats, but the collapse of the copra trade rendered action unnecessary, and the idea was dropped. One misses the songs of birds in the tropical jungle, yet there are said to be some seventeen species of land birds so far spared by cats. These include a little green pigeon (*Ptilinopus rarotongensis*) and the Cook Islands Fly-catcher (*Rarotonga dimidiata*), whose scientific names betray their origin. The Long-tailed Cuckoo (*Urodynamis taitensis*) passes through Rarotonga *en route* for New Zealand, where it breeds, and little snipe-like birds are to be seen resting in the meadows before resuming their migrations. Domestic fowls have gone wild and are sometimes shot for sport. Their undersized chickens are, curiously enough, called *moa*, the Maori name of a giant extinct New Zealand bird.

At Rarotonga I saw no seagulls, wide-awakes, petrels, or albatrosses, but the Brown Booby and Frigate Bird are known there. Several White-tailed Tropic Birds were seen amongst the mountains behind Avarua, their satin white plumage relieved by a black stripe through the



Walls of rock have been built in the lagoon to trap fish, which, becoming lost in the maze, are left stranded by the tide.
[Photo.—*G. P. Whitley.*



The flare from a torch of coconut leaves attracts flying fishes at night, when they are netted from canoes. [*Sketch by* G. P. Whitley.

eye. The most charming bird of all was the little White Tern (*Leucanous albus*), which fluttered like a white butterfly against the green mountain sides or the bright blue sky. This species lays its egg on the branch of a tree, making no nest.

REPTILES.

There are no snakes on Rarotonga, not because some Pacific saint has followed St. Patrick's example, but because large stretches of ocean bar their entry. For the same reason there are also, apparently, no native Amphibia, though the Rarotongan word for frog, *Rana*, is, curiously enough, the same as the Latin. Turtles are said to be scarce, preferring the warmer waters further north.

A little skink lizard, called *moko*, is common in the bush and regarded as sacred. I once saw hundreds of *moko*, their footsteps like the patter of rain as they scurried over a thick carpet of fallen leaves beneath a large Barringtonia tree which had probably sheltered them during a storm the night before. It has been suggested that geckos and other lizards were introduced into the South Sea Islands by canoes, whilst the universal respect accorded them throughout Polynesia has been used to argue an Indian origin for the Maoris, who perhaps recognize in the *moko* a miniature of the dreaded crocodile.

CORAL CREATURES.

Rarotonga is completely surrounded by a coral reef, but at Avarua, the capital, the reef-crest is only about one hundred yards from the beach, and the intervening space is almost filled with dead coral rock, the amount of living coral being small; evidently this is almost a deceased reef. If at Michaelmas Cay, Queensland, the birth of an island had been visualized,[1] this Avarua reef shows senile decay and even burial, for, a little to the eastward, the elevated shoreline has encroached on the old lagoon, there overlain by part of the excellent road which encircles the island. However, at Titikaveka, on the southern side of Rarotonga, the reef-crest is far from the shore and a deep lagoon intervenes, where coral growth is luxuriant and brilliant fishes swim and feed. There is a different ecological facies every few dozen yards on these reefs, and months would be required for their survey and study. Here, slimy algæ coat the dead coral, whilst corallines and lithothamnion spread their stony covering; there, coral is flourishing in all its beauty; elsewhere, brown and dead, it crumbles and rots. In some parts of the lagoon there are even freshwater springs, and all these features influence the lives of the coral creatures.

Large black Sea Cucumbers, or *rori*, feed on the sand just as on the Barrier Reef or at Lord Howe Island, and even further afield. These, like the dozen other species of holothurians at Rarotonga, are of no commercial value. Their allies, the Brittle Stars, brown and blue Starfish (*Linckia*), and Slate Pencil Urchins, are quite common, and the larger Sea Eggs are segregated in the lagoon as a food supply by the natives.

[1] T. Iredale and G. P. Whitley: AUSTR. MUS. MAGAZINE, ii, 1926, p. 418.

Coconuts and Ironbark Trees (Casuarina) make a shady approach to the beach, fringed by Scævola, Tournefortia, and Goat's-foot Convolvulus.
[Copyright photo.—*S. Hopkins.*

FISHES AND FISHING METHODS.

There are a few small freshwater fishes at Rarotonga and a species of eel which is regarded as inferior in flavour to a similar kind imported from Mitiaro, another of the Cook Islands. The marine fishes are typical coral reef forms. Many are gorgeously coloured, others have long finger-like fin-rays, whilst a striped Surgeon Fish or *manini* (*Rhombotides troughtoni*) is very common. The largest fishes live outside the reefs; these are the sharks, swordfish, bonito, and manta rays. The smallest fishes are little green *Eviota*, which may spend their entire lives in one rock-pool. The *nou* or Stonefish is common amongst dead coral, and is much dreaded because of its venomous dorsal spines. If a wader tread on these, he is driven mad with pain and may even die as a result of the poison. I was informed that a native cure consists of applying a poultice of the mashed up twigs, leaves, seeds, and other parts of a convolvulus and a tree, known respectively as *Pohue* (*Merremia nymphæifolia*) and *Miro* (*Thespesia populnea*). This poultice is changed every half hour.

All sorts of fishing methods are in vogue amongst the natives, but the more finely flavoured fish of New Zealand are imported by many of the white residents. The *ume* or Unicorn Fish, which comes in shoals to feed in the harbour at high water, is caught by being encircled with a seine net run out by two canoes. Natives then plunge into the enclosed water, and, peering through diving goggles, spear the fishes under water, throwing them, when caught, to their friends in the boats. Often coral blocks are similarly surrounded, and the natives leisurely poke amongst the

coral crevices and grottos for fish and octopus, remaining under water for very long periods.

Basketwork traps are made to catch schools of *ature*, a fish like the Sydney Yellowtail, but which has apparently not visited Rarotonga for several years.

Various kinds of fish poisons are employed. The nut of the *utu* or Barringtonia tree is shredded and placed in the water, with the result that large fishes flee the scene, and all the small ones, even the very young, are stupefied and leave their coral shelters to die nearby. The foliage and fruit of a shrub (*Tephrosia piscatoria*) and a plant known as the New Guinea Root (*Cerbera manghas ?*) are also beaten with a stone and give off a milky substance in the water with deadly results. Naturally these destructive practices have to be stopped at times to enable the lagoon to become restocked. Then the king orders a coconut palm leaf, tied up to imitate the shape of a man, to be erected on the reef. This is the *raui tapu*, the Rarotongan equivalent to our notice-board: "Fishing prohibited here."

A charming study of a Rarotongan maiden, a modern Oreiad in a tropic setting.
[Copyright photo.—*S. Hopkins.*

Octopus ink is still used for fishing by some of the natives. Captain J. D. Campbell informed me that the ink bag is very carefully cooked for a long time and, by experts, is not polluted by the addition of any thickening substances. The resulting material is carried in a *parua* shell with a leaf lid and suspended from the neck with a cord of sennet. A little drop of this specially cooked octopus ink on a hook is all that is required to catch surgeon fishes, *manini*, and others.

Flying fishes, *maroro*, are caught at night, being netted from canoes in which one man holds a flare of burning coconut leaves to attract the fish. Fishes are also speared on the reef by torchlight. Ordinary line-fishing is practised with bent nails or imported hooks, which have replaced the old shell hooks, though these are still used for bonito fishing. A remarkable elbowed wooden hook is submerged into deep water offshore to catch the oily *paru* and the barracouta.[2] Walls of stone are erected on the reef to entrap fish as the tide ebbs. A bite on the back of the fish's "neck" soon ends its struggles. At Aitutaki, but not at Rarotonga, huge sharks are caught by native divers, who place a noose over their tails as the sharks lie on the bottom amongst the coral.

SEA SHELLS.

There is rather a poverty of sea shells at Rarotonga, because molluscs with large eggs, such as the Bailer Shell, have been unable to spread so far across the Pacific, and the absence of mangroves, nipa palms, and other trees of tropical shores is also responsible for a lack of their associated molluscan faunas. The Rarotongan sea shells have evidently originated as floating eggs or swimming larvæ brought by the ocean drift from the north-west.

[2] J. D. Campbell: *Mankind*, i, 1932, p. 112.

It is difficult, however, to form a true idea of the molluscan population, as the reefs are daily combed for food, and such forms as clams (*paua*) and whelks are prevented from growing to any size. Pearl Shells are common in the northern Cook Islands, but not at Rarotonga, and the commercial Trocas and Turbo are said to be rare. One of the bivalves, known as *kai* (*Asaphis taitensis*), is eaten and the shells used as scrapers and for other purposes. A little knobby whelk, *mangeongeo* (*Morula*), is regarded as a relish, tasting rather like mustard. Cowries of many beautiful kinds are common and are sold to tourists or used as poker chips, whilst brown-spotted Pencil Shells (*Terebra maculata*) may be collected as they crawl, half-buried, over the sand. On the niggerheads or cast up coral blocks are found limpets and nerites. *Toeroa* was the name given to a razor shell (*Pinna*), a shell quite unlike the *toheroa* of New Zealand, now famous as a base for soup. The large Frog Shell, a whelk called *karikao* (*Bursa*), is used as a trumpet to announce the coming of each driver of a horse and cart along the main road. The *ariri* or Turban Shell (*Senectus*) is chosen as a home by the large land hermit crab.

One shell, the *ungakoa* (*Vermetus*), looks more like a giant worm-tube than a mollusc. The mouth of its shell tube, circular and razor-edged, protrudes from the surface of the reef, so that even the leathery soles of the natives are often badly cut by these creatures.

Pelagic animals are popularly supposed to be rare in Polynesian seas, yet I found several Violet Snails (*Ianthina*) and a solitary Portuguese Man-o'-war (*Physalia*) washed ashore.

I was anxious to secure, if possible, any loricates or chitons on the reefs and managed to find several specimens of these little eight-valved shells, which proved to belong to a new species (*Rhyssoplax whitleyi*). Hedley,[3] quoting Pease, stated: "The absence of Chitonidæ from Polynesia has been noticed by authors as a remarkable fact, abounding as they do in the surrounding provinces, especially on the west coast of America, at Australia and New Zealand."

Sea Hares and other slugs are eaten by the natives, regardless of the purple juice squirted over their faces and hands. In all other places but Polynesia these animals are regarded with a superstitious horror. The Rarotongans also eat the eggs of these slugs and are particularly fond of octopus.

LAND SHELLS.

Rarotonga is famous for its land molluscs, of which there are some extraordinary forms: the Marsupial Snail (*Libera*) is a conical land snail which lays its eggs in the umbilicus, where the young are carried; *Thaumatodon* has rows of saw-teeth within the mouth of the shell; *Tornatellina* is a dainty cone of glass. Native girls procure little snail shells of the genus *Helicina* from Mangaia and, bleaching some to make contrasting patterns, weave them into ornaments and garlands. These, like all snail-like shells, are called *pupu*. Some Corkscrew Snails, common under stones, belong to freshwater species of *Melania* or the apparently introduced *Subulina octona*. Mr. T. Iredale, who has identified my shell collection, informs me also that a slug which was named *Limax rarotonganus* proves to be an introduced European species, *Agriolimax lævis*.

CRUSTACEANS.

All sorts of crabs are found on the coral reefs, especially under stones. *Carpilius* has blood-red "finger-marks" on its carapace, the Box Crab (*Calappa*) looks like a carved ivory box and buries itself in sand when disturbed, whilst little hermit crabs inhabit shells under nearly every stone. There are no Robber Crabs at Rarotonga, but the large *unga* or Land Hermit Crab scampers out of one's way at night or ruins the lawns of amateur gardeners. Near the edge of the beach lives a little crustacean whose large eyes and long tails give it a remarkable

[3] C. Hedley: *Austr. Mus. Mem.*, iii, 1899 (Atoll of Funafuti), p. 550.

appearance, whilst its very rapid movements render it most difficult to catch.

In the depths of the cool jungle inland, where a waterfall drops into a rocky pool, little freshwater shrimps crawl along the bottom and nibble the toes and legs of bathers. Another kind, of a beautiful gunmetal blue colour, creeps up the wet rocks or swims against the current. As, in the damp moss overhead, millipedes swarmed, quite a collection of arthropods could be made without much trouble. There is a species of scorpion at Rarotonga, and several kinds of spiders, one, the *katipo*, reputed to bite, whilst the centipede has an evil reputation for the same unpleasant habit.

INSECTS.

The introduction of many plants into Rarotonga has not been attended by so great an increase in the insect population as might be expected, as most of the many importations have been raised from seed. Nevertheless many insects have become acclimatized and added to the probably small original insect fauna, so that now there is almost as much humming, buzzing, hovering, flying, and creeping by the sunlit roadsides of Rarotonga as in a glade of the New Forest or an open piece of Sydney bush. Ants are common and may have been introduced by drifting debris, blown leaves, or the flight of their winged forms. The Copra Bug was rare during my visit as no copra had been treated for some time, the market having lapsed through the popularity of whale oil. Butterflies, moths, flies, leafhoppers, dragon-flies, bees, and grasshoppers are common. Scale insects are kept in check by Chalcid wasps, but fruit fly, supposed to have been accidentally introduced from New Caledonia, is the worst pest. A species of mealy bug attacks the Pandanus trees. It has been stated[4] that the mantis or *ee* is a common pest on Rarotonga, but this is apparently an erroneous identification, based on the Stick Insect (*Græffea crouanii*). A prominent insect is the Gallipot Wasp or Hornet, said to have been introduced into the islands from South America. Cockroaches are also common, especially at the bottom of utensils used by the distillers of illicit fruit-beer. I saw no mosquitoes or other noxious insects, though the ubiquitous flea was sometimes in evidence, whilst, as an unhappy ending to this article, it may be recorded that the lamp on our bridge table one hot night was responsible for the premature death of innumerable tiny "wogs".

[4] E. Belcher: *Narr. Voy. Sulphur*, ii, 1843, p. 19.

Reviews

INSECT BEHAVIOUR. By Evelyn Cheesman, F.E.S., F.Z.S. (Published by Messrs. Philip, Allan & Co., Ltd., London). 8vo., pp. vii + 189, illustrated; 1932. English price: 4s. 6d. net.

This delightful little book, by an authoress well known as a highly skilled entomologist, should appeal to all who are interested in the ways of insects. Its special mission is to give to the lay worker or "man in the street" some insight into insect behaviour. In the introduction it is shown how the old-time naturalists believed insects to be intelligent, though present-day entomologists consider that these actions should be attributed to instinct. The nine chapters which follow are devoted to: (1) The Antiquity of Insects, (2) Simple Actions and Their Origin, (3) The Tyranny of Tropisms, (4) Failure of Instinct, (5) and (6) Instincts, (7) Variation of Instinctive Behaviour, (8) Awareness of Failure, and Danger (9) Summary. An index completes the work.

Miss Cheesman's activities as an insect collector in the Pacific and other parts of the world have been the means of bring-

ing her into contact with many interesting forms of insect life, and in her book she writes entertainingly of the amazing instincts shown by many of the insects she has encountered.

A.M.

WHAT BUTTERFLY IS THAT? A GUIDE TO THE BUTTERFLIES OF AUSTRALIA. By G. A. Waterhouse, D.Sc., B.E., F.E.S., F.R.Z.S. Illustrated by Neville W. Cayley, F.R.Z.S. (Angus and Robertson, Sydney, 1932). 8vo., pp. 291, 34 plates. Price: 12s. 6d.

Angus and Robertson, Ltd., has now published *What Butterfly is That?* uniform with the colloquially titled *What Bird is That?*, the letterpress being by Dr. G. A. Waterhouse, the coloured plates by Mr. Neville W. Cayley, and the life histories in monochrome by Miss Phyllis F. Clarke (Mrs. D. S. North). This work is one which should interest all Australian nature lovers, for it is written by an author who is famed for his knowledge of his subject. It is designed to provide a ready means of identifying Australian butterflies, and, at the same time, to give such information as is at present known about the life histories of the species. The author expresses the hope that "these glimpses of strange and wonderful lives may be an incentive to some to find out details of them at present unknown". There exists no popular work dealing exclusively with Australian butterflies, as the late W. J. Rainbow's *Guide to the Study of Australian Butterflies* is out of print, and *The Butterflies of Australia*, by Messrs. G. A. Waterhouse and G. Lyell, is intended for the advanced worker in entomology, so that there remains only the chapter devoted to the Lepidoptera in Dr. R. J. Tillyard's *The Insects of Australia and New Zealand*. The arrival of the present work is therefore most opportune. The chapter on collecting should prove of service to the beginner forming a collection, since it explains how and where to collect, and how to set and care for the specimens captured or bred. Any criticism that may require to be levelled at so useful a work must be of an extreme nature, and perhaps one may be pardoned for wishing that in a work already lavishly illustrated, the masterly drawings by Miss Clarke (Mrs. North) had been reproduced in colour instead of monochrome, and that more of them had been included. Also in the matter of vernacular names, which rarely interest the scientific worker, but are eagerly seized upon by the novice, some of the vernaculars selected are similar to those used for Australian birds, so that confusion may result. The selection of apt vernaculars or common names for our Australian fauna is a problem almost impossible of solution, since little attempt is made by the Australian people to study their mammals, birds and insects, and to suggest names for them such as we find in old countries. We congratulate the author, artists, and publishers on the publication of this well produced work, and confidently recommend it to all interested in the butterflies of Australia.

A.M.

In November a party consisting of Messrs. H. J. Carter (Hon. Entomologist, Australian Museum), Keith C. McKeown (Assistant Entomologist, Australian Museum), and J. Armstrong made a collecting trip to Garrawilla Station, Mullaley and the Nandewar Ranges, near Narrabri. The season unfortunately proved to be later than usual, and owing to the cold dry weather the Nandewars were found to be very barren of life, a condition undoubtedly due to the season. Good collections were, however, made at Garrawilla, Gulgong, Tamworth, the Hastings Range, the Comboyne and Wingham, including material new to, or previously poorly represented in, the Museum collections.

Some Aboriginal Beliefs and Customs

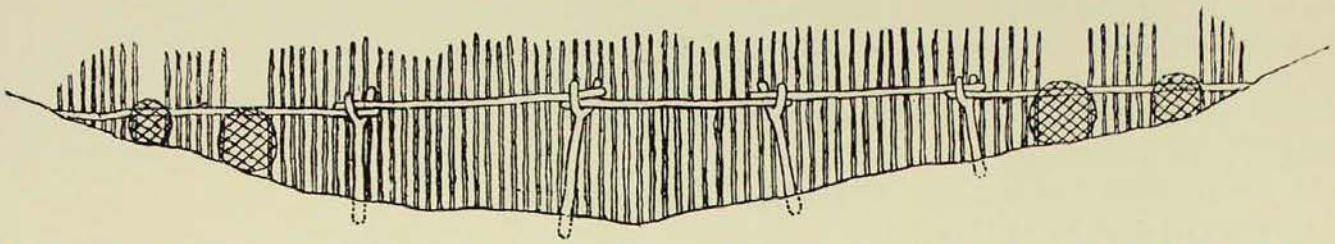
BY A. W. BUCKNELL.

I WAS born at Yarawa on the Boomi, near the present border town of Mungindi, and in my youth I came much in contact with the blacks living in that district. They were a branch of the great Kamilaroi tribe, which once occupied a large area of northern New South Wales west of the Dividing Range and a portion of southern Queensland. They were a happy, lazy, laughing people, not by any means dangerous or quarrelsome. In my childhood I learned something of their myths and customs, and of their skill in tracking, fishing, and hunting. Biamai Deah was their great god and creator, and I was told that many years ago he, with two wives, came to earth at Collarenebri on the Barwon River, and that, after remaining with the people for some time, he travelled up the Barwon, taking his wives with him. The blacks believed that after death they went to the cluster of stars which we call the Pleiades, but whether they all went there, or only the good, I never learned.

They had great faith in their medicine men. Once old Cowbail Billy—whose birth or class name was Kumbo, a man of some repute as a sorcerer—had been away for some time. On his return he explained that he had come home in his *boolee* (whirlwind). This was told me by our house boy, whose birth name was Hippi, but he seemed to be more amused than impressed. I think that Hippi, who had been much amongst white people, had no great faith in Cowbail Billy.

In their natural state the blacks could count only up to three—*marl*, *boolar*, and *coolabar*. For four or any number over four they used the word *boodalarbar*. They could, however, represent numbers rapidly on their fingers, and I knew one

Aborigines, using hand-nets, fishing in a swamp.
[Photo.—*Captain Frank Hurley.*



Fence, or barrier, erected in creeks for the purpose of catching fish. The fish are either speared or caught as they make through the openings.

[*After* Roth.

pure-blooded aborigine who could count sheep as well as a white man, but he had been among whites and sheep since childhood.

A very strict custom prevailed which forbade a man to speak to, or even be seen in the company of, his mother-in-law. This often caused us inconvenience at the homestead, for there was always a gin (woman) in the kitchen and a house boy to do odd jobs about the place. After yarding the horses the boy would go into the kitchen to get his breakfast, which he took outside to eat, but if the kitchen woman happened to be his mother-in-law, or possible mother-in-law, he was bound by custom not to go into her presence. This difficulty was usually overcome by letting a child take his food to him.

HUNTING AND FISHING.

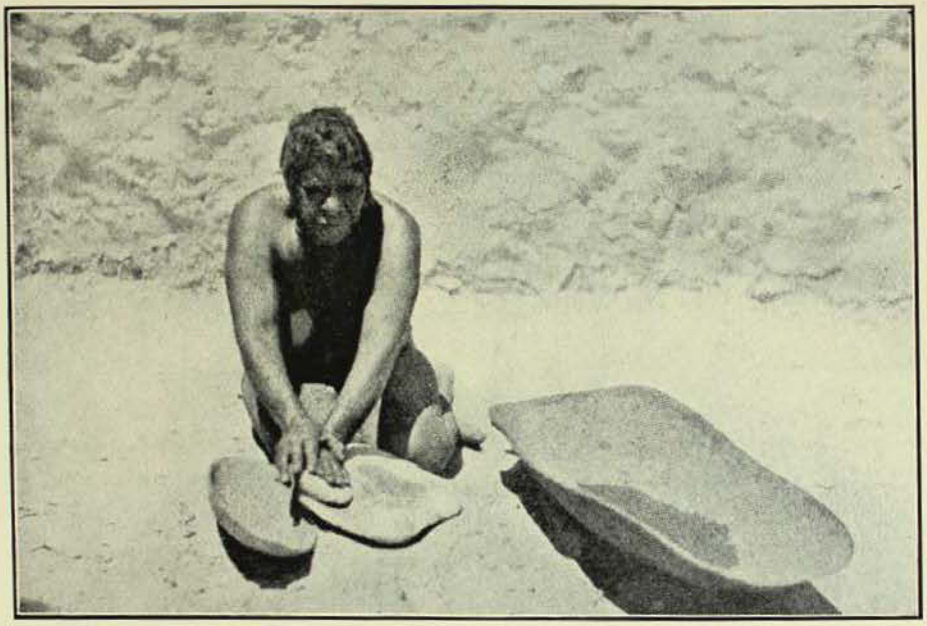
Their methods of hunting and fishing were most ingenious and interesting. The emu (*dhinoan*) being a shy bird, and its numbers kept down by the dingoes and the blacks themselves, could not be captured without the exercise of considerable cunning. A man would climb a tall tree near the track usually followed by the emus when going to and from water. He was armed with a heavy spear, more than twice as heavy as the ordinary throwing spear. A bunch of coloured feathers was suspended from the tree, reaching nearly to the ground. The emu, a most inquisitive bird, would step aside to examine the bunch of feathers, and thus place itself at the mercy of the heavy spear crashing down on it from above.

There were various methods of catching fish. When the rivers and creeks were low, a barrier of upright sticks and bushes was erected at shallow crossings where the water was about two feet deep, and fish would be trapped in large quantities. If a big catch was desired they would be netted. Single fish were caught by hand. Once I had occasion to visit the blacks to secure the services of old King Dicky, our most reliable tracker, to follow up some sheep that had been lost. At that time the blacks were camped near a large lagoon, which rarely, perhaps never, went dry, but was then very low, no deeper perhaps than three feet. While I sat on my horse waiting for Dicky to get ready, two young men took a net into the water and threw out on the bank enough fish to feed the whole camp of about forty people for a day. On another occasion I was out all the morning with Dicky tracking sheep when we came to a muddy waterhole in the *gil-gil*. We did not have much food with us, and Dicky said he would get a fish. He went crawling and feeling about in the waterhole, and before I had the billy boiled there was a splash and a splutter, and Billy had a nice fish, enough for both of us.

To catch ducks they chose a spot in a dry watercourse between two lagoons and erected a net across it. The ducks when disturbed would fly from one lagoon to the other, and as they passed over the net boomerangs were thrown high above them, making a whistling sound like that of an eagle. This would cause the ducks to swerve downwards to become entangled in the net. At night a bright fire was lighted, and ducks flying overhead, mistaking the firelight for water, would come to the ground, to be captured before discovering their mistake.

GRASS SEED CAKE.

A kind of bread was made from the seed of the annual barley grass (*kunnully*). In good seasons this grass grew in abundance on the plains and the seed, which, unlike our barley, has no husk or ear, could be gathered in quantity. To grind the seed a gin would squat by a "grinding mill", a flat stone about a foot or more across, and hold a smaller stone, flat on one side, in both hands. From a bark dish (*coolamon*) by her side she would take a mouthful of water, and as she ground the seed she would squirt some water on it, thus grinding the seed and kneading it into dough in one operation. The dough, baked in hot ashes, made quite good tasty bread called *dooerl*. Before long, however, the native grass-seed bread gave place to that made from white man's flour.



Grinding munyeroo seeds. Water is sprinkled on them whilst grinding, and a dark paste is produced, which is accumulated in the wooden bowl or pirrha. This is either eaten at once or cooked in ashes. The mill stone, muddha, may have two grooves, one at each side running full length, which are worn by the rubbing stone.

[*After* Horne and Aiston.

Many kinds of roots were gathered for food, the most important being *coobiei*, a yam as large as a potato, and a smaller yam called *milarn*. Many fruits were in use by the blacks, such as the *ngipan*, which is quite tasty if one does not bite on the very hot seed, and the *bumble*, a wild orange, which serves both as food and drink.

MARRIAGE CUSTOMS.

Marriage was regulated by certain rules of relationship; if these were broken trouble might arise, but disputes of this kind seldom had serious results, as the authority of the old men was generally sufficiently strong to settle the argument and enforce the law. One fight, however, the result of a matrimonial tangle, did have a fatal result. A black strange to the district and known as Policeman Billy, as he had served in the police force, became a shepherd on a neighbouring station. He took as wife a local woman known as Kittigar, whose class or birth name was Martha. A local black known as Eliza's Tommy considered that he had a prior claim to Kittigar, and went over to get her. After he had explained the situation to Billy the latter magnanimously said, "All right, as she is yours, take her." So Kittigar went away with Eliza's Tommy. After proceeding for a few miles they came to a fence, and Tommy said, "You stay here while I go back and kill that blackfellow." When he came back to Billy and wanted to fight, the latter refused, saying, "I won't fight you now, you are drunk. Come back when you are sober and I will fight you." But Tommy was determined to settle the quarrel then and there, and the duel commenced. A white man happened to be present and saw the whole affair. The two were well matched, Billy a sturdy fellow of about thirty, with manners and speech more like a white man's than a black's; Eliza's Tommy, aged about twenty-four, a more active man with perfect limbs and action. Both were well armed, each having a large knife in addition to their native weapons. After some sparring Billy stabbed Tommy in the chest, inflicting a severe wound,

A woman in mourning, wearing a widow's cap. Her body is covered with white pipeclay. Clay is applied daily for some months until the mass becomes helmet-like, and may weigh up to fourteen pounds. It is removed by cutting the hair close to the head, and is then placed on the grave.
[*After* Worsnop.

from which he died; but before he fell he had strength enough to draw back and hurl three boomerangs at his opponent. Billy was arrested and tried for murder, but was acquitted, as the fight had been forced upon him. This was the only occasion, to my recollection, when a black's quarrel had a fatal ending.

BURIAL CUSTOMS.

Whenever possible the blacks interred their dead in the ground, scratching a hole about four feet deep. If, however, a death took place a long way from sandy or soft soil, the body would be placed in the hollow of a tree, a few bushes and sticks being pushed down over it. After a death the women set up a wailing, which they continued for some weeks. A most mournful sound it was, something like the howl of a dingo. Some of the old women put a cap of clay on their heads, carrying it for some time.*

HALF-CASTES.

In conclusion, I must say a few words regarding the half-castes. It is a common saying that a half-caste has the vices of both races and the virtues of neither, but my experience does not bear this out. I knew numbers of half-castes, and very competent men they were, combining the general knowledge of the whites with the bush-craft of the blacks. In many cases half-castes were left in charge of stations, mostly small unfenced cattle runs, and they proved themselves to be most trustworthy and efficient, and, on account of their astonishing tracking and scrub-riding abilities, no cattle could get away from them.

* These caps were usually made of burnt gypsum (plaster of paris), sometimes mixed with pipe-clay. As a rule they were worn by widows as a token of grief. Amongst the Darling River tribes the nearest female relative other than the widow assumed one.—EDITOR.

Two exhibits of special interest are now on view in the entrance hall. One includes examples of the commoner venomous snakes of Australia and illustrates methods to be adopted in the case of snake-bite. Dissections show the poison apparatus in typical snakes, the methods of extracting the venom are illustrated, and samples of the venom are exhibited. A number of harmless lizards which are often regarded with fear are also included.

The other exhibit consists of a number of genuine and counterfeit coins arranged to assist in the detection of forgeries, often a matter of some difficulty. The features in which spurious differ from genuine coins, such as milling, colour, thickness, hardness, are illustrated by examples.