# AUSTRALIAN MUSEUM MAGAZINE

All Streets and

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



A Chapter from the Life Story of a Cicada - A. Musgrave Insect Foods of the Aborigines - Thos. G. Campbell On the Cause of Phosphorescent Light in Sea Water Arthur A. Livingstone The Cameo Shell - - Tom Iredale The Birth of an Island Tom Iredale and Gilbert P. Whitley Aboriginal Message Sticks - W. W. Thorpe Legless Lizards or "Snakes with Fins" J. R. Kinghorn

More Life of the Tidal Flats

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The Black Helmet Shell (Cassis madagascariensis). It is from this species that the finest cameos are cut. The shell derives its name from the darkness of the basic layer. Like other helmet shells, this is found only in the Tropics and is of comparatively recent origin.

[Photo.-G. C. Clutton.



VOL. II., No. 12.

OCTOBER-DECEMBER, 1926

# Editorial. A Marine Biological Station.

THERE are many problems of marine biology which can be solved only by the aid of a properly equipped station where

aid of a properly equipped station where the animals can be studied in the living or fresh condition. Practically every country with a seaboard except Australia can boast of at least one marine laboratory, but Australian students are still without this valuable adjunct to research.

As long ago as 1878 the establishment of a zoological station on the shores of Port Jackson was mooted, Baron Miklouho-Maclay, a distinguished Russian scientist, then resident in Sydney, in addressing the Linnean Society of New South Wales used these words, "Next after the tropics the widest field offered to the investigator of nature, and consequently the most suitable region for the establishment of zoological stations, is Australia, with a fauna so interesting, so important, and so very far from sufficiently known, especially as regards anatomy and physiology. Such a country would be the place for a zoological station or to speak more correctly, for several such stations.'

His suggestion was considered by a committee of the Society, who reported that the proposal was an excellent one and should be acted upon without delay. Certain steps were taken, a sum of money was raised, and trustees appointed. A temporary station was actually established on the Military Reserve at Watson's Bay, Baron Miklouho-Maclay being placed in charge, but after a short time it was discontinued.

Again in the early 'nineties the project was considered, together with a proposal to establish an aquarium, and, from a Parliamentary Paper dated 1892 and addressed to the Minister for Public Instruction, we learn that the Trustees of the Australian Museum met several times as a committee in conjunction with the Commissioner of Fisheries, the Trustees of the Marine Biological Station, the Director of the Botanic Gardens, the Superintendent of Technical Education, and the Curator of the Technological Museum, and presented a report recommending that a building should be erected on the east side of Farm Cove between the Botanic Gardens and Mrs. Macquarie's Chair, to serve as an aquarium and a biological station. But the suggestion was not carried out.

The lack of such a station has often been felt, and indeed it is not to our credit that here, where the marine fauna is second to none in interest and importance, and where the facilities for its establishment are of the highest, an institution of this kind is still in the future.

The advantages offered by marine biological stations are many. It is only in such laboratories that students can examine delicate organisms and study their development, physiology, and minute structure. Many phases of marine life, for example the response to various environmental factors such as temperature, light, salinity, cannot be adequately investigated on museum material. The spawning habits and rate of growth of crustaceans and fishes, the larval stages and life histories of molluscs, echinoderms, worms, and many other aquatic creatures are important objects of research not merely from the purely scientific point of view, but also on economic grounds.

We are ignorant regarding the nature of the food of our edible crustacea and fishes. All animal life ultimately depends on the material and energy stored in plants, but the basis of oceanic life is the plankton (floating life) of the sea. We know but little regarding the composition of the plankton characteristic of Australian oceanic waters, but the study of these organisms, which are largely microscopic, would be greatly stimulated had we a properly organised marine laboratory.

Other useful purposes which could be served by a marine station would be to supply specimens for university and other classes and for museums, and to collect data regarding migration of fishes.

It is doubtful whether Farm Cove would now be regarded as a suitable site ; shipping has developed very considerably since 1890. and the harbour waters, particularly on the southern shores of Port Jackson are not so free from pollution as they were thirty years ago. It is a desideratum that a marine biological station should have a supply of the purest sea water, and that diverse natural features such as lagoons, rocky promontories, sandy and muddy bottoms, should be in close proximity. It should however be possible to find somewhere along the many miles of foreshore afforded by Port Jackson a spot where most if not all of the necessary conditions could be obtained.

# Notes and News.

At the September meeting the resignations of Mr. E. Wunderlich, F.R.A.S., President since December, 1925, and of Sir William Vicars were accepted with great regret. Mr. Wunderlich has been a trustee since 1914 and took a deep interest in the affairs of the museum, to which he has made many generous donations, the most valuable being the aboriginal group consisting of three figures. Sir William Vicars became a trustee in 1923, and his business ability and advice were highly appreciated by his colleagues.

Among those who have visited the Museum during the last three months were Dr. Radcliffe Brown, newly appointed Professor of Anthropology at the University; Mr. Donald Campbell, Protector of Aborigines, Alligator River District, Northern Territory; Mr. Edward O. Armitage, F.E.S., Melbourne, who is keenly interested in the study of greenstone and jade; Dr. W. MacGillivray, Eroken Hill, the well-known ornithologist; Messrs. O. A. Jones, B.Sc. and A. E. Denmead, B.Sc. of the University of Queensland, who examined our collection of Palaeozoic fossils; Mrs. Richards of San Francisco, who is studying the Pacific island peoples; Miss Ida Dawson, who has travelled extensively in South America, and who presented a collection of Patagonian stone implements.

An exhibit of unusual interest has been installed recently. This is a collection of skull casts of prehistoric races of man ranging from *Pithecanthropus erectus*, the so called "Ape Man" of Java, to the Crô-Magnons, the fine tall race which succeeded Neanderthaloid man in Europe. Special interest attaches to the "Dawn Man," *Eoanthropus dawsoni*, of Piltdown, the Rhodesian skull from Broken Hill, and the Talgai boy of Queensland. For comparison an aboriginal skull from Western Australia, showing some very primitive features, is included.

The acquisition of the collection of fossils and recent shells made by Mr. Varney Parkes makes an important addition to the palaeontological and conchological section. Mr. Parkes has been a keen and discriminating collector since boyhood, and the collection contains many superb specimens, particularly from the Permo-carboniferous of the South Coast of New South Wales.

# Obituary.

THE sudden death of Mr. Charles Hedley which occurred at his residence, "Nuku-

lailai," Mosman, on September 14th, has removed from our midst one of Australia's most eminent scientists and one who was deservedly popular among a large circle of friends both here and abroad.

He was born in England in 1862, and spent much of his youth in the south of France and in Switzerland. He came to Australia as a young man and was for some time on the land in Queensland. But, natural history always had a strong attraction for him, and in 1889 he entered the service of the Queensland Museum, Brisbane, and later, as naturalist, accompanied Sir William Macgregor on an expedition to British New Guinea. In 1891 he removed to Sydney and became attached to the Australian Museum, where in 1896 he became Conchologist and in 1908 Assistant Curator. In 1920, on the death of R. Etheridge, Junior, he became Acting Curator and subsequently Principal Keeper of Collections. He resigned in 1925 to become Scientific Director of the Great Barrier Reef Investigation Committee and was still in the service of the Committee at the time of his death.

Mr. Hedley was recognized as one of the world's leading conchologists, and there were few branches of zoology of which he did not have an extensive knowledge. He was an accomplished botanist and ethnographer, and had made a profound study of zoogeography, in which he was an acknowledged leader.

Mr. Hedley was an intrepid and seasoned explorer : he had travelled widely and had made many extended trips to Torres Strait, New Guinea, and various Pacific islands, and few men had a more intimate knowledge of the Pacific and its inhabitants. In 1896 he accompanied the Royal Society of London's expedition to bore the Funafuti Atoll and made important contributions on the ethnology and natural history of the island to the Memoir\* issued by the Trustees of the Australian Museum. He was a Fellow of the Linnean and Malacological Societies of London, and Honorary Member of the New Zealand Institute, and of the Royal Societies of Victoria, Queensland, South Australia, and Western Australia, and a Corresponding Member of the Academy of Natural Sciences of Philadelphia. He was a past President of the Royal, the Linnean, and Royal Zoological Societies of New South Wales. In 1916 he gained the David Syme Prize for Scientific Research and in 1925 the Royal Society of New South Wales awarded him the Clarke Memorial Medal, the highest honour in its gift.

He was completely absorbed in his work and was always ready to make sacrifices in the interests of scientific advancement. He was a most generous donor to the Australian Museum both in specimens and works of reference, and many of his collecting trips, which invariably yielded a rich harvest of results, were financed by himself.

Mr. Hedley was invariably courteous and kindly, and his charming personality and accomplishment as an expositor and conversationalist had endeared him to a large number of friends. He was always helpful to younger workers, many of whom acknowledge their indebtedness to his encouraging assistance and advice. He was exceedingly energetic and took great pleasure in long treks on foot through the bush and by the seashore and those who were privileged to accompany him on his walks derived great enjoyment from his entertaining and informative conversation.

Only recently Mr. Hedley returned to Sydney from Queensland and was happily making preparations for a trip to Japan as one of the Australian representatives to the Pan-Pacific Science Congress. He contracted a cold and more serious symptoms followed, but no one anticipated that his death would occur so soon.

By the staff of the Australian Museum, many of whom had been associated with Mr. Hedley for a long period and had experienced many kindnesses at his hands, his death is keenly felt, and the utmost sympathy is extended to Mrs. Hedley and his adopted daughter.

<sup>\*</sup>Memoir III. "The Atoll of Funafuti," 1896-1900.



First the insect anchored itself firmly to the bark and then a split appeared down the centre of the back. [Photo.—A. Musgrave.



Then the thorax and the first segment of the abdomen were gradually pushed out. [Photo.—A. Musgrave.



The head and eyes next appeared and also the bases of the wings. [Photo.-A. Musgrave.



After which the insect commenced falling backwards and drew out the wings and legs. [Photo.-A. Musgrave.

# A Chapter from the Life Story of a Cicada.

BY ANTHONY MUSGRAVE, F.E.S.

URING the hottest months of the year when the cicadas are trilling their loudest, of all the arboreal songsters none is so noisy nor so deafening as the insect the children call the Double Drummer, and which naturalists know as Thopha saccata. This is one of the largest and handsomest of our species, measuring over five and a half inches across the outspread wings and about two inches in length. The head and thorax are brown in colouration and marked with black, the abdomen is reddish-brown and black, while the large membranous wings, with their red-brown or black nervures, are clear and free from spots. The most conspicuous feature about this cicada, and one which readily distinguishes it from any other species, is the large swollen opercula which project on either side of the abdomen in the male, though they are absent in the female, she, like the females of all cicadas, being entirely destitute of any sound-producing apparatus. These opercula doubtless act as resonators, serving to augment the sound as it is produced.

The Double Drummer cicada occurs in open forest country such as we find near Sydney, and it ranges from South Australia to Brisbane. Little is known of the lifehistory of the insect, but, while collecting at Como, near Sydney in November, 1923, I secured a series of pictures of a Double Drummer emerging from its pupal case, and at the same time carefully noted the time between each stage of its transformation, and these observations constitute a brief and hitherto unrecorded chapter in its lifestory.

On this November morning cicada pupae were emerging from the ground in numbers and climbing up the tree-trunks in order to attach themselves to the bark and await the next period of their transformation, the emergence into the adult state. I focussed my camera on to one specimen on a gum-tree trunk, and also made notes on its emergence as well as on another specimen close by.



Two and a quarter hours after the shell had first begun to split the white and flaccid wings of the insect were drying and bardening in the rays of the sun.

[Photo.-A. Musgrave.

#### THE TRANSFORMATION.

About half an hour after the pupa had crawled up the tree, a split appeared down the centre of the back and slowly widened as the insect pushed its way out of the case. Thirteen minutes later the thorax and first segment of the abdomen were visible, then, after a space of fifteen minutes, the head and black eyes slowly appeared to the accompaniment of convulsive twitchings. Six minutes later the cicada commenced to fall gradually backwards. The upper parts of the wings and legs were now exposed, and in the course of four minutes the whole of the wings and legs were visible and the cicada was lying right back. It remained in this



The bases of the gum trees frequently bear numbers of the empty pupal shells of cicadas. [Photo.—A. Musgrave,

position for about half an hour when a Red Bull-dog ant, Myrmecia gulosa, appeared with the evident intention of slaving the helpless insect. I brushed the ant away as I was not anxious to lose pictures of so interesting a subject, but the cicada was disturbed and began to move forwards. In seven minutes' time it had come forward and drawn its abdomen right out of the pupal shell. The wings all this time had been gradually lengthening and were now half the length of the abdomen. At noon, or two and a quarter hours after the pupal case had commenced to split, the insect was out of its case and the white and flaccid wings were drying and hardening in the rays of the sun.

During the year ending June 30th, 1926, the lecture activities of the Museum were maintained in the various fields established now for some years.

Seventeen evening lectures were given to over 4000 auditors, 350, the highest individual number, attending a lecture by Mr. A. Musgrave. Fifteen lectures were delivered to 3500 children attending the metropolitan and suburban public schools, Mr. J. R. Kinghorn addressing the largest As the time at my disposal was limited, I was unable to wait until the insect flew away, and therefore cannot say how long the wings took to dry.

The other specimen I watched, took only about one and a half hours to complete its transformation. Its pupal shell commenced to split down the back at 10.32 o'clock, and by noon it was out of its pupal case and the wings nearly fully developed.

On all the gum-trees and saplings in the vicinity the same process was going on, and on the butts of some of the trees were numbers of the fragile pupal shells still firmly an-

chored by their claws.

The cicadas have numerous enemies and even before they have been able to effect their slow and possibly painful transformation from the pupal to the adult stage, they fall victims to various species of ants. Mound or Gravel ants, *Iridomyrmex detectus*, are well to the fore as slayers of these defenceless insects, and they roam over the tree-trunks in search for them. Bulldog ants too, are numerous, and doubtless cause a serious diminution in the cicadas' ranks.

Nevertheless, the number who escape are many, for while I was recording these few observations, the survivors in the trees aloft kept up a sustained and deafening trilling.

individual audience, numbering 475. The extension lectures were continued, six being delivered to 1160.

Other series were those to pupils of the New South Wales Institution for Deaf, Dumb, and Blind; gallery talks; Bird Day lectures; addresses to visiting classes.

Gallery attendances to the Museum totalled 276,873, an increase of 37,515 over that of the previous year.

# Insect Foods of the Aborigines.

BY THOMAS G. CAMPBELL.

MONG the Australian aborigines the A variety of food-stuffs is considerable, not only by choice, but also from the difficulty of obtaining a permanent and regular supply of any one article of diet. Their bill of fare includes a vast number of both animal and vegetable substances, and in fact almost anything capable of being chewed is regarded as food. During periods of drought and other times when larger game was scarce, the maintenance of an adequate food supply was one of the greatest problems which the aborigines had to face, for they are not food-producers, but food-gatherers. Only in isolated cases is any attempt made to till the soil; hence their nomadic habits are closely correlated with the varying food supply and the change of seasons, for certain foods are obtainable only for a limited period each year. In view of this, it is not surprising that some of the larger-bodied insects, or those forms which could be obtained in considerable numbers, would be eagerly collected by the blacks to augment their often scanty larder. Most insects appear in a district for a comparatively short time each season, and the appearance of those species needed for food, was of considerable moment to the blackfellow. The appearance of such an insect as the "Bugong Moth" was of great importance to some of the tribes of New South Wales.

#### THE BUGONG MOTH.

The Bugong Moth, Euxoa (Agrotis) infusa, is one of the commonest species belonging to the Family Noctuidae, its larvae being of the typical "cutworm" or plague caterpillar type. Plague caterpillars often occur in various parts of the world, destroying gardens and fields by almost denuding them of vegetation. At intervals plagues occur in New South Wales, several species of moths allied to the "Bugong" being responsible for great damage. In America similar plague caterpillars are usually referred to as army-worms." Bugongs were at one time much sought after by the natives as food.

In his Wanderings in New South Wales, Dr. G. Bennett gives a good account of this The Bugong Moth (Euxoa infusa), one of the plague cut-worm moths upon which certain of the New South Wales aborigines used to feast, after re-moving the wings and scales from the bodies.

[Photo.-G. C. Clutton.

moth and the methods employed by the natives in its capture and preparation as food. In the early 'thirties of last century he paid a visit to the Tumut district, and while there saw the natives feasting upon this insect. The main facts of his observations are embodied in this account.

The word "Bugong" is of native origin, and was applied by the blacks of the Tumut district to the multitudes of moths that used to congregate in that locality; it was from this moth that the Bugong Mountains took their name, for it was among the crevices and rocks of this range that the moths occurred.

Prior to 1860 or thereabouts, the months of November, December, and January were quite a season of festivity among the blacks of the locality, who would assemble in the mountains to collect and feast upon the moths. The bodies of these moths contain a quantity of oil and they were relished as a palatable and fattening article of diet. They were collected by means of a blanket or sheet of bark placed below one of the numerous fissures which occur among the rocks of this area, and upon this the moths fell when disturbed or smoked out by means of small fires. They were then gathered in bags in considerable numbers and were prepared for use in the following manner. A small



piece of sandy soil was selected and cleared : usually a shallow hole was scraped in the soil and in this a fire was built and kept burning until the sand had been thoroughly heated. The embers of the fire were then drawn aside; great care was exercised in doing this, for, should the bodies of the insects be scorched, according to their superstitious beliefs, a violent storm would inevitably arise. The moths were then poured from the bags on to the heated earth and stirred around in the hot ashes until the wings and scales were removed from the bodies, after which the bodies were placed on a sheet of bark and allowed to cool. When cool the bodies were either eaten without any further preparation, or else were pounded into a thick mass resembling fat, by placing them in a hollow piece of bark or shallow wooden vessel and crushing them with a stone.

The oil from the bodies of these moths is said to be similar in taste to a sweet nut. Cakes made from the crushed bodies would not keep longer than a week, frequently less, but if smoked they could be kept for a much longer period. It is said that on the first few occasions when this food was used by the natives it made them very ill and subject to severe attacks of vomiting,



Warramunga Aborigine of Central Australia performing one of the ceremonies connected with an ant totem. The object of these totemic ceremonies is to promote the supply of the honey ants, and ensure an ample amount for food. [After Spencer and Gillen.

but after a few days they began to thrive and fatten upon it.

ANTS.



Honey-pot or Sugar Ants (Camponotus inflatus), gorged with honey. These are much sought after by the natives of Central Australia who dig them out of the soil by means of sticks. The distended abdomens are later bitten off and swallowed. The remainder of the body is discarded.

[Photo.—G. C. Clutton.

Australia "Sugar Ants" are much sought after by the natives as food. Two species. Camponotus inflatus and Camponotus cowlei. are collected and eaten. During the Horn Scien-Expedition tific 1894 in places were seen where colonies of these ants had been dug out from the loose sandy soil. The ants used by the natives are really abnormal forms o f " worker " individuals. which have become so gorged with honey that they are unable to move. Such forms of ants are popularly known as " honey pots," their aband domens, distended with the honeysubstance. like are bitten off and

In the arid por-

tions of Central

swallowed. The remainder of the bodies are not eaten.

Among some of the native tribes of the Central Australian region there is a special food ceremony,<sup>1</sup> the carrying out of which is believed to have some bearing on the supply of these ants, the object of the ceremony being to ensure an abundance of this esteemed delicacy.

The adults and larvae of the Green Tree Ant, Oecophylla smaragdina, which occurs

<sup>&</sup>lt;sup>1</sup>Spencer and Gillen, "The Northern Tribes of Central Australia," p. 199,

in North Australia, are frequently used as food by many of the north Queensland aboriginals. In the Cooktown district the natives were in the habit of collecting the nests, which were opened upon a rock or some smooth object, causing the adults to scatter, leaving behind the white larvae or grubs. When all the adults had been removed, the grubs were collected and formed into a ball, by rolling them in the palms of the hands, after which the mass was swallowed. If the contents of one nest failed to satisfy the cravings of hunger, then several were collected and treated in a like

palates." A similar liquid formed from the bodies of Green Tree Ants and their larvae was also commonly used by certain of the north Queensland blacks as a remedy for many and varied ills, being regarded as a suitable cure for stomach troubles, headaches, coughs, colds, and other ailments. The preparation of these ants when required for medicinal purposes was the same as when they were used as food.

Ants and their larvae were readily eaten by the aborigines of New South Wales, and one method of securing the adult insects was to stand upon the ant nest so as to disturb



Arunta Natives of Central Australia performing the ceremony of the Udniringita or Witchety Grub Totem. As with the ant totem, the object of this ceremony is to ensure an abundant supply of the Witchety Grub for food purposes.

After Spencer and Gillen.

manner, the contents being rolled into one big ball, which was usually washed in water before being eaten, the water being afterwards used as a drink. Often the bodies of the ants were crushed and mixed with water, the liquid so formed being consumed separately, while the residue of the ants' bodies was either eaten or discarded altogether.

In The Naturalist in Australia Saville Kent says: "Mashed up in water, after the manner of lemon squash, these ants form a pleasant acid drink which is held in high favour by the natives of North Queensland, and is even appreciated by many European

the inmates. Thus disturbed the ants would swarm up the legs of the native hunter, who scraped them off in handfuls and transferred them to his mouth. The eggs and larvae were collected from the nest, which was broken open with sticks.

#### CATERPILLARS AND CHRYSALIDS.

Throughout the continent a great many varieties of insect caterpillars and chrysalids were looked upon as dainties by the aborigines and though it is difficult to ascertain the various species of adult insects to which these larvae and pupae belong, very many

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are timber-boring species. Many woodboring caterpillars were cut out of trees and rotting logs and eaten raw, apparently with as much esteem as white people show for oysters. A common practice was to roast the larvae in the embers, when they are said to have a delicate, nutty flavour, being regarded by many white people as excellent fare. Those grubs found boring in the trunks of the common wattle trees are said to make the best food, and the native hunters often carried small hooked implements by means of which these larvae were raked out from their burrows. From an old grub-eaten tree a very good meal could soon be obtained by the aid of such implements or with a tomahawk.

#### THE WITCHETY GRUB.

In Central Australia the "Witchety" grub is regarded as an important item of food. As in the case of the "honey pot" ants an elaborate ceremony is performed,<sup>2</sup> the natives believing that this ceremony promotes the appearance and supply of the grub. The "Witchety" grub is about four or five inches long and about the thickness of a man's finger, and is chiefly found burrowing in the roots of certain eucalypts. They are dug out by means of yam-sticks, and after being slightly roasted are eaten. They are said by those whites who have tasted them to possess a very fine flavour.

Under the term "Witcheties" is sometimes included a number of insect larvae of various kinds, but the true "Witchety" grub is regarded as being the caterpillar of one of the large wood-boring moths.

#### BEETLE GRUBS.

Several kinds of edible beetle grubs occur in Queensland, and one species of Longicorn Beetle, *Eurynassa australis*, was greatly relished by the natives who collected them from the decayed trunks of trees. These

<sup>2</sup>Spencer and Gillen, "The Northern Tribes of Central Australia, p. 179, Fig. 45.

Mr. N. S. Heffernan, already a generous benefactor, has recently presented a fine exexample of a Reef Island (Santa Cruz group),



Larva and adult of a Longicorn Beetle (Eurynassa australis) frequently used as food by the north Queensland Aborigines. The larvae and adults are slightly cooked in the hot ashes, the hard wing cases of the latter being first removed.

[After Carl Lumholtz.

were sometimes eaten as soon as caught, but usually the practice was to collect them in small baskets and take them to the camp. They were prepared by roasting in the ashes until they became crisp and brown. Carl Lumholtz, the Norwegian naturalist, who travelled extensively in Queensland from 1880 to 1883, considered the larvae of this beetle to be the best food which the natives offered him, and he likened their flavour to that of an omelette. The adult beetles were roasted, the hard wing covers or elytra being first removed.

Apart from the insects here dealt with, very many other butterflies, grasshoppers, cockroaches and cicadas as well as numerous other forms, have been used for food by Australian aborigines in their uncivilized condition.

Nowadays, however, due to contact with the white man, and the adoption of his food and habits, many phases of aboriginal life are fast disappearing. Although in remote parts the tribes continue to live the life of their ancestors and devour the foods which they did, yet in the near future it seems probable that many interesting articles of diet, including insects, will have practically disappeared from the aborigines' menu.

outrigger canoe. These canoes are no longer being made and few, if any, are to be found in any museum.

# On the Cause of Phosphorescent Light in Sea Water.

#### BY ARTHUR A. LIVINGSTONE.

TOW many readers can take their minds back to some delightfully calm summer evening spent rowing on the harbour or an estuarine water ? An occasion when each dip of the sculls produces a lurid phosphorescent light in the disturbed water and the boat leaves in its wake an eerie In a smaller way a fish's vivid trail. sudden dart through the same water will bring about a similar effect and set one conjecturing as to its cause. It may be thought that the sea water itself is phosphorescent, but as this is wholly incorrect we must seek elsewhere for a solution of this apparently strange phenomenon.

Dahlgren who states that :—" The light is produced by the oxidation or burning of a substance named 'luciferin,' that has been secreted in the living flesh or protoplasm of the organism's body cells. This substance, once so secreted, is no longer living material but is a product which may be used at once or may be stored, either in the living cell or in internal reservoirs, until it is needed to produce the light either in the living cells, in cavities of the body, or outside the animal in the surrounding water or air. Secondly, while the luciferin alone will oxidise without showing any light, it requires the presence of a second substance, also secreted by the



A.—Noctiluca miliaris, well known as a responsible agent in the cause of phosphorescence in sea water. B.—The same organism showing buds (after Brooks) C.—A section showing the anatomy of this one-celled animal (after Huxley).

n. nucleus; f, flagellum; t, tentacle; d, denticle; an. anus.

It has been discovered that such an occurrence has a very simple origin and is caused by the activities of a minute singlecelled marine animal called *Noctiluca*. This organism is present in the water in enormous numbers at periods when conditions favour its multiplication. Under these circumstances any sudden agitation in its immediate vicinity will produce a luminous effect, and the consequent glow is stated by a prominent authority to be the "manifestation of their response to mechanical, electrical, thermal and chemical stimuli."

A more detailed explanation as to the cause of the glow is given by Professor U.

animal's body and called 'luciferase,' in order that its chemical combination with oxygen shall produce the light. Strange to say, only very little, almost no heat is generated by this oxidation." It may be well to state that this foregoing extract explains not only the light emitted by our *Noctiluca* but by all other phosphorescent animals and plants.

The form of the organism *Noctiluca* is globular, and when luminescent it is visible with the aid of a small lens as a jelly-like protoplasmic body somewhat resembling a small jellyfish. Under the microscope it is seen to be covered by a delicate cuticle, and on one side of the animal is a small groove from which arises a stout tentacle; near the base of this is the mouth, which is followed by a short gullet. The nutritive particles, when secured, are held in minute pockets called vacuoles, which float freely throughout the substance of the body during assimilation. Although possessing a flagellum, which serves as an aid to locomotion in many other singlecelled animals, *Noctiluca* is incapable of self propulsion and simply drifts about with the rest of the plankton.

The organism is most versatile in its mode of reproduction, a characteristic of all singlecelled animals. Ordinarily it propagates by a process known as binary fission in which the adult animal splits longitudinally and gives rise to two of its kind. It is probably to spore formation, however that we must look for the explanation of the occurrence of vast quantities of *Noctiluca* at certain periods. This process is accomplished by individuals budding off great numbers of young, which are freed in the surrounding water when developed. It would appear that a special combination of circumstances is necessary for spore formation, and it is quite possible that such is responsible for the occurrence of Noctiluca in enormous numbers in circumscribed areas. Under such conditions much mutual jostling naturally takes place, and the resultant faint spasmodic glows in the water may be noticed by a close observer. The presence of the organism may be verified by dipping one's hand into the infested water and allowing the fluid to drain carefully through the fingers. Invariably a few individuals will remain glowing on the palm for a short period.

Conditions in tropical regions seem to be particularly favourable to the occurrence of Noctiluca, as the following extract from the pen of Miss Edith Williams of the Doubina Mission Station, Bartle Bay, Papua, will show. She writes :---" It was early in August that we first saw them. At six o'clock in the evening the sea was, as usual, greyish blue with faint golden reflection of the setting sun. An hour later I saw what I took to be a lantern, or a fire-stick borne by a native whilst fishing off the rocks at the point. At times it vanished but only to reappear in the same place. Then I noticed the same kind of light in front of the house, and yet further beyond us. So, calling the children, I went to the front steps and sat watching. Each wave as it broke on the shingly beach seemed to be lit by a thousand tiny electric bulbs, or as one child said, 'the sea is on fire.' After a few minutes our curiosity led us to the beach. Tired after the day's work I sat on the path above enjoying the beauty without the additional walk to the water's edge.

"With a sudden shriek the whole family ran together up the path. 'Oh it is shooting us; we are afraid.' 'Sillies, what ' Oh is there to be frightened of ? You are not afraid of lightning. This is like the lightning; I think it is a kind of electricity in the water.' So back they went and I followed, curiosity overcoming weariness. And what a reward ? There in the water, as it broke in a shower of spray at our feet, in the wet sand at the water's edge, in every wave that rolled towards us, were myriads of pin-point lights. 'The sky has fallenlook! stars everywhere in the sea,' the children cried. The dog ran in barking as at a stranger, and came to us again with little lights on his legs. With excited cries of 'E-oh' and louder exclamations as each wave broke scattering its golden glory the children gradually gained courage. Soon they were bringing me their hands full of the wet sand in which the tiny lights showed like fireflies, only with a steady light. But we could not pick them out. Then a handful of water was brought and gradually filtered through the fingers till only the tiny lights remained.

"The flash of an electric torch and a small pocket lens revealed a minute globule of jelly 'just a drop of water' as a child remarked. But we found it was not water, as it clung to an inverted palm and could be transferred from hand to hand and yet retain its shape. No movement could be discerned in the tiny creature; it seemed entirely at our mercy or the mercy of the waves.

"One night a firefly joined the party of admirers, and we noticed that its light fluctuated and was controlled as it were by a set of shutters, whereas the light in the wee ' jelly-fish ' was steady and clear.

"For about five or six weeks the lights appeared in the same way each night, even on moonlit nights it occurred, but was not so brilliant as on dark nights. It was a golden blue light, soft and clear, giving more of an opalescent tinge than the fiery phosphorus which one sees so often at night as the oars dip in the water or in the wake of a vessel.

<sup>1</sup> Doubina is the home of the Anglican Mission for half-caste children and has been in existence here for only five years. During that time there has not been, to my knowledge, any occurrence of the phenomenon so marked and strikingly noticeable as the present one. One half-caste woman living about a mile from the Mission Station informed me that she often saw it on dark nights but she could not give any definite descriptions."

## The Recent Expedition to the Santa Cruz Group.

A N event of considerable interest from the Museum point of view and the natural history world generally was the return, on September 3rd, of two of the Australian Museum Scientific Staff, Messrs. E. Le G. Troughton and A. A. Livingstone from a collecting expedition amongst the little known and very interesting islands of the Santa Cruz Group. During nine weeks absence a month was spent in travelling and five weeks collecting amongst the islands with the very satisfactory results indicated in the accompanying photograph, which illustrates the unpacking and sorting of the collections.

The remote situation of the Santa Cruz its association with the Group and earliest voyagers, particularly the tragic fate of the intrepid Frenchman La Perouse, renders the locality of paramount interest to naturalists, and it is to the generosity and keenness of Mr. N. S. Heffernan, District Officer of the Group, that the Trustees and their officers are indebted for the unique opportunity to obtain collections and study the conditions of life in such interesting and profitable surroundings. For several years Mr. Heffernan has been an enthusiatic collector for our Museum, displaying so much interest in museum work that he was recently elected an Honorary Correspondent of the Australian Museum. Upon his being transferred to the Santa Cruz Group he kindly renewed an invitation previously extended to visit him at Ysabel in the Solomons, and for five weeks the Museum's officers had the pleasure and interest of being his guests, the hospitality including a cruise amongst the islands of the group in the fifty ton auxiliary vessel *Tulagi* during which visits were made to the island of Naunaha, within the Vanikoro Lagoon; Utupua; Santa Cruz and the close lying Nia and Trevanion; three of the Reef Islands, including Peleni, which until recently was inhabited by pure Polynesians although within sight and easy sail of the other islands of the group inhabited by pure Melanesians. The hostility which kept these neighbouring peoples apart has been largely broken down of late, and the natives, though perhaps unreliable, are generally very friendly in their attitude.

One of the most picturesque experiences of the trip was provided by encircling the active volcano known as Tinakula, which rises sheer from its rocky shore to form a cone 2,200 feet high. About every eleven minutes this giant safety valve of Nature heaves a rumbling sigh, marked by a red glare at night and gusts of black smoke by day, while from the crater situated on the north-west side of the summit great stones are hurled into the water or come rolling and bounding down, leaving trails of sulphurous smoke. This outpouring of stones has left the mountain side looking like a gigantic slag heap, in marked contrast with the green buttresses of undergrowth on the south-east side of the volcano. Members of the party landed for a little while and collected rocks and shells, which have proved of great interest to specialists concerned.

On each of the above mentioned islands collections representative of the fauna were made, while the native life was studied and photographed, and native implements and work collected. But it was at Vanikoro where the main interest and activities were centred, for it was upon the treacherous reefs of this island that the bold navigator La Perouse was wrecked, meeting an untimely fate which is even now shrouded in mystery. The coral reefs encircling the island are at places two and a half miles from the shore, and the openings are rendered dangerous by shoals of coral rock. On these reefs many vessels have perished, and in a few fathoms search a waste of the short time available. The early voyagers Quoy and Gaimard, who accompanied the *Astrolabe* in its search for traces of La Perouse over one hundred years ago, are the only naturalists who made detailed collections at Vanikoro prior to this visit, and it will be readily understood that the very extensive collections brought back must prove of the utmost interest and value to specialists and the Museum collections.

Both officers pay a tribute to the universally helpful treatment accorded them by



Messrs. Troughton (standing) and Livingstone unpacking the collections. Island currency, bows, skulls, native fishing tackle, totem poles, mammals, birds, reptiles, corals, fish and all kinds of marine life are well represented.

[Photo-G. C. Clutton.

may be seen the remains of La Perouse's ships. Hereabouts, with the voluntary aid of the Japanese owners and native crew of a Trochus shelling vessel, much marine life was collected, and the thrill experienced of diving with swim-glasses amongst the brilliant aisles of coral. At two places on Vanikoro nearly opposite the wrecks, relics of La Perouse have been found, and though the Museum officers made a search, the ground was so dug and sifted as to render further Messrs. Burns Philp and Co. Ltd., and their officers ; also to the manager and members of the staff of the Vanikoro Timber Company. Mr. Troughton having been the guest of the latter company for a fortnight. The Japanese proprietors of a Trochus shelling vessel also devoted a day's work to the interests of the Museum, but it is primarily to the generosity of Mr. Heffernan that our united thanks are due for the wonderful opportunity to benefit the Museum and science generally.

# The Cameo Shell.

BY TOM IREDALE,



A magnificent specimen of the Horned Helmet Shell (Cassis cornuta). This species is the giant of the Helmets and it ranges throughout the Tropics. Cameos cut from this species have a white figure on an orange or pink ground. Occasionally this species doubles, that is, its two layers separate. This specimen is fourteen inches long and was collected by the late Charles Hedley at Michaelmas Cay, off Cairns, Queensland.

[Photo.-G. C. Clutton.

THE Ancient Greeks and Romans, about B.C. 364, developed the art of carving in bas-relief in onyx, a hard ornamental stone and one which will take a high polish; these carvings are known as cameos. The origin of the name is doubtful; maybe it is from *camaeus* the base Latin term for onyx, or perhaps it is derived from *camea*, the Arabic for talisman, and to the Arab, it should be remembered, any engraved stone was talismanic.

Various forms of onyx, or banded agate, were employed for this work and were named according to the colours of the layers of which they were comprised, as sardonyx (white and ruddy brown), chalcedonyx (white and grey), besides which there are other varieties known as jasper onyx and in Italy and practised till comparatively recently, but the difficulty of obtaining onyxes of good quality was so great that some other medium was sought, and this led to the use of shells, which by reason of their softness are more easily worked. Probably some of the earlier workers tried their art upon shells, as suitable varieties were brought into the Mediterranean countries at an early date, about the beginning



Same specimen viewed from the side, showing the resemblance to the ancient warriors' helmet, hence the name of Helmet Shells. [Photo.-G. C. Clutton.

bloodstone onyx. The stones for these cameos found their way into Europe from the Orient and many of them were of great size and beauty.

Some of these cameos are of great artistic merit and bear the name of the artist responsible for them. Thus we have specimens with the name of Dioscorides, or Athenion. Choice examples such as these are contained in the famous galleries of Europe.

In the 15th century, that is in the Renaissance period, cameo cutting was revived of the Christian era. The passage of the Cape of Good Hope opened up a free intercourse with the East, the progressive western voyagers bringing back much in the way of goods, especially products of nature. On the strand of Mauritius, a little island in the south of the Indian Ocean, a place where vessels replenished their water and food supplies after rounding the Cape, many large and beautiful shells were discovered. These found their way to Europe and were regarded as rarities of the first rank. Amongst them were shells appropriately and simply named Helmets from their resemblance to the headgear worn by the warriors of the early ages. This abbreviated name led to confusion, and readers of the accounts of early voyagers were never certain whether the writers were referring to a shell or to a helmet, but subsequently this confusion was avoided by the use of the term "Helmet Shell." Half a dozen different kinds of these big shells are known and each is made up of differently coloured layers.

The rarity of the shells did not allow of their use for many years, but about a century ago they had become sufficiently common to be utilised in a commercial manner, and the industry of cameo-cutting was again revived in Italy. The shell is composed of three layers, an outer, an inner of a white or cream, and a basic layer of red of various shades. The industry began in Rome and was then prosecuted in Genoa, where about the middle of last century, less than a hundred workers were employed; most of these, however, were artists.  $\Lambda$ little later, through the popularity of these cheaper cameos, an Italian began work in Paris and large numbers of inferior workmanship flooded the market, and in the mid-Victorian era, there was scarcely any lady without her set of cameo brooches. In order to distinguish these cameos from those carved from stones, they were technically termed shell-cameos, but the shorter name was more commonly used. A French writer in the beginning of last century observed that these shell-cameos were worn even by queens.

Their popularity waned, but quite recently they came into fashion again, though the desire to manufacture them cheaply led to their production by means of machinetool work, and none of these modern specimens show the beauty of the carefully wrought, hand-tooled, early examples.

Their mode of preparation in the last century was as follows. The shell is first cut into pieces the size of the required cameos by means of diamond dust and the slitting mill, or by a blade of soft iron fed with emery and water. It is then carefully shaped into a square, oval, or other form on the grindstone, and the edge finished with the oil stone. It is next cemented to a block of wood, which serves as a handle to be grasped by the artist, while tracing out with a pencil the figure to be cut on the The pencil mark is followed by a shells. sharp point, which scratches the desired outline, and this again by delicate tools of steel wire, flattened at the end and hardened. and by files and grinders for the removal of the superfluous portions of the white enamel. A common darning needle fixed in a wooden handle, forms a useful tool in this very minute and delicate species of carving. The careful manipulation necessary in this work can be acquired only by experience; the general shape must first be wrought out, care being taken to leave every projection rather in excess, to be gradually reduced as the details and finish of the work are approached. It can be easily recognised that such slow and tedious work would not repay the worker of to-day. so that the fact that the Cameo Shell is a native of Australia will not lead to the introduction of the cameo-cutting industry.

The magnificent specimen of the Helmet Shell here illustrated was collected at Michaelmas Cay, off Cairns, north Queensland in July last by the late Mr. Charles Hedley. The shell showing the cameo\* does not belong to the same species, Cassis cornuta Linne, but to the allied species, C. madagascariensis Lamarck, from which the best cameos were cut and which was known as the Black Helmet. This name was given, not on account of its superficial appearance, but because the basic layer of the shell was very dark, almost black, and thus provided an excellent contrast to the relief of the almost white carving, the other species showing both paler backgrounds, as in the figured specimen, and also less pure white images.

These carved shells are uncommon, as they were mostly worked as curios. The commercial method is that described above, the carving being done on prepared surfaces only.

<sup>\*</sup> See Frontispiece.

# The Birth of an Island.

BY TOM IREDALE AND GILBERT P. WHITLEY.

MANY islands are just isolated patches broken off the mainland of a continent by

a submergence of connecting low land or by earth movements; some, much more rare, have been forced up by volcanic action from below, whilst others, like the proverbial Topsy, "just growed." The latter kind may be observed in every stage of growth off the Queensland coast, where the Great Barrier Reef, for a length of 1,200 miles, presents



Michaelmas Cay, off Cairns, north Queensland; coral showing above the water at half-tide, representing the first stage in island development. [Photo.—T. Iredale.

some thousands of them. As a majority of these have not yet broken the ocean surface, they present great difficulties to navigators, and it is fortunate for Queensland that, inside the maze of reefs, a navigable channel exists.

These growing islets are all built up of coral, the production of countless thousands of little animals. These creatures are sometimes termed "coral insects,"

but this is a misnomer as they are unlike insects in every way; they are really polyps closely allied to the common sea-anemone. Sea anemones are solitary animals, common in rock-pools, whose mouths are surrounded by the petal-like tentacles by which they sting their food and pass it into their mouths; they do not form limy cups from their food as corals do. While there are a few kinds of solitary corals, most coral polyps live in colonies, each one inhabiting a circular

hollow, although the individuals are continuously joined. When one polyp, or a series of polyps dies, its neighbours are not affected, so that the coral still increases, the rate of growth much exceeding that of death, until the surface of the sea is reached, a more or less solid fabric being achieved in the process.

The action of the sun and weather reacts rapidly on the exposed polyps and death

> results on a large scale, while disintegration also spreads apace. The living coral continuously grows more vigorously as it nears the surface, consequently, when the coral is near the tide limit, it is more luxurious and more varied, and makes a more attractive picture than it does at a greater depth. The dead coral is hustled hither and thither by winds and waves, massed at one time and dispersed at another. but little by little it accumulates in certain

places. Help is given it by hurricanes which break off large masses and hurl them about, so that year by year the main coral mass becomes more solid through the breakage of loose pieces. When a sound base is thus made, pulverised coral (coral sand) moves about as the wind changes, but ever increases until there appears at low water a small



Michaelmas Cay; coral reef exposed at dead low spring tide. This represents the second stage, the coral becoming exposed to the action of the elements. [Photo.—T. Iredale.

sand-bank. Continued wind and wave action upon this builds and builds until the sand-bank reaches high water mark, but for some years little alteration is made until a stabilisation of the sand is achieved. Passing sea-birds may rest upon this for a time to breed, when circumstances may have driven them away from some older nesting place. The birds which thus assist are sea-swallows or terns, probably of the crested species, forms which delight to breed on sand-spits.



Michaelmas Cay, showing extent and boring plant. The highest point is only eight feet above high water mark. [Photo.-T. Iredale,

A year or two of their life and the sand is manured and made available for plantgrowth, which soon appears in the form of grasses, whose seeds are wafted by winds, or mayhap brought by birds. When the grasses take root they provide an excellent sand-binding factor and the healthy sand gives them good growing power, so that the

islet now grows apace. Year Year by year the grasses bind the sand by more firmly and enlarge the area, and then other sea-birds, which prefer grassy spots, visit the locality. Again these assist in manuring the sand and every season sees an additional area added, while drift brings seeds of different plants, which flourish on the favourable ground, so that in time the vegetated cay becomes a woody islet. Years pass, each one of which adds its quota to the area and vegetation, and all the while the coral is steadily growing.

The form of the islet is fashioned also by the wind and waves, and we see in Queensland that all the islets lie due north-east and southwest, the prevailing winds in the tropics being south-east for nine months of the year and north-west for the remainder. Thus, while the fruitful drift is from the north, the prevailing wind is from the southward, which accounts for the nature of the invading

> flora and fauna. It is very difficult for a temperate form to drift north and live, while it is easy for a tropical one to drift south and still remain in the tropics and flourish. Moreover the northern drift occurs during the time of best growth and is thus doubly favoured. Consequently the flora of these coral cays is tropical and as a result, the fauna will also be tropical. This fauna is brought by means of wind, drift, and bird-passage, the

Photo.—*T. Iredale,* birds themselves arriving of course by means of flight. Around a coral islet, attendant upon the coral life, is an abundant fish, molluse, and other invertebrate fauna, which provides sufficient food for birds. We therefore find birds breeding on these cays throughout the year; when some kinds move away, other species take their place.



Michaelmas Cay, showing vegetated sand-bank and Wideawake Terns (Onychoprion fuscata).

As above noted, the wind, weather, and coral are all working at the same time, and the island formed by their efforts, provides a nucleus for other islets. It may prove a buffer to hurricanes, but the wind will move the sand about to a less degree. Moving sand is fatal to coral growth, being as deadly a factor to marine life as anything known. The direction of the movement is governed by the vegetated cay, so that on the windward edge of the islet, there is abundant coral growth, while on the leeward side coral growth, when within the area of sand-movement, is at a minimum. Consequently the dead coral on that side is overgrown by seaweeds, and these provide a new factor in islet formation. It is not yet known how large a factor this is, but it is undoubtedly important. The process here outlined indicates the stages of infancy which may be seen and studied in the waters of tropical Queensland.

Michaelmas Cay, off Cairns, North Queensland was selected as the site of boring operations by the Great Barrier Reef Investigation Committee and the writers were invited to pursue zoological studies there during May and June of this year. The cay showed the vegetated stage here described, whilst within sight were two younger sand-banks, one showing at all tides but lacking vegetation, the other showing only as the tide fell; a third similar to the last was further distant.

The vegetation of Michaelmas Cay occupied the entire area left bare by the tides, a patch some 313 yards long by 66 wide, and appeared to be quite young, for in no place did it rise more than about eight feet above sea level. There was a coco-nut tree only a foot or two high, with wind-torn leaves, a sorry object when compared with its magnificent progenitors on the mainland, and also a few young shrubs; but the vegetation mostly consisted of grasses and weeds. The drift from the north continually brought seeds, many of which must have floated for many days without losing their powers of germination.

Of the insects and their allies on Michael. mas Cav, there were about thirty kinds. most of which were fliers, such as grasshoppers, moths, flies, and beetles. A few were flight. less and their origin was a mystery. Some kinds may have travelled on drifting material or have been introduced by the very few ships which have visited the spot. Ants, cockroaches, and spiders were quite common flightless forms. There were also ticks and lice, parasitic on the sea-birds, obnoxious creatures which frequently transferred them. selves from their hosts to the members of the party, much to their discomfort. A collection of some six hundred specimens of insects, ticks, and similar forms has been brought back for the Museum.

The fauna of the islet, however, did not claim so much attention as that of the reefs, which was much richer. The coral extended some six hundred yards on the



Giant Clam (Tridacna gigas), the largest species of mollusc, in situ. This specimen measured about three feet six inches in length.

pity.

[Photo.-T. Iredale. south side and eastward a mile or so, where it was exposed at half spring tide and was being broken and killed each day. This vision of ruin was appalling at first sight, but consideration for a little while envisaged the birth of a cay similar to the one we were living on, and interest routed Here and there were niggerheads, blocks of coral torn and smashed, now wind and weather worn, crumbling and decaying. Smaller pieces showed similar death, while all the time the ominous crunch of dead coral was felt under foot. The few

living things were repayment for the sight of

such desolation, however, as here we met with the Giant Clam, also known as the Holy Water Clam, in a living state. This magnificent molluse, the unrivalled giant of its class, is also a poem of beauty, its brilliant mantle being bejewelled with shining eyes, its size amazing and its weight astonishing. On these matters we were content to accept the published records, a length of four foot six being established, and a weight of the shell alone at five hundredweight. Many smaller clam-shells with even more beautiful and bizarre molluscs were glimpsed among the dead coral, though most other molluscs had to be searched for, as they had sought shelter below the ruins.

The fishes of the reefs were so beautifully coloured that they rivalled the most gorgeous butterflies, as they swam in little schools. darting, when disturbed, into the shelter afforded by jagged stocks of coral. Some were sea-green, others boldly striped with black and white, whilst combinations of colour baffling description were often seen. One fish, however, cares nought for flaunting display, preferring to lie inertly amongst the dead coral, being exactly the same colour as its surroundings. This is the deadly stone-fish, whose thirteen venomous spines make boots essential to any who walk on coral reefs, for though coral scratches are themselves poisonous, the punctures of the stonefish are fatal ; but we were fortunate enough not to meet with this fish, or if we did, we saw it not. There was a striking absence of big fishes in the inshore waters, except at night, and no sharks of any considerable size were seen. Flying fishes were sometimes noticed, leaping in schools over the water in the lagoon.

The elvers or transparent young of the Freshwater Eel (Anguilla) are expected to ascend rivers and streams leading from the sea at this time of the year. Already some specimens have been caught at Long Bay, New South Wales, averaging less than  $2\frac{1}{2}$  inches in length, but many more are needed for some special research now being carried out by Dr. Johannes Schmidt, the Danish specialist. Should any of our readers catch young eels, they are invited to send them, packed in moist rag and not necessarily preserved, to the Director of the Australian Museum, Sydney. By so doing they would be assisting materially an important piece of biological investigation, for details of which they are referred to "The Story of the Freshwater Eel," an article which appeared in the October-December, 1925, issue of the Australian Museum Magazine.

The third Pan-Pacific Science Congress will shortly be in session at Tokyo. A number of Australian scientists left Sydney on Saturday, 25th September to attend, among them Mr. R. H. Cambage, F.L.S., O.B.E., and Mr. E. C. Andrews, B.A., Government Geologist, Trustees of this Museum. Both have been closely associated with previous Congresses and on account of their scientific attainments and experience are well fitted to represent Australia on this occasion. Subsequently Mr. Andrews will proceed to Yale where he is to deliver the Silliman Memorial Lectures, taking as his subject the geology of the Pacific.

# Turtles' Eggs as Food.

BY A. MUSGRAVE.

IN the MUSEUM MAGAZINE April-June, 1926, appeared an article entitled, "From Sea to Soup: An Account of the Turtles of North-west Islet," by Mr. G. P. Whitley and myself. This article has been widely read, and the following letter received from Mr. H. W. Champion, of Port Moresby, gives some interesting facts about the value of turtles' eggs to the Papuans.

In your very interesting article in the "Museum Magazine" on the Turtle you say that the eggs are not palatable as a food. This surprises me, as among all the coastal natives of this Territory turtle eggs are eaten with relish. It would not be too much to say, I think, that the natives place them high as an article of food. It might be said by the ignorant that "cannibals" will eat anything, but the Motu people for instance have, so far as I know, never been cannibals and appear to hold such a practice in as much detestation as we do, and though less fastidious in their tastes then we are, are a very clean eating people.

I can assure you too, that more than one whiteman has told me he likes turtle eggs to cat, not only in conjunction with other food, such as puddings, but poached in a frying pan like bird's eggs. Natives occasionally hawk them for sale among Europeans. I have had them offered to me here in Port Moresby on several occasions, but I have never had the courage to try what they were like to eat.

Our statement was based on the experienceof members of our party who tried them fried but, however, did not care for the somewhat unsavoury appearance of the dish. the uncoagulated white and gritty-looking yolk not appealing to their palates. We were aware that turtles' eggs are relished by the natives of the Pacific and elsewhere. a fact well recorded, but the views set forth in our article were based solely on our knowledge and experience of the turtles of the Capricorn Group. Since receiving Mr. Champion's letter, Mr. A. A. Livingstone of the Museum staff while on a visit to the Santa Cruz Group, has tried turtles' eggs boiled, and, unlike our companions on the Capricorn Island trip, considers them to be quite as palatable as fowls' eggs. It would appear then, that much depends on the palate of the taster.

### Museum Postcards.

IN our last issue reference was made to the forthcoming issue of coloured postcards.

The first series, comprising thirty Australian bird studies, is now practically complete and will, therefore, be available for distribution shortly. This series will be followed by one of mammals.

The object of issuing these cards is the great need for accurately drawn pictures of our native fauna, for which there is a constant demand from educational institutions. The drawings have been prepared by Lilian M. Medland (Mrs. Tom Iredale) and each design has been carefully reviewed by Professor Launcelot Harrison, B.A., B.Sc. Coupled with such care in preparation, is four colour printing of a very high standard. It can be fully claimed, therefore, that in these cards will be found that which has been long sought for.

The bird series has been divided into six sets of five cards each, as enumerated below, and each set is accompanied by an informative leaflet written in popular terms. The price is nominal, 1/- per set of five, but to educational institutions there will be allowed a discount of 20 per cent. on all purchases (direct from the Museum) to the value of £1 and upwards.

Set A1. Emu, Plain Turkey or Bustard, Brolga or Native Companion, Native Hen, Scrub Fowl.

Set A2. Top-Knot Pigeon, Black Swan, Wedge-tailed Eagle, White Goshawk, Boobook Owl.

Set A3. Rosella, Banksian Cockatoo, Fan-tailed Cuckoo, Frogmouth, Kookaburra.

Set A4. Lyre Bird, Jacky Winter or Brown Flycatcher, Red-capped Robin, Whistler or White-throated Thickhead, Willie Wagtail or Black and White Fantail.

Set A5. Elfin Wren or Red-backed Wren, Fairy Wren or Blue Wren, Emu Wren, Gouldian Finch, Scarlet Honeyeater.

Set A6. Regent Honeyeater, Gillbird or Wattle Bird, Black-backed Magpie, Satin Bower Bird, Raven.

# Aboriginal Message Sticks.

BY W. W. THORPE.

A<sup>S</sup> an aid to our memory we frequently tie a knot in our handkerchief or make a note in our pocket book. The Australian aborigine has, of course, to resort to some other means to jog his mind and these reminders take the form of what white men term, variously, "message or memory sticks," or "blackfellows' letters." These sticks take different forms, some being flat, others round or rounded, and are either plain or carved. Dr. W. E. Roth, who for many years was Protector of Aborigines in

which was known to be hostile—for aborigines, like most others, are always glad to receive tidings and messages.

These sticks are of great use in trading, for many trade routes are of great length and in journeying along them the bearer would have to traverse many territories. In northern Queensland there is one that approaches five hundred miles in length, and in Western Australia there is another that, starting from the nor' west, zig-zags its way to the South Australian border.



Passport from the Lake Way District, East Murchison, Western Australia. [Photo.-G. C. Clutton.

Queensland and knew their ways well, believes that the markings had no relation to the message carried by the bearer, and in support of his contention he states that on one occasion when he had been entrusted with a communication he purposely mislaid the stick and was subsequently handed another which was dissimilar. In his opinion the stick was merely a guarantee of good faith to show that there was no gammon. He also states that he has known of sticks being utilised more than once, that is covering two or more messages. It has been suggested that the markings are pictographic, which in a few instances would seem to be true, but nevertheless it is clear that Dr. Roth's opinion that the stick proves the bona fides of the bearer is the more reasonable, for he was always treated with respect even when passing through country

Trade and barter are intimately linked with these implements-if one may so term them. What is wanted by one aboriginal, and cannot be obtained from his own hunting ground, he has to obtain elsewhere. Maybe he requires some flint from which to manufacture spear heads or tomahawks, or something else that will enable him to obtain the necessities of life. Knowing where this essential commodity may be had, and not being able to go personally, he despatches a friend whom he provides with a message stick. This friend arriving at his destination produces his warrant, thus establishing his bona fides, and states his quest. The head man probably recognises the markings, if there be any, as the "sign manual" of the sender, or else the characteristics, and hands over the goods required.

The payment in kind may involve another trip, or perhaps the headman will despatch a messenger, armed with the same "stick," to state and obtain his needs. It will thus be seen that the stick plays a very important part in native life.

Dawson, who wrote nearly fifty years ago, gives a very graphic account of the use of the message stick in western Victoria :— "When a chief has a matter of great impass their hands down the stick, and ascertain the number of men required from the tribe. They then decide who are to be sent. The stick is next forwarded by messengers from the tribe to the nearest chief, who sends it on to the rest, and so on until all are summoned. The most distant tribe starts first, and joining the others in succession, all arrive in a body at the camp of the chief who sent for them.



"Message " or "Memory" Sticks. The larger flat specimen carried with it a challenge to fight, the smaller [a reply. The following are the messages accompanying each respectively :---" From Billy Brookes to Jack Gerambey. We want you to bring all boys from Tully, Cedar Creek and Glenalis to fight Goldfield mob, Marraber, Tinaroo, Barron River, Geranda, and Atherton boys; fight take place Scrubby Creek next Sunday." "Jack Gerambey to Billy Brookes. Can't come down till after Christmas; wait two weeks more, me come with the Tully and Cedar Creek boys. Tully boys want spell after big walk-about. All boys will be at Scrubby Creek to meet you in two weeks." Atherton, Cairns District, Queensland. [Photo.-G. C. Clutton.

portance to settle, and desires the advice and assistance of friendly tribes, he despatches two messengers to the nearest chief with a message-stick. This message-stick is a piece of wood about six inches long and one inch in diameter, with five or six sides, one of these indicating by notches the number of men required from each. The messengers are not allowed to explain the business of the proposed meeting. Immediately on a chief receiving the messagestick, he sends for his principal men, who They are accompanied by their wives, but not by children, or by very old persons. In the evening, when the children of the tribe and the women have gone to bed, the chiefs decide what is to be done; each chief tells his people what is required, and all retire for the night."

Besides the stick emblematic tokens were often carried. For instance if the message was the notification of an initiation ceremony, a bullroarer accompanied the message stick. Similarly, a man's apron impaled on the point of a spear implied war; or a mass of pipe-clay, an emblem of mourning, prepared the visited camp for news of a death.

The method of carrying messages in a cleft stick, as practised by the African tribes, has been introduced into the Northern Territory. The written message which is enclosed in ti-tree (*Melaleuca*) bark, and carried by the messenger after the manner of a little flag.

When Sir Baldwin Spencer and the late F. J. Gillen were carrying out their investigations in Central Australia some years ago, they met with an instance of this which I quote here as it is of some interest. "Towards evening we were surprised to see two strange natives coming into our camp, one of them carrying what they call a 'paper vabber.' It turned out that our friend Mr. Kell had very kindly sent out after us some messages which had come along the line for us after our departure from Powell Creek. The two men had followed us up for just one hundred and ninety miles, carrying the 'paper yabber' in a cleft stick. Though they had come through strange tribes, first the Umbaia and then the Gnanji, yet so long as they carried this emblem of the fact that they were messengers, they were perfectly safe. The natives are quite accustomed to messengers travelling from tribe to tribe to summon groups to take part in sacred ceremonies. Such messengers always carry a token of some kind-very often a sacred stick or bull-roarer. Their persons are always safe, and so the same safety is granted to natives carrying ' paper yabbers' for the white man. These two men had travelled ninety miles in the last three days so as to overtake us. They were perfectly happy when they reached us, the sense of having been successful in their work being apparently quite sufficient to satisfy them-with, of course, in addition, a plenteous supply of food and tobacco when they reached us. They spent the night in camp and left us next morning with a good stack of flour, meat and tobacco, and a pipe and a knife for each of them, quite cheerful at the prospect of a return journey of nearly two hundred miles to their own camp at Powell Creek. Their only luggage, apart from food, was a spear and a spearthrower.

"These 'paper yabbers' are a mystery to the unsophisticated native. On one occasion a friend of ours sent a native with a small parcel of tobacco to a camp some distance away. At the same time he sent a note saying how many sticks the parcel contained. As a general rule a package as this would be delivered intact, but the native knew what it contained and the temptation to open it and abstract a few sticks was



Message Carrier; a modern innovation. A written message is wrapped in paper-bark, inserted in cleft stick, and carried in this condition.

South Alligator River, Northern Territory.

[Photo.—G. C. Clutton.

too strong. When, on his arrival, he was taxed with the theft, he was highly indignant with the 'paper yabber,' because he had hidden it away in a hollow tree trunk while he opened the parcel, in order that it could not possibly see what he was doing, and he thought that it had, in some unfair way, found out what he had done and told the white man."

In the Australian ethnological gallery of this Museum may be seen a very fine series of these sticks illustrating their diversity of form and markings.

# Legless Lizards or "Snakes with Fins."

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

HAVE you ever killed what appeared to be a small snake, which on examination, proved to have two small scaly flaps, one on each side of the body about a third of the distance from the head to the tip of the tail ? Or perhaps, at one time or other, you have seen one preserved in a bottle, and proclaimed by the owner as a "snake with fins." Such creatures are often brought or sent into the Museum with letters containing a host of questions relating to them such as :—" Is it a snake with fins," "A slow worm," or "blind worm ?" and,

the best known, in fiction if not in fact, isthe "Slow Worm" of Europe, but that reptile belongs to a family known to scienceas the Anguidae, whereas the Australian species belong to the Pygopodidae, a very remotely related group of lizards which aremuch nearer to the little geckos in structurethan to the scinks. The lizards under discussion therefore are snake-like in form, but are restricted in their distribution to-Australia and New Guinea, and are known as scale-footed, or more commonly as leglesslizards.



Burton's Legless Lizard (Lialis burtonis). The sharp snouted form which is widely distributed throughout Australia. [Photo.-H. A. Longman.]

"Does it bite ?" "Is it venomous ?" "Is it new or rare ?" My answers may be found in the following lines :—" It is a lizard, and although snake-like in general appearance has all the characters and attributes of a lizard, with the exception that it has no fore limbs, and the hind ones are reduced to small scaly flaps situated one on each side at the hinder part of the body."

Snake-like lizards are known from other countries besides Australia, and perhaps There are fourteen species of legless lizards belonging to the Australian group, two of which occur in New Guinea, one being restricted to that country while the other, Burton's Legless Lizard, is widely distributed almost throughout Australia. Both of these lizards have long narrow snouts, the New Guinea species in particular, and they belong to the same genus, the Australian form being known as *Lialis burtonis*. While the usual colour of this species may be plain brown,

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olive, or greyish above, and spotted below, many beautifully marked and coloured specimens are to be found, especially in the tropical parts of Australia. The average length of a fully grown adult is twenty inches, but some in the Museum collection measure twenty-seven inches, while the body, which is covered with smooth scales, is of almost equal thickness throughout, and about as stout as a fountain pen.

*Lialis* is, perhaps the commonest species of legless lizard in Australia, but a very

more brightly coloured and more beautifully marked with lines, spots, or colour patterns than *Lialis*, bright reds and blues, outlined with whites and blacks, rendering some specimens most conspicuous when removed from their natural haunts, and placed on a table.

There are other species of *Pygopus* to be found in New South Wales, one with blunt keels on the scales, and a well marked head and body, and the other with smooth scales, uniformly coloured body and dark head.



Pygopus nigriceps. One of the rarer species, closely allied to P. lepidopus. The scale-like [legs may be seen, one on each side, near the bend in the body.

[Photo.-G. C. Clutton.

close second is one known as the "Common Legless Lizard" (*Pygopus lepidopus*), a blunt snouted form, which attains a length of about twenty-five inches when fully adult.

Pygopus, when uniformly coloured brown or olive, is, on account of its rounded snout, very snake-like, but it has a very rough, file-like appearance, due to the presence of sharp keels or ridges which extend down the centre of each dorsal scale, and which form eleven to thirteen longitudinal rows from head to tail. This species may be even Both of these forms are comparatively rare, and much sought after by Museum authorities; we certainly would welcome additional specimens for our collection.

There are several very rare species, and the genus *Paradelma*, of which we have only one specimen in the Museum, is restricted to Queensland. A small species, with a long name—*Ophidiocephalus*—is unique, only one specimen having been found in Central Australia by the Horn Scientific Expedition, which visited those regions in the year 1894.

Two very worm-like forms Aprasia, and Ophioseps, which do not exceed six inches in length in the adult stage, are restricted in range to Western Australia, while another. slightly larger species, also from Western Australia is *Pletholax gracilis*. The latter species is very thin and file-like, each dorsal scale having two sharp keels. The first specimen ever discovered, over forty years ago, went with a collection of zoological material to the Philadelphia Academy of Sciences, where it now reposes as the type of the species, and it was not until two years ago, that a second specimen was discovered on the banks of the Swan River. It was this specimen which I recently had the opportunity of describing and figuring for the first time in the Museum Records.\*

The most snake-like of the whole group, are several species belonging to the genus Delma, and though none of them may exceed fifteen inches in length, the general build, and markings, even to the black cross-bands on the head, give these little lizards a remarkable resemblance to young Brown Snakes, *Demansia textilis*, for which they are often mistaken, and suffer in consequence. One species of Delma - (D. fraseri) - iswidely distributed throughout Australia, but a variety of this one, and two other species, are restricted to the eastern portions of the continent.

A legless lizard may be distinguished from a snake by a number of easily discernible characters, some of which are as follows :— It has a thick fleshy tongue (that of a snake is rod-like, and deeply forked). It has an eyelid composed of a circular scaly ring (a snake has no eyelid, the eye being protected by a transparent scale). The ear opening is usually distinct (a snake never has an external ear opening). The scales of the belly are squarish, and not much larger than those of the sides of the body (the belly scales of a snake are transversely enlarged).

The main differences however are skeletal, but one only need be mentioned here. In snakes the lower jaw bones are separated in front, and are independently movable, but in all lizards they are fused, and are firmly united into a single bone, much the same as our own lower jaw.

This helps to explain why lizards usually chew their food, and are not able to swallow objects whole as snakes do. Many people seem to have the idea that legless lizards are venomous, perhaps because they resemble snakes, but the assumption is quite unwarranted, for they are harmless. I have never yet seen one of these lizards attempt to bite when handled, and even though it did I doubt whether its blunt teeth would do more than to pinch the flesh.

The tail of a legless lizard, like the tail of a gecko, is very brittle, and will easily snap off in the hand of its captor, thereby allowing the lizard to escape. In breaking, the muscles which are attached to the vertebrae, tear out, leaving eight hollows in that part attached to the body, into which the eight thorn-like muscles on the end of the broken part fit. In place of the portion of tail lost, the lizard is able to reproduce a new end, but it is very short, bears scales which are very different to the original ones, and the vertebrae are replaced by a rod-like cartilage.

As far as is known, all Australian legless lizards lay eggs, these being elongated oval in shape, and parchment-like in texture. They are usually laid in some decayed stump or under a log, afterwards being covered with decaying leaves and other bush debris.

The food of Pygopods is very variable; the majority appear to confine their diet to beetles and other insects, but *Lialis* and *Pygopus* occasionally eat other smaller lizards, as stomach examinations have proved. It would appear, therefore, that legless lizards would be rather valuable creatures to have wriggling through the garden or farm, where otherwise beetles might be doing damage, and we may count them among our reptile friends.

This issue completes this volume of the AUSTRALIAN MUSEUM MAGAZINE, for which the index will shortly be available. For the convenience of our readers arrangements have been made for the binding of their volumes in an attractive and durable cover uniform in style with the previous volume. The charge for this will be 8/6 (posted 9/-), or cover only, 4/- (posted 4/2).

<sup>\*</sup> Records of the Australian Museum, Vol. XV. No. 1, 1926, pp. 58-59.

# More Life of the Tidal Flats.

In a previous issue of this MAGAZINE (Vol. II., No. 8, October-December, 1925), the first of a series of articles appeared dealing in a popular manner with the marine fauna of the tidal flats at Gunnamatta Bay, Port Hacking by Messrs. F. A. McNeill, Tom Iredale, A. A. Livingstone and others. Regular readers are already, acquainted with the geography of the locality and some of the interesting shellfish which live there.

THE OCTOPUS.

URING the summer months octopods are very numerous on the flats. They frequent shallow water and their presence can always be detected by the character of their strange abodes. These are constructed as burrows in the soft sandy bottom and are lined with cockle and other shells which also encircle the entrance in the form of a rampart. The unfortunate occupants of these shells formed the food of the repulsive tenant who now rests contentedly among the skeletons of his prey, using them as a protection against the caving in of the Nests often soft sand. occur in areas some from the distance cockle banks, and the nature of their comshells ponent tell plainly the story of nocturnal visits and massacre in the tidal zone. Agitation near the mouth of a burrow will cause the occupant to protrude an



A few minutes' wrestling with the octopus leaves the creature in a more or less exhausted and flaceid state when there is little writhing to disturb posing and photography. In the centre of the tentacular mantle may be seen the teeth laid bare by the out-turned limbs, which each carry two rows of suckers. The fleshy membrane between the limbs assists in swimming, this motion being carried out with head foremost and limbs trailing behind.

Photo.-F. A. McNeill.

enquiring arm which will cling to one's hand until suspicion prompts its withdrawal. Forcible ejection of an octopus from its burrow is well nigh impossible, but the creature may be persuaded to come near enough to the entrance for its retreat to be effectively blocked by the insertion of a stick

at will to act as a "smoke screen "and cover retreat. It is apparent, however, that the octopus rarely uses its "ink" to this end, for rough handling or injury is necessary to induce an ejection. On the other hand, the allied cuttlefishes to be found in the same locality are easily prompted to do so. Like

the octopus into the surrounding water. Here the creature lies motionless awaiting the next move of the aggressor, who is lost in admiration of its daring. As king of the tidal flats the octopus rarely knows defeat among the animals of its own world and cannot easily comprehend a danger greater than those experienced in its everyday life. When approached it will dart swiftly away, launching its body backwards in rocket. like rushes with the tentacles or arms trailing in its wake. Propulsion of the body is accomplished by the forcible ejection of sea water through a mus cular tube on the undersurface of the animal and known as the funnel. Opening on the inside base of this funnel is a tube connected to the inksac, the contents of which can be released

or like object below

the body. When this accomplished

quick jerk will throw

is

a

these cuttlefishes the octopus is possessed of a chameleon-like faculty of changing colour, and can lie sprawled upon the sand with its eight webbed tentacles outstretched in such a manner as to render detection difficult. In the same way it may lie inert on a patch of green seaweeds, where its colour will blend

either among the rocks on the nearby shore or beneath some secure object in the shallows near her shelly abode. The mid-summer month of February is a favourable time to search for these little clusters of rice-like bodies, which are securely fastened to their anchorage with the aid of a glutinous sub-

in perfect harmony with the surroundings.

Much has been told and written of the great strength and sucking propensities of octopods, but it is safe to say that, on the coast of New South Wales at least, there occurs no species large enough to menace man, and the suckers on their tentacles can barely raise blood to the surface of the skin. Further, the sucking cups on the surface of the tentacles are in no way connected with the animal's nutritive system as many people believe. In effect, they act only for clinging purposes, being operated independently on the vacuum principle. It is the strong beak-like teeth in the mouth which should be carefully avoided by zealous collectors, as those of some New South Wales species, measuring about four feet from tip to tip of the outstretched tentacles, are large enough to sever a finger.

Unlike the cuttlefishes, the octopus is practically devoid of any skeletal structure.

but its relationship to other shellfish is detected by some vestigial traces in the head region of a one time external shelly armour.

When laying her eggs the female octopus selects some secure repository for her brood, attack according to the size and nature of the Smaller crabs are reached for from a prev. crevice with the outstretched feelers, which "flick" the victim and draw it into the encompassing folds of the tentacular mantle-Here can be held in capture upwards of

Occasionally one finds a track of the sand snail sufficiently removed from a nearby maze to per-mit of photography. The one here shown is very deeply furrowed in soft sand, and the eruption at its end marks the spot where the snail has gone below the surface. Two examples of the cone-shaped variety of snail responsible for this type of track are ranged alongside it.

[Photo.-G. C. Clutton.

stance. Each cluster contains many hundreds of eggs, and three or four batches. may be credited to a single laying, which is said to extend over a period of several days.

The degree of intelligence displayed by octopodshasdrawnwords of admiration from the pen of many keen observers. It is this attribute that has contributed to the creature's superiority among the numerous members of its group (Mollusca). We learn from authentic an source that an octopus, after killing a small rockfish, placed it as a decov in such a position as to attract small crabs within easy reach of a tentacle. This incident is all the more remarkable in that fishes do not ordinarily form a part of an octopus's bill-of-The creature fare. always prefers shellfish and crabs as food. and will consume fish only as a last resort satiate hunger\_ to When embarking on a crab-hunting excursion, the octopus employs various means of



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twenty small crabs awaiting their irrevocable destruction. If a crab be in the open, the octopus rises above its intended victim, and, with its widely outstretched and webbed tentacles, forms a parachute to swoop downwards upon the prev like a cloud.

Were it not for the repulsive appearance of the octopus, its flesh would be in great demand in Australia as a delicate article of diet. In Italy the prejudice against it has long since been overcome, and the capture of both the octopus and cuttlefish is a regular industry, finding much support among the populace.

#### SAND SNAILS.

Among the flotsam and jetsam of the sand bank are to be found the shells of innumerable molluses, and close examination of these accumulated remains will disclose many that are perforated with holes. The keen eved children who collect shells for stringing into necklaces find these holes convenient aids to that purpose, little knowing the



Among any accumulation of dead shells on the flats one can find numerous examples showing un-deniable traces of the attack of sand snails and other borers. The holes are found to be bored at any point of the victim's shell, which they enter at all angles. A partly bored hole in the middle of the largest shell shows where some depredator has been disturbed, or has met with a particularly hard layer of armour and forced to transfer activities elsewhere.

[Photo.-G. C. Clutton.



The egg rings or nidi of the sand snails are The egg rings or nidi of the sand snails are con-spicuous on the tidal flats in mid-summer. At least three varieties can be recognised, but it is difficult to associate them with the snails responsible for their building. Here are shown two live shells of the large depressed snail of the flats, which is believed to manufacture the big coarser nidus shown. Note the oper-culum or lid closing the opening of the shell of the up-turned snail in the picture.

[Photo.-G. C. Clutton.

sinister end that has overtaken the late occupants.

In the molluscan world there are both herbivorous and carnivorous feeders among the gastropod or snail-like shellfish, and these are provided with a ribbon-like structure called a radula. This is armed with numberless minute teeth which enable its owner to grind away the matter upon which it feeds. Now the carnivorous gastropods prey upon the lamellibranch or two-valved shellfish which are inoffensive creatures with no true mouth or means of protection other than their enclosing shells.

The sand snails (Polinices) of the tidal flat are carnivorous gastropods and their numerous tracks are to be seen everywhere on the surface of the moist sand. Leaving deep furrows in their wake, these depredators move slowly across the banks with the aid of their large fleshy feet, which are thrust forward beyond their shells in the form of a spade. When a victim is encountered, a snail

will attack its shell with the rasp-like radula which is carried curled up at the back of its mouth, and assisted by a potent acid secretion from a gland on the underside of the foot, this gradually grinds down the opposing surface until a hole is bored completely through; this allows of easy access to the soft body of the contained animal. The heavy shells of the common cockle are practically immune to the attack of the snails, but on occasions even these are neatly perforated, and even the heavy herbivorous whelk and such-like forms occasionally fall victims to the thorough carnivore.

Sand snails are adepts at burrowing, and often work their havoc below the surface of the sand, where they usually retire when the tide exposes the flats. They can be secured by tracing a surface furrow to where its end is indicated by a little eruption of sand (see illustration), marking the spot where the



The Sea Hare (Tethys angasi) is the most beautiful and graceful of its kind to be found on the tidal flats. Owing to its rare and isolated occurrence, one is seldom favoured by the pleasing spectacle of the bronze green and warm brown colour so artistically distributed over its form. Above, the delicate purplish folds of the mantle are at times visible as the edges of the reflected lobes of the foot slowly undulate while the animal wends its dignified way through the shallows. One third natural size.

James Stuart, del.

mollusc has disappeared. Smart excavation with the fingers will reveal the burrower at a shallow depth with body fully expanded, but almost instantly this is contracted into the shell and the opening closed by a closefitting lid or operculum (see illustration). The eggs are interesting objects to behold as they lie upon the flats, and during the warm months of the year they are particularly plentiful. Those of at least three species can be recognised, all in the form of a broken ring or hoop with overlapping ends, and arranged in a cone-like fashion. The colour of these nidi, as they are called, is that of the surrounding sand, the grains of which have contributed to their construction. If one of these egg masses be held to the light or broken transversely across, numerous small glassy cells in the solid body of the structure will be revealed, and in the contained jelly-like substance is the developing embryos of the sand snail.

#### SEA HARES.

To neglect any mention of Sea Hares in a discussion on the fauna of a tidal flat would be tantamount to leaving the story half told. For, apart from being among the most characteristic inhabitants of the area, these quaint molluses have a striking and unique history. Throughout hundreds of years they were credited with the possession of malevolent powers and these ridiculous beliefs were held by diverse peoples. In the countries of the Mediterranean it was regarded as dangerous even to look at them, such cases of daring being said to result in the loss of the onlookers' hair. This belief was epitomised in the name *depilans*, given to one species by an early naturalist; the group or generic name Aplysia, by which the Sea Hare was long known in scientific literature, was intended to convey similar distaste. It was said that if the creatures were handled, the individual whose lack of fear urged such courage, would be visited by dire sickness, which was more pronounced if the disbeliever was of the feminine gender. A curious remedy suggested was the usage of a dried male specimen, but as the Sea Hare proves to be bisexual, search for the male would have been an indefinitely prolonged process. Moreover, the puce fluid which the creatures emit was also considered able to burn one's flesh, whilst its smell was regarded as most noxious. While such fallacies have been handed down even to our own enlightened age, the natives of the Moluccas and other Pacific islands were not only completely ignorant of them, but were partaking of certain species, when available, as a regular article of diet. Apparently, the earliest naturalist who took note of Sea Hares in Australia lived in credulous enough times to consider it useful to observe that they did not possess any of the qualities credited to them, as he had proved.

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At Gunnamatta Bay Tethys sydneyensis often graces the tidal flats with its olive oreen and brown colouration for a few weeks during its migratory rounds of the local bays and estuaries, and may be found in great numbers browsing on the beds of seaweed in the shallow pools left by the receding tide. This form is typical in character, with a soft fleshy body four to five inches long and



Being no longer in use as an external protection the shells of Sea Hares have become greatly modified in shape, and better suited for the position they occupy in offering rigidity to the soft folds of the mantle. The above illustration (about natural size) shows a calcified shell of Dolabella, with the soft integument of its surface ruptured by a crack in drying. In most other Sea Hares, the shell is more degenerate, non-calcified and quite flexible.

[Phote -G. C. Clutton.

of slug-like appearance. It is adorned with two pairs of tentacles on the head, the larger pair being flattened and erect, grotesquely suggesting the ears of a hare; at the base of these the eves are situated. A shell is present, but this is of non-calcified degenerate nature, and not external as in other gastropods; it is concealed by the folds of the mantle or gill cover, situated in the opening along the middle of the back. This opening is formed by two lobes of the soft fleshy foot, which are reflected upwards on both sides and overlap the back in the form of two loose flaps. The continual motion of these flaps in the water assists the owner in negotiating the weed patches and stimulates the flow of oxygenated water to the gills through the inhalant siphon just beneath them in

the mid-line of the body. Besides this opening there is a mouth situated below the front of the head, and an excretory pore at the rear of the body formed by a fold of the mantle. If handled or irritated, this Sea Hare, like others of its kind, is liable to discharge a large quantity of puce fluid through the excretory pore, which mixes readily with the water and causes a dark stain in the immediate vicinity of the animal. No doubt this fluid renders their soft bodies immune to molestation by natural enemies, and compensates in no small measure for the lack of a protecting shell. Also the fact that both sexes are united in the one individual makes them prolific breeders, so that their ranks are doubly proof against annihilation in an environment where only the very fit survive for any length of time. Cold appears to be one of the worst enemies of Sea Hares, for exposure causes them to huddle up their bodies by contraction and take refuge below the surface of the soft sand. With the onset of winter all but the very hardy and more persistent species disappear from the flats. The eggs are laid in long strings from a pore on one side of the "neck" region, and cemented closely together into what appears to be an inextricable tangle. These are anchored to any convenient weed stem and are generally recog-



The green egg strings of Dolabella are more con-spicuous than those of the other Sea Hares by reason of their thickness and size; single masses may be three to four inches in thickness and eight to ten inches long. Masses like the one illustrated are often found partially covered by the soft surface silt deposited by the tides. The sluggish producer of such an egg-string is often submerged beside its handiwork, and a close scrutiny of this picture (lower left) will reveal a slit-like aperture (the inhalant siphon) opening on the surface of the sand and indicating the presence of a Dolabella.

[Photo.-G. C. Clutton.



When handled preparatory to being posed for the camera a short wait is necessary before the aberrant Sea Hare Dolabella regains its usual composure. It displays its resentment by partial contraction, and intermittent discharges of a puce-coloured fluid. The bristly appearance of the body, greenish in colouration, is due to the presence of numerous fleshy processes.

[Photo.-F. A. McNeill.

nisable by their distinctive colour. Those of Tethys sydneyensis are creamish, while the eggs of Tethys sowerbyi from the same locality are yellow. This last form is a swimming visitor to the flats, brown in hue, and a most interesting spectacle as it flaps its seemingly laborious way through the shallows much in the same way as an old and over-heavy domestic duck struggles to leave the ground. It is very long in the neck, and the quaint arching of this member in the action of swimming reminds one of a prancing steed. Nevertheless, such a form of progression is far in advance of the crawling stage common to most Sea Hares, and allows of a wider scope of operations, as exemplified by the scattered occurrence of this swimmer on the flats.

An aberrant form known as *Dolabella* scapula is by far the largest and most noticeable of the Gunnamatta Bay Sea Hares, but it is exceedingly sluggish in habit. It is to be found right throughout the year, certainly depleted in numbers through the colder months, and no doubt these off-season stragglers have been too slow in seeking the safe refuge of the deeper waters of the bay; the great mortality noticeable during the winter points to this fact. In mid summer great quantities of *Dolabella* are to be found on the exposed flats, six or eight individuals often occurring within the radius of a few yards.

Always seemingly inert, it is hard to understand how they gain sustenance, for their bodies are nine or ten inches long and three of four inches across, and weigh as much as one and a half pounds. They are much tougher and more solid than their allies, the lobes of the foot reflected joining neatly along the midline of the back to form a continuous surface over this region. On account of this peculiarity a very definite inhalant pore becomes at once conspicuous on the dorsal surface, and this always remains open and exposed when the creature lies buried in the sand. Unlike

Sea Hares of the locality. the other Dolabella has a well calcified shell, but this a non-calcified integuis covered by ment similar in composition to the flexible shells of its allies, and is soft and supple where it extends over the edge. The egg masses are a light foliage green in colour like the animal itself, the strings being about one-sixteenth of an inch in thickness. They are longer in proportion than those of the other Sea Hares of the flat, and a single mass may measure as much as 240 inches. The honours for egg production among the Sea Hares, however, must be bestowed upon the black Tethys hyalina, often found in the nearby waters of Port Jackson and the Parramatta River. One huge mass of continuous egg string laid by an individual of this species was tediously unravelled recently by Mr. G. P. Whitley of the Museum staff and totalled the almost incredible length of 865 inches. If we allot the very conservative total of 100 developing embryos to every inch of this egg string, we would have a total of 86,500 young from the one parent. But fortunately or unfortunately not all the eggs attain maturity. They are attacked by all manner of sea creatures before the young are released, and these in their turn have to undergo another hazardous period during development and before they become adult.