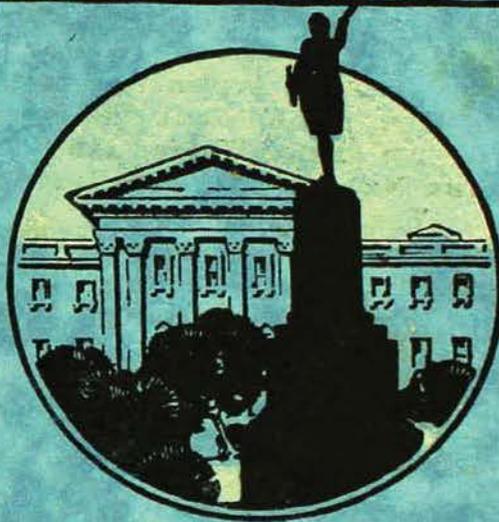


The
AUSTRALIAN
MUSEUM
MAGAZINE

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



- Races of the Mid-Pacific - *Wm. W. Thorpe*
A Seaside Ramble - *F. L. Grutzmacher, F.C.S.*
Plague Fleas and Rats - *Dr. E. W. Ferguson*
Pigs' Tusks and Armlets - *A. R. McCulloch*
Toilet Articles from Ancient
Egypt - *Wm. W. Thorpe*

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Making rope on the Island of Mailu, Papua. The women are engaged removing knots and excrescences from a tough bush vine, which makes excellent canoe lashings and halyards.

Copyright photo.—Captain Frank Hurley.



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Editorial.

A museum must either go forward or retrograde; there is no standing still, for, as the late G. Brown Goode, of the Smithsonian Institution, Washington, said in an oft-quoted passage, "One thing should be kept in mind by any organisation which intends to found and maintain a museum, that the work will never be finished, that when the collections cease to grow they begin to decay. A finished museum is a dead museum, and a dead museum is a useless museum."

The Australian Museum has a distinguished past, thanks to the able administrators who preceded us, but it behoves us to look now to the future, to keep our institution abreast of the times scientifically, to advance in step with similar institutions in other States and countries, to use our utmost endeavours to see that the museum gives the best possible service to the people at whose expense it is maintained.

In the first number of this Magazine we have briefly set forth the purpose and work of museums in general, and the Australian Museum in particular, and we shall not now enlarge on these, but we would again emphasize the fact that museums have two main objects, namely, to serve as storehouses for collections which have formed or will form the subject matter of scientific investigation, and, secondly, to interest and

instruct the general public. It will be obvious that to fulfil these functions there must be ever increasing accommodation, for collections never decrease in size, but, on the contrary, are always being augmented. Thus, in the matter of space, museums, like the daughters of the horse-leech, are ever crying "give, give," and we propose to set forth some of the reasons why this question is an urgent one in the case of our own museum.

The museum buildings are overcrowded. The exhibition galleries are of course filled to repletion, and new exhibits can be introduced only by removal of others. This may not be entirely a misfortune, for few exhibits are so fine that they cannot be replaced by better, but the most attractive and instructive exhibits are ethnological and faunal groups, and these require much more space for their effective display than do series of mere specimens. We hope to instal a number of such groups in the near future, but we are sadly handicapped by lack of space and other facilities.

A "type" room, in which a carefully selected series of specimens and preparations illustrates the divisions of the animal kingdom and the basis of zoological classification, is of immense service to students, but at present there is no gallery suitable for this purpose

in the Australian Museum; it should be self-contained, separate from the main galleries, yet easily accessible.

Again, many museums have a section specially devoted to children, the exhibits carefully chosen to awaken the interest and expand the minds of the little ones; we might well establish such a room in the Australian Museum if space were available.

Our library is seriously congested, and we are under the painful necessity of housing the overflow in cellars and other unsuitable places. We have no reading room, where visitors can sit in comfort when consulting books of reference. It must be kept in mind that a scientific library is to be regarded as a tool, and every workman likes his tools to be handy and in good order.

Our storage capacity is very inade-

quate for the needs of our reserve collections, which are just as important as the exhibited series. Moreover, what accommodation there is consists mostly of ugly, galvanized iron buildings, which are a continual source of annoyance. They leak periodically, the insidious white ant attacks the woodwork, and in the heat of summer these buildings are the reverse of comfortable.

The building as it stands is incomplete. May we not hope that at no distant date an effort will be made to finish at least one wing according to the plan already in existence?

We conclude with another quotation from G. Brown Goode: "The degree of civilization to which any nation, city or province has attained is best shown in the character of its public museums and the liberality with which they are maintained."

Notes and News.

Mr. Ernest Wunderlich, a highly esteemed member of the Board of Trustees, who was closely associated with the foundation of this Magazine, left in the end of December on an extended trip to Europe. During his absence he will visit museums and kindred institutions, and gather information regarding their management.

Dr. Arnold Heim, of Zurich, Switzerland, during his recent stay in Sydney, paid several visits to the Museum. He was particularly interested in the ethnological collection, and has arranged for an exchange of implements from the Swiss lake dwellings in return for Australian aboriginal objects.

Mr. A. F. Grimble, M.A., Lands Commissioner, Gilbert and Ellice Island Colony, while on a visit to Sydney in December last, called at the Museum seeking information on the fauna of that island group. He is keenly interested in the fishes, and was supplied with collecting gear, and will send back his takings for identification.

The Museum field parties, consisting of Messrs. A. F. Basset Hull, E. L. Troughton, H. S. Grant, and J. H. Wright, who were collecting in South and Western Australia, have now returned, bringing a large series of mammals, birds, and other specimens. On the Recherche Archipelago a number of seals were secured, besides skins and eggs of sea birds.

Messrs. A. R. McCulloch, E. L. Troughton, G. C. Clutton, W. Barnes, and Miss P. F. Clarke returned from Lord Howe Island about the middle of March. They have been successful in securing a large series of birds, and materials and sketches which will be utilised in preparing various scenic groups for exhibition in the museum. The cost of the expedition has been largely defrayed by donations from Messrs. A. E. and O. Phillips, Sir James Burns, Sir Hugh and Mr. William Dixson, to all of whom our best thanks are due for their liberality.

Native Races of The Mid-Pacific.

By W. W. THORPE.

An exhibit recently installed in the Melanesian Room, is a series of plaster facial masks of the natives of the Pacific, taken and coloured from life.

The three main groups of these peoples are the Polynesians, Micronesians and Papuasians, the latter, for convenience, being separated into three subdivisions, namely: The Melanesians proper, The Papuo-Melanesians, and the Papuans.

THE POLYNESIANS.

These people have often been referred to as "The White Race of the Pacific," because of Caucasian traits in their personal appearance and conduct. Formerly they were scattered over a very wide area, but are now considerably reduced in numbers, and in some islands almost extinct. They ranged over a very huge triangular region, apex at the Hawaiian Islands in the north-east, and New Zealand forming the south-west corner, while their most easterly limit has been fixed at Rapanui or Easter Island. Within this triangle lie the Ellice, Phoenix, Navigator, Cook, Austral, and Marquesas Islands, and other smaller archipelagos. Some islands coming more within the geographical area of Melanesia are Polynesian in population, *i.e.*, Ongtong Java (Lord Howe's Group), and Rennell Island in the Solomon Group.

The Polynesians entered the Pacific at some time subsequent to the Melanesians. In all probability they came down from the Malay Peninsula, through Java and the East Indies, to the Solomons and adjacent groups, but finding them already occupied by the Melanesians, and unable to settle there, they passed on until islands were discovered either to be uninhabited, or with a limited population, which they either destroyed or with whom they mingled. Their point of contact with the fixed Melanesian population seems to have been the Fijian Group.

The Polynesians are heavily built and well-proportioned. Their height fully

equalling that of the European. Apart from the nose being artificially flattened, the features in the main are attractive. The skin is dark brown with an olive tinge. These tints are faithfully portrayed in the Hawaiian Group already set out in the Museum. The hair is also very dark brown, sometimes black, and wavy, but not in any way resembling the texture of the Papuan or Melanesian, or the straight hair of the Malay. The head is of peculiar shape in that it is broad, sloping high from the forehead, and flattened at the back.

The typical Polynesian is open and candid, unsuspecting, and devoid of treachery, cheerful and good-natured. He is a good fighter and an undaunted navigator. Cleanliness and a taste for neatness are characteristic of these people. The language is euphonious, and they possess an abundance of songs and traditions which have been handed down through many generations.

The Polynesian constructs a wooden dwelling of a very substantial nature, and the detail of structure is often remarkable. The women excel in the manufacture of a cloth commonly known as *tapa*, a fabric prepared from beaten bark and tastefully decorated with native dyes and stains. This material is often beaten to a delicate thinness and several pieces are joined together, forming huge rolls up to one hundred feet in length. *Tapa* in course of manufacture forms part of the Hawaiian tableau, while a large sheet may be seen as a background to the Fijian exhibits in the wall cases.

It is in wood carving that one sees Polynesian art at its best. We have only to point to the productions of the Maories and Marquesans in support of this statement. On the other hand these people made no pottery, and, in its absence, wooden vessels and gourds were used as receptacles. Being a seafaring people, special efforts were expended in canoe-building. These were often of great size, and it took years to construct one vessel.



Taiwhaio, Maori chief, New Zealand, Polynesian man, adorned with kiwi-feather cloak and holding staff of office.

Cooking is done by steaming or baking in ground ovens, the men taking their share in the preparation of food. A pit was made and filled with wood, upon which stones were piled. This was set alight, and, as the fire burned down, the heated stones sank to the bottom. The food to be cooked was then wrapped in large green leaves, and placed in the hole upon the stones, covered with leaves and earth, and left for some time. When removed it was invariably found to be completely cooked, and in a juicy condition.

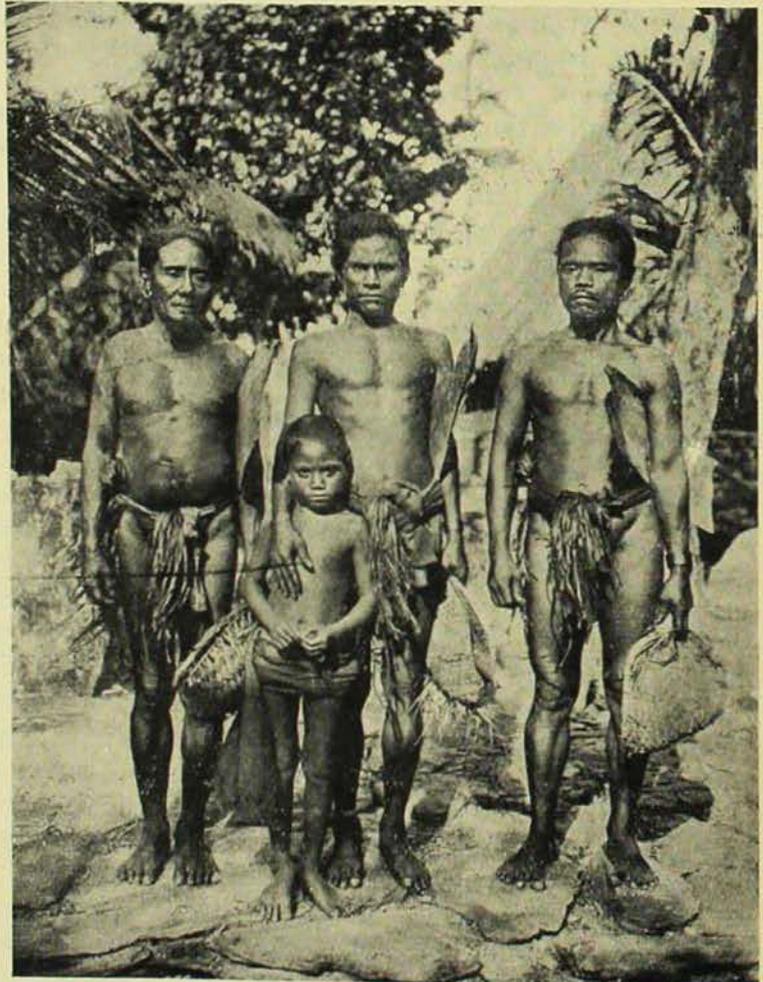
The women folk spent most of their time making bark cloth and baskets, in other domestic duties, and fishing.

Tattooing of either the face, trunk or limbs was a fairly common custom. In some islands the men only were tattooed, while in others

the women alone bore this decoration. Clothing was limited, the men as a rule wearing the T bandage of native cloth, and the women a loin cloak of the same material, or a leaf dress. The Maories and Hawaiians often had more elaborate garments of flax and feather-work for those of rank or to be donned on festival occasions. On these days the garments were more voluminous, and flowers were added as garlands.

The Polynesians brought with them into the Pacific the betel-nut chewing habit, and adopted the intoxicant *Kava* wherever the plant was found to be indigenous. Their weapons were few, and the almost entire absence of the bow and arrow may be mentioned.

An important part was played by the custom of *tabu*, a system of prohibition, forbidding contact with persons or



Men of Yap, Carolines. Tyes of fair Micronesians, showing clothing and palm-leaf baskets.
Photo—A. Matsumura.

things for the time being or permanently. For example, a king of Polynesia must not touch the ground for fear of serious consequences to his people. The marking of gardens with *tabu* symbols was sufficient to safeguard them. *Tabu* could also be utilised in the conservation of food over lean seasons, as when game or fish were scarce.

Hereditary chieftainship was the form of government usually recognised, and the state religion was controlled by a priestly caste, who served numerous gods.

THE MICRONESIANS.

The Pacific Ocean north of the Equatorial Line is studded with innumerable islands, and, because of their limited size, the area is collectively known as Micronesia. The islands included under this name are the Gilbert, Marshall, Caroline, and Ladrone Archipelagos. The latter group are at present inhabited by a race derived from the Philippine Islands. This archipelago was discovered by Magellan in 1521, and, because of his inability to trust the then inhabitants (Chamorros),



Warriors, Gilbert Group. Dark Micronesians, wearing coir armour, fish-skin helmets and armed with shark-teeth weapons.

owing to their habit of pilfering at every opportunity, he called the group the Ladrone (Thieves) Islands. This name was changed to Mariana Islands in 1668. The inhabitants of the remaining archipelagos are of a very mixed type, the dominant elements being probably a combination of pre-Malay (Indonesian) and Polynesian. Some ethnologists consider the Micronesians to be a branch of the Polynesian race, but the slightly mongoloid caste of feature differentiates them from the true Polynesian.

The Caroline Group, now named after Charles II., of Spain, was discovered by Portuguese navigators in 1527, and called Sequeira, but in 1686 they were annexed by the Spanish, who renamed them in honour of their own reigning king. The natives here exhibit a remarkable variety of complexion, being dark in the west and a lighter brown towards the east. In the east also the Polynesian element is more pronounced, and the custom of tattooing is very prevalent; on the other hand Papuan influence is likewise apparent.

The Caroline Islanders are exceptionally good seamen, and in common with Marshall Islanders possess direction-charts to guide them in their inter-insular voyages.

Special attention may be directed to the currency of the Carolines. Shell money changes hands for commodities, and, in the island of Yap, immense rings of limestone, up to three tons in weight, are used as money. These masses have a communal proprietorship, and belong, not to the individual, but to the village. A peculiar interest attaches to the Carolines also on account of the ruins of large stone buildings set up at some remote period by a prehistoric race. The primitive use of the hand loom is also practiced in this island group.

The Gilbert or Kingsmill Group consist of about a score of atolls or low coral islands enclosing lagoons. The inhabitants are very dark, and of fine physique. They are for the most part a fishing community. For protection against a two-handed sword of shark's teeth the warriors wear a complete set of armour composed of closely inter-laced cocoanut fibre.

THE PAPUASIANS.
(MELANASIAN DIVISION.)

These are shorter than the true Papuan, the nose more depressed, and the hair less frizzy. These people have been described as the earliest race to populate the islands of the South Pacific. Their range includes the south-east of New Guinea, and the islands eastward as far as Fiji, where the mingling with the Polynesians, already mentioned, has taken place. This intermixture is slightly less apparent in New Caledonia. The following groups are considered to be more or less pure Melanesian:—Admiralty, New Britain, New Ireland, Solomon, and New Hebridean Groups.

As a race the Melanesians are closely allied to the negroes, but differ considerably from the aborigines of Australia. As the name implies they are normally dark-complexioned, although not all of uniform tint.

The Admiralty folk for many years bore the unenviable reputation of being a treacherous and cannibalistic race. Their weapons consist of spears and daggers, bearing points or blades of obsidian, a volcanic glass occurring in the group. These weapons are also made with the barb or armature of the stingray. The Admiralty islanders are adept at constructing large bowls cut from solid logs and provided with elaborate fretwork handles. The crocodile is frequently represented in their carvings, and shell-bladed adzes are peculiar to the Admiralty Group. Huge cylindrical drums are also to be found in the villages.

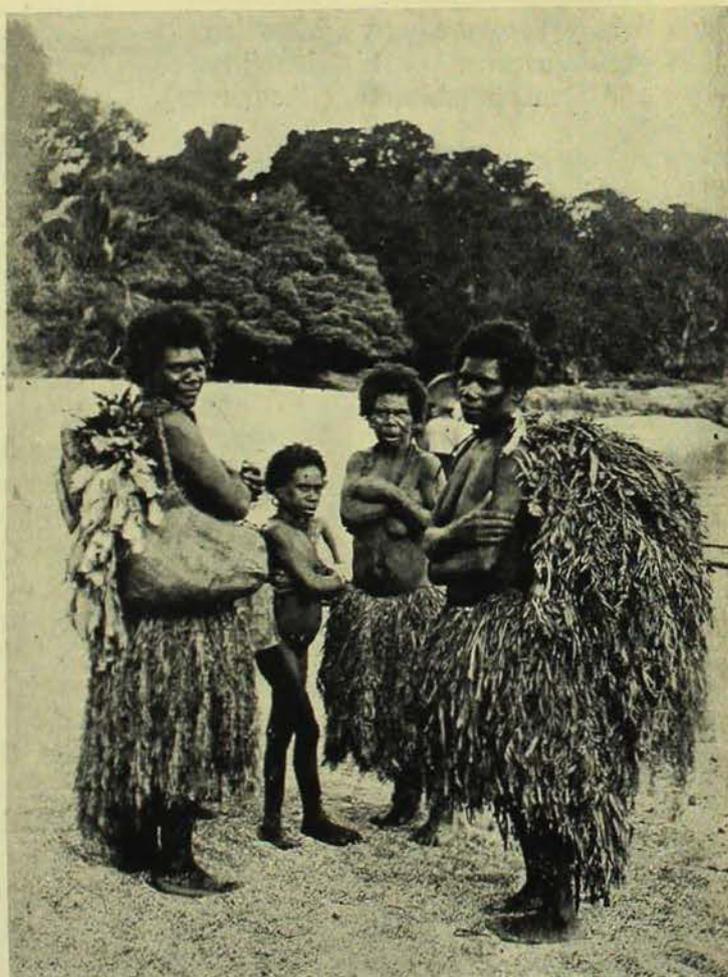
The New Britain people make enormous fish traps and use shell-money. Their weapons are varied; the most striking, in more senses than one, is the heavy stone-headed club. New Britain seems to be the home of

secret societies *par excellence* in the Pacific.

The New Irelanders are very adept at woodcarving. On view in the Museum one may see an extensive series of what were once solid logs intricately carved with all manner of devices mostly of a zoological nature.

The Solomon Islanders are noted for their beautiful shell inlay work. Sections of the pearl oyster and Nautilus are largely used, being set in the resin of the *Parinarium* fruit. Canoes, figures, weapons, ornaments, all partake in some measure of this form of decoration.

The New Hebrideans are of smaller stature than the average Melanesian. Among the features which distinguish the inhabitants of the New Hebrides may be mentioned the custom of deforming the human head in infancy, the absence of pottery except in Espiritu Santo, the use of feathered arrows, and government by chiefs, who claim to have



Woman, New Hebrides. Diminutive Melanesians, wearing Hibiscus bark dresses.

Photo—Dr. G. Brown.

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 AUS. MUSEUM LIB.

inherited the right from a spiritual source.

The New Caledonians, in common with the Fijians, but not to such a marked extent, show signs of the Polynesian infusion. They are largely on the decrease, and the time is not far

drinking of kava, or *yagona*, introduced by the Polynesians may also be mentioned.

PAPUASIANS

(PAPUANS AND PAPUA-MELANESIANS)

The great island of New Guinea lies immediately to the north of Cape York, Queensland, and is separated from Australia by the shallow waters of Torres Strait. The western half is Netherlands (Dutch) territory, while the eastern part was, till recently divided longitudinally into German and British New Guinea, the latter or southern portion being officially designated Papua.

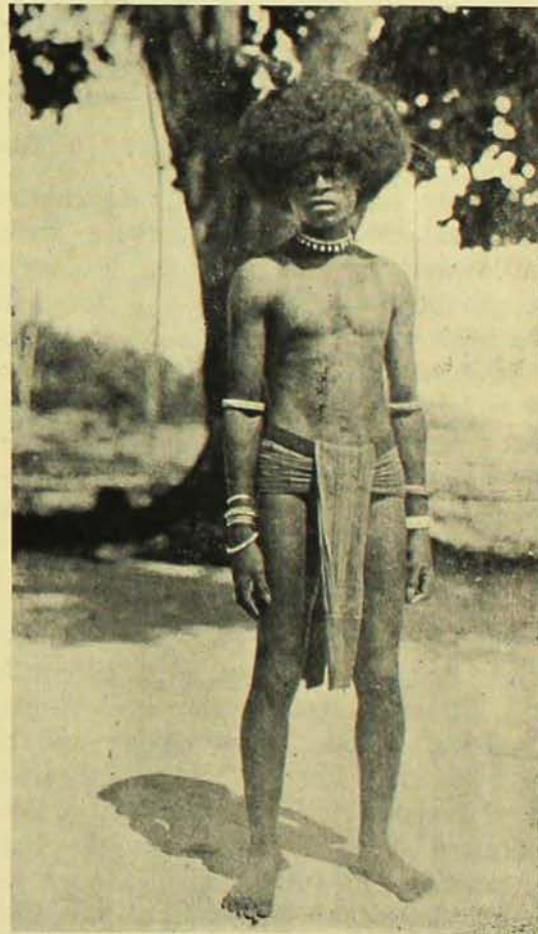
Many islands lie off the south-eastern extremity, and those in Torres Strait form, as it were, stepping stones between Australia, and the land of the Papuan. The true Papuan, a taller race than the Papuo-Melanesian, inhabits the north, north-western and south-western portion of the island, including also the Torres Strait, whilst the latter mixed



Fijian Man.—Melanesian with slight Polynesian infusion, wearing old style of tapa head dress and beating drum.

distant when the New Caledonian will become extinct. The special features of these people include currency made from the fur of the flying fox, a crude form of pottery; adze blades and ornaments of greenstone, and a plaited device for throwing spears.

A short account of the Fijians not elsewhere included may complete this brief description of the Melanesians. They are a fine race, though formerly much addicted to cannibalism. Their weapons are massive clubs and spears, and a Melanesian type of bow and arrows. Pottery with a vegetable glaze, and *tapa* cloth are made by the women folk, but the output of both is considerably reduced, while the former is almost an abandoned art due to the introduction of European utensils. The



Man, Dutch New Guinea. True Papuan, showing clothing, and woolly nature of the hair.

Photo—R. G. Niall.

and shorter race is to be found in the eastern archipelagos and the contiguous parts of the British territory. There seems to have been two distinct migrations into these Papuo-Melanesian areas. Compared with the Polynesians the New Guinea folk are indifferent seamen, and may be more correctly described as an agricultural race. Pottery is made in many parts, and a large quantity is produced in the Fort Moresby district, and traded regularly by water to the west, where sago is given in exchange. Bows and arrows are the chief weapon of the Papuans, but are everywhere absent amongst the Melanesian types. These are replaced by stone headed clubs, and palmwood spears, though these latter weapons are not unknown amongst the bow-using people. An immense variety of stone clubs are made, some indicating great skill and patience in their production.

The houses of New Guinea vary considerably. They are usually erected on piles, and in the east many of the villages are set up on the sea shore, where the tidal waters advance and recede below their dwellings. Communal houses to hold more than one family are common. Special club-houses, restricted to the use of the men, are built in many places. In wood carving the Papuan depicts motives of man and animals, while the Papuo-Melanesian in his art favours bird and fish designs. The betel-nut habit is general throughout New Guinea, but kava indulgence is practically unknown. Great attention is paid to the coiffure, and various styles of hair-dressing are adopted.

A great deal has yet to be learned regarding the inhabitants of New Guinea. Much has been ascertained, but the major portion of this large island is still a *terra incognita*.

A Seaside Ramble.

By F. L. GRUTZMACHER, F.C.S., F.G.S.

(A lecture delivered at the Australian Museum, 9th June, 1921.)

Sydney residents are particularly favoured with regard to seashore work. Little work may be done on a shingle beach, for the grinding of the stones in the wash of the waves is not favourable to life, and Sydney beaches are not overwhelmingly prolific. But a rocky shore such as we have all along our coast is ideal, and all the creatures mentioned afterwards may be found at our front door.

JELLY-FISHES.

One of the things, however, which we often find on the sand is a jelly-fish, and, although on the shore it is rather repulsive, in the water it becomes a most graceful thing. There is little that is solid about it, for it is mostly water contained by a delicate network, but nevertheless its organisation is more complicated than its first appearance would indicate.

Around the circular edge of the top or "umbrella" you may find, as a rule,

small dents at equal distances apart; these contain peculiar organs which seem to give the animal a sense of direc-



Jellyfish; its stinging tentacles are used to paralyse its prey and also afford protection to the animal itself, and to other creatures such as small fishes, which live in close association with it.

Photo.—A. R. McCulloch.

tion when swimming. This swimming is done by undulatory motion of the "umbrella." The mouth of the jelly-fish is a four-sided opening at the end of a

short stem hanging from the centre; the food is taken in and digested in a large stomach which extends into four pouches, and from these, canals convey the digested food over the body. The canals run into a circular canal going around the edge of the "umbrella," and all these are usually quite visible through the transparent animal.

Looking down on the top of a jelly-fish we may often see four reddish purple bodies inside the jelly, in shape something like a Maltese cross. These are reproductive organs, and the development of the young jelly-fish is very curious. The egg when discharged develops into a little free-swimming creature, but this soon attaches itself to some projection, loses its swimming powers, and becomes fixed. Then it proceeds to grow a number of buds, which look something like a pile of tiny soup plates one above the other. These buds eventually break off from one another and each separate bud becomes a new jelly-fish. Thus each jelly-fish is really the grandchild of the jelly-fish which produced it, the parent being the intermediate creature which developed the bud.

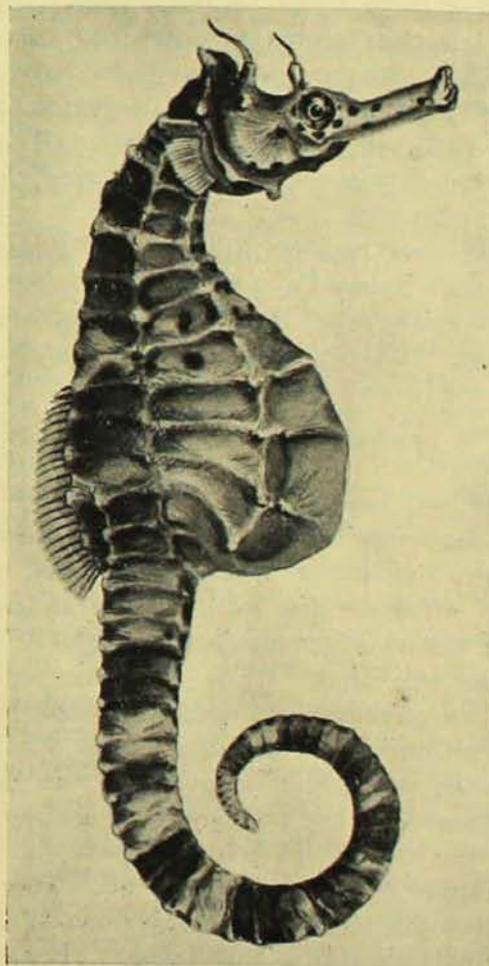
THE PORTUGUESE MAN-OF-WAR.

Another creature often washed up on the sand is the blue-bottle or Portuguese Man-of-war. This also is in the same class as the jelly-fish, though in a different order. They are very pretty, but, as bathers know, very dangerous, for their sting is truly dreadful. The deep blue air bladder, rounded at one end and slightly pointed at the other is, in some species, surmounted by a small crest, and has a tiny opening at each end, controlled by a set of muscles. The blue-bottle is not really one animal, but is a whole colony of animals. Under the floating bladder which is filled with air are the long tentacles, armed with terrible poison darts, which float out far around the blue-bottle; but besides these there is a whole host of shorter structures, the individuals of the colony. These, strange to say, are not all alike. The blue-bottle colony has only one stomach common to all the members, and

some of these individuals are engaged only in supplying that stomach. They have mouths and absorb food for the benefit of the whole colony, but they do nothing else. Others are gifted with powers of reproduction, and provide new colonies, but they do not feed themselves; they simply make use of the common food absorbed into the whole system by their brothers.

SEA-HORSES.

Washed up on the beach after a heavy gale we may often find the curious sea-horse. There can be no doubt as to why it is called "sea-horse," for its head bears a most ridiculous resemblance to a horse's head. A curious feature of its body is that the latter is composed of a series of rings, something after the manner of a caterpillar. These rings extend right down to the tail, and this organ is extremely prehensile. The fish



Seahorse—*Hippocampus abdominalis*.
A species occurring in shallow water off the coast of New South Wales.

swims in a vertical position, using its back fin as a propeller, but its tail is always on the alert to seize the stem of any plant which it may meet in the water. Using the weed as an anchor to prevent itself from being carried along by moving water, the fish awaits any food which may happen to come along. A curious thing happens when two sea-horses swim against each other; their prehensile tails involuntarily interlace, each grips the other, and it is only with the greatest difficulty that they are able to free themselves again. They have to catch hold of some weed with the under part of the chin and then struggle and pull until the two tails part.

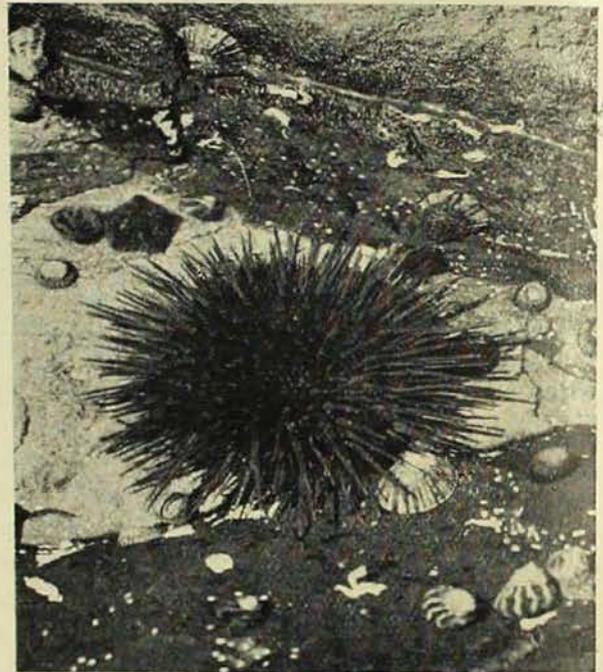
The sea-horse shares with the kangaroo the honour of having an abdominal pouch, and uses it for the same purpose. But whereas the young of the kangaroo are not born in the pouch but are placed there afterwards, the sea-horse places the eggs in the pouch and leaves them there to be hatched. The pouch then serves as a shelter for the young. Strange to say, it is only the male fish which possesses a pouch, and he relieves the mother of all responsibility concerning the upbringing of her offspring.

Another curious thing about this fish is that it has the power of moving its two eyes quite independently of each other.

PHOSPHORESCENT ANIMALS.

If you happen to be at the beach in the darkness of the evening, particularly where the waves break over rocks, you will often see the water lit up by lines and flashes of greenish-white light of intense brilliancy. The phenomenon is known of course as phosphorescence. Now on account of this name quite a large number of people believe that this light is caused by the presence of phosphorus in the water. Actually there is no phosphorus in the sea at all. The illumination is caused by myriads of living animals called Noctilucae. They are very tiny creatures, almost circular in section, and have a diameter of from 1-20th to 1-100th of an inch. Their ap-

pearance may be compared to that of a microscopic peach made of jelly. On one part of the body, like a projecting stalk, is a kind of tail, with which the little Noctiluca whips the water and drives itself along. If one of the living animals is touched with a needle point a flash of light is immediately visible, and any irritation makes it reappear. This accounts for the lighting up of the sea near the rocks or as the waves hit the sand; the breaking wave dashes the little creatures against the rough barrier and they flash out their indignation and give us the phosphorescence. This lighting up may be a kind of self de-



Sea urchin (*Toxocidaris erythrogrammus*). The commonest species in and around Port Jackson, sheltering in the crevices of rock-pools in the mid-tidal zone. In the foreground may be seen a few striped periwinkles (*Monodonta obtusa*).

Photo.—A. Musgrave.

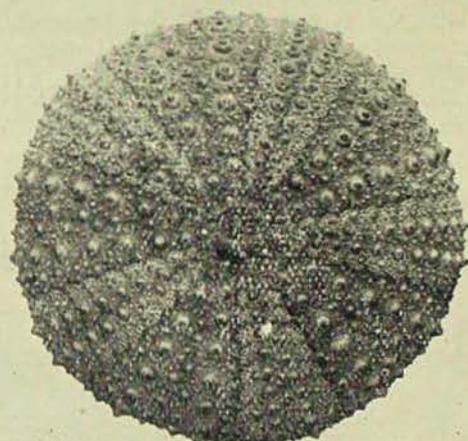
fence with the idea that the bigger creatures would hesitate to swallow fire. The light becomes particularly brilliant in the little animal just before it dies, but with death it ceases altogether.

There is something very queer about this phosphorescence of the Noctilucae. The light is so strong that the illumination from an ordinary tumbler filled with sea water containing the animals is sufficiently powerful to enable a person to

read a book. But the light gives out no heat, and the most delicate temperature recorders are unaffected by it. Nor is it produced by any kind of combustion, for oxygen gas, the greatest of all supporters of combustion, has no effect on it.

SEA-URCHINS.

Sea-urchins will be found in hollows on the undersides of the rocks at dead low tide. They are curious animals, living in a shell case or test, which, when thrown up on the shore denuded of spines, is often called a sea-egg. This shell is composed of limestone and is not all in one piece; several hundreds of pieces go to the making of even the



Corona of sea urchin (*Toxocidaris erythrogrammus*).

The corona or shell with the spines removed. The bands of tubercles mark the points of attachment of the spines, and the perforations intermingled with the smaller of these form the openings through which the feet protrude.

Photo.—A. Musgrave.

smallest. The shell is quite thin, and its growth is really marvellous. When quite young, the animal is less than the size of a marble, and it has to grow. Its case has to hold it and must therefore be made larger, but the animal is inside it; how can it make its case larger from the inside? The secret lies in the fact that the case is not all in one piece. All the pieces fit most accurately, but each is covered with a layer of living tissue which passes between the joints and which can secrete

lime from the sea water. In this way the various pieces are extended at the edges, all still fitting tightly, and so the case is enlarged though the builder inside never sees what he is doing.

The spines of a sea-urchin are all movable and present a dangerous opposition to an attacker. They are often very numerous; in a large purple urchin common on our coast I once calculated the number to be about 1,100.

The sea-urchin is also well provided with feet. They do not always project, but are pushed out when required. They consist of little, white, hollow tubes with a sucking disc at the end, and are provided with fine muscles. When the animal wishes to walk, it forces the tubes through holes in its case by filling them with water from the inside as if from a force pump, and when they are full the muscles take control and the animal walks.

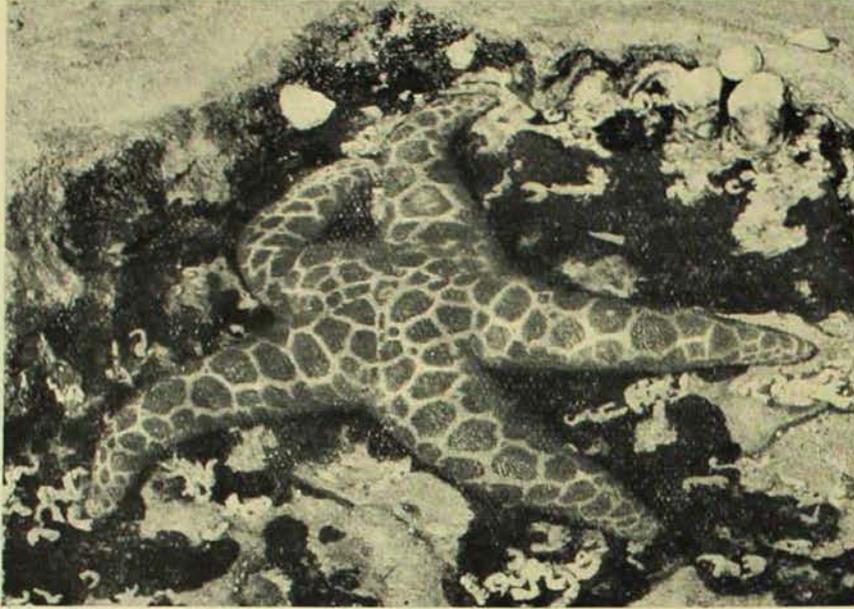
The mouth of the sea-urchin consists of five jaw-like parts each bearing a powerful tooth. The teeth project through the central opening under the shell, and can exert enormous strength. It is largely with these teeth that the urchin cuts out the hollow in the rock where it lives.

STARFISHES.

The general design of all starfishes is based on the same foundation, that of rays projecting from a central disc. They are remarkably "leggy" creatures, as you will see if you turn one over smartly on its back. The little white legs will be seen waving wildly in the air. In construction they are much the same as the tube feet of the sea urchin.

Each ray of a starfish has a small primitive eye spot at the end of it, and just above it is a small projection like a tentacle which is used as an organ of smell, so that the starfish is well provided with noses. A very beautiful starfish is found on the rocks exposed to the battering of the ocean, and I am sure that the colouring on its back must have inspired the first artist in Satsuma ware.

A starfish is a very remarkable animal in its method of feeding. It fre-



Mosaic starfish (*Plectaster decanus*).

Usually an inhabitant of deep water, but not uncommonly found on rock faces in sheltered water below the limit of the low tide. In life this is an extremely brilliant object, the upper surface consisting of red patches ornamented with a network of white calcareous ridges.

Photo.—A. Musgrave.

quently attacks a morsel far larger than its own mouth (which is in the middle of the underside of the central disc.) This does not distress the starfish, because it can perform a most extraordinary feat with its inside. When it cannot get its food to its stomach, it does the opposite, and takes its stomach to the food. It projects its stomach out through its mouth, folds it around the victim, and keeps it there until all the food is digested. When that is done the stomach is drawn back again to its proper place. The walls of the stomach are very loose and crinkled inside the body, and this allows for the necessary stretching.

The starfish has the property of absolute indifference to mutilation. If divided into halves each half grows another, and we have two animals instead of one.

The life history of the starfish is also very extraordinary. It comes from an egg which gives forth a tiny free-swimming creature something like a microscopic worm. This animal grows and grows, but it is not the future starfish. For, after a time, from a small rudiment inside it another animal grows, and as it progresses it steals the stomach and

digestive organs of the original animal and takes them for its own use, though it grows a separate mouth of its own. The poor foster-mother dies and actually becomes part of the food of the new animal, which has grown from a part of the foster-parent's body. The sea-urchin, which is also a close cousin of the starfish, has a development somewhat similar.

BRITTLE-STARS.

Very curious are the brittle-stars, common on the rocky shores at low tide.

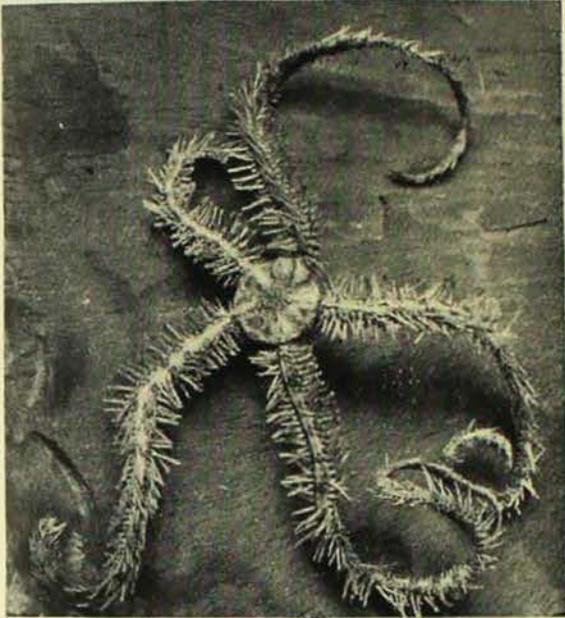
Like a starfish in appearance, they are quite unlike it in movement, for their arms are long and very flexible, and, unlike the starfish, which creeps slowly



The eight-rayed starfish (*Asterina calcar*), and the five-rayed starfish (*Asterina exigua*), are our two commonest forms, and, occur abundantly in pools left by the receding tide.

Photo.—A. Musgrave.

along, they travel at a rapid rate. They move by a succession of snake-like undulations of their arms, and these long arms are attached to a central disc which is quite small. In the starfish the rays



Brittle starfish (*Ophiothrix fumaria*).
Common under loose stones in pools, and in crevices between tide marks.

Photo.—A. Musgrave.

seem to be part of the body, but in these creatures they seem like mere appendages.

The name "Brittle-star" given to these curious animals refers to the extraordinary way in which they break themselves to pieces when captured. A lizard will snap off its own tail if held by it, but the brittle-star, when angry or terrified, deliberately breaks all its arms into fragments to show its annoyance. But this does not mean that the creature is committing suicide, for after a short interval all the broken parts will be renewed and the animal will be literally as good as new.

SEA-SQUIRTS OR ASCIDIANS.

At dead low tide you may find the Cunjevoi or sea-squirt, which has the scientific name of *Cynthia*. You may easily know it by the fine jets of water which it squirts up as you approach. Despite the pretty name of *Cynthia* it is about as ugly a thing as is made; it is like an irregular, very warty, and

somewhat hairy bag, with two openings like mouths at the top of its body. These mouths gape open when the tide is coming in and are then seen to be red in colour.

This animal is one of the greatest curiosities of the shore, inasmuch as it belongs to the same sub-kingdom of animal life as ourselves—that is, it is one of the vertebrated animals or animals with backbones. I am not saying that the sea-squirt has a backbone, but I mean that the young sea-squirt has the beginnings of one, which, however, it loses as it grows up. The fact is that *Cynthia* is a shocking degenerate. The young animal is something like a very small tadpole in shape and is able to swim quite freely; it has a well developed nervous system, a good eye, and other sense organs. But after a very short time it fixes itself to a rock and begins a retrograde movement and ends by becoming the immovable degenerate adult which has lost all visible connection with the higher types of life. There is of course a reason for this. *Cynthia* is an awful example of the effects of having plenty of food without having to work for it. Long ages ago it was probably an active creature, but food was plentiful and the animal just had



Cunjevoi (*Cynthia praeputialis*).

The cunjevoi overlap the extreme edge of the low tide mark, exposed to the full wash of the surf on the coast.

Photo.—A. Musgrave.

to open its mouth as it went along and the food went in. This made it lazy, so it tried the effect of just sitting down with its mouth open, and found that it got its food just the same. The result was that finally it just anchored itself

to a rock and remained there, too lazy to move. Another result was, of course, that its own sense organs degenerated through disuse and finally disappeared, and so through the ages it gradually changed to the dull senseless thing it now is. Cynthia always reminds me of the story of the very old-age pensioner who, when asked by a kind lady how he passed his time said, "Zumtimes I zits and thinks, and other times I just zits." Cynthia "just zits."

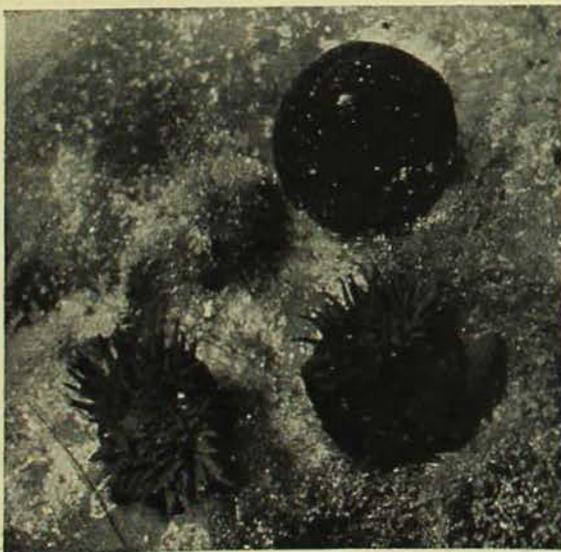
The two openings of which I spoke as showing red when gaping are connected with the food supplies, which consist of the minute life of the sea. As the tide rises the animal is covered and the water is drawn in through one opening and expelled through the other, and the food is extracted meanwhile.

A remarkable thing about the adult sea-squirt is its heart, or rather its blood circulation. The heart is something like a bag bounded by strong muscles, and its pulsations, which send the blood around the animal's body, are simply muscular contractions which begin at one end of the bag and slowly travel until they reach the other end. But here is the remarkable thing—the blood does not always flow the same way. After the pulsations have reached the end of the bag there is a short pause;

then they begin again in the opposite direction, so that the blood is driven round the body also in the opposite direction.

SEA-ANEMONES.

The sea-anemones, some of the most beautiful creatures of the animal world, may be found in cracks and hollows on the rocky shore. It is rather difficult sometimes to believe that they really are animals, as they look so much like flowers. The cylindrical body has a strong muscular disc underneath, by which the animal clings to its support, and at the top there is an upper disc bearing circles of tentacles, usually beautifully coloured. The tentacles, which are quite flexible, each contain a little dart, which is injected into the victim when the anemone seizes its prey. If you touch them with your fingers you can feel them cling. Although this will cause no discomfort to you, it is otherwise with small shell-fish, etc., which are paralysed by the grip. In the centre of the rim of tentacles is a large mouth, which communicates with a wide stomach occupying nearly half of the interior of the body. The anemones are extremely voracious, and even creatures with hard unappetising shells are just swallowed whole and the shell is thrown out again after the soft body has been absorbed. The finest anemone on our coast is the sea dahlia (*Oulactis muscosa*), which is found in exposed places such as near the mouth of Middle Harbour and on the coast. Its tentacles are pale bluish purple in colour and the centre is often a rich velvety brown. It has a curious habit of plastering its body with sand grains and sea shells, which quite disguise it when the tentacles are closed. In the more sheltered spots, we find the sea waratah, (*Paractis papaver*) smaller than the other, with a smooth, dark brown body and coral red tentacles. It is often called the "blood sucker," which gives it a reputation entirely undeserved.



The Sea Waratah Anemone (*Paractis papaver*). Under rocks in dark corners this blood-red sea anemone expands its tentacles. The contracted animal at the top shows the condition of the anemone when not submerged.

Photo.—A. Musgrave.

CRABS.

Plenty of little shore crabs will be found on the rocks and may often be noticed feeding. It is a quaint sight to

see the crab standing up on the tips of all its legs and looking like some self-satisfied old person, as it deliberately raises each "hand" alternately to its mouth. Talking of feeding reminds me that the stomach of the crab is remarkable in having a set of working teeth inside it. The lining of the organ is thickened and hardened with lime, so as to make a sort of framework, and on this there are three hard calcareous teeth which work into each other and project into the stomach cavity. Very powerful muscles work these teeth and cause them to grind up the food. It is to be hoped that the crab does not suffer too often from toothache!

A young crab is very unlike a crab. When it first comes out of the egg it is a free swimming little creature with a thin, loose, transparent skin all about it. As it grows it casts its skin from time to time, develops legs, loses its long tail and gradually becomes the adult crab which often cannot swim at all.

BARNACLES.

Acorn barnacles are found all round the rocks, more often exposed to the air than not. They have made fair progress towards becoming land creatures, but are prevented from further progression by their fixed habit. Yet when young, the larva is a quite active creature. But after a while the young barnacle attaches itself to a rock, grows a hard armour casing around itself and loses all powers of locomotion. It is fixed to the rock head downwards and

passes all the rest of its life in this upside-down condition.

When the tide rises, a central door in the shell of the barnacle opens, and the animal searches for food by thrusting plume-like feet in and out with a sweeping motion, which draws to them the minute life on which the creature feeds.



Rock Crab (*Leptograpsus variegatus*). The commonest crab on the coast of New South Wales. To be seen everywhere along the rocky foreshores, swiftly retreating into a safe hiding as an onlooker approaches.

Photo.—A. Musgrave.

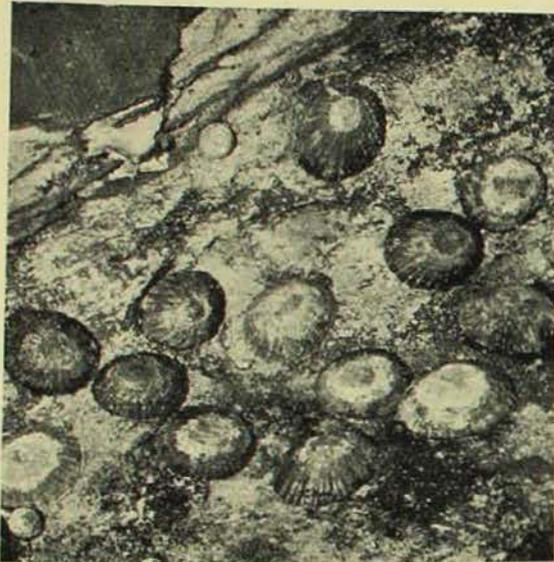
Along a stretch of barnacle-covered shore quite a distinct swishing, grinding sound may be heard as the acorn shells get busy in the rising tide.

SHELLS.

The whelks of our beaches (which are not the same as the European whelks) all have very strong shells, usually with some notable device on them to resist battering or crushing, for mostly they are fond of the rocky shores where the waves have full play. The small rock-whelk, for example, dark brown in colour and about an inch long, has a shell studded with girdles of small hard knobs, while the "belted whelk"

has a series of ridges arranged in rings around the shell. This whelk prefers places where it can get the full force of the sea's battering.

The mouth of the shell of a whelk is broken at the end furthest from the apex of the shell by a deep notch, through which an organ called the sip-



Limpets (*Cellana variegata*).

To be found high and dry on the rock flats when the tide is out.

Photo.—A. Musgrave.

hon acts. This is a spout-like projection which enables the animal to receive the aerated water for breathing.

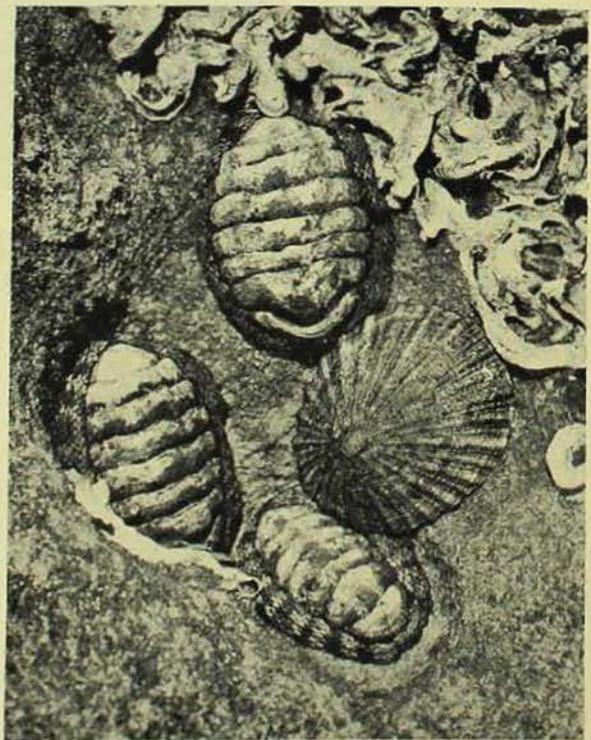
The opening of the shell can be entirely closed by a tightly fitting door called the operculum, which the creature draws into it. This operculum is a characteristic feature of those Gastropoda (snail-like shell-fish with only one shell). In the case of the land snail, the opening is closed in winter by a hard layer of mucous matter called the epiphragm.

PERIWINKLES.

Periwinkles may always be found crawling about in the rock pools. In the periwinkles, or sea snails, there is no notch in the margin of the shell such as is possessed by the whelks. The presence or absence of this notch is a fairly sure guide to the feeding habits of these creatures, for if the notch be present the animal is almost certain to be carnivorous, while, if it is absent, the animal is a vegetarian.

Some of the periwinkles have almost deserted the sea as a home, and especially is this the case with a very small bluish-grey periwinkle (*Melerope mauritiana*), which is found in clusters in hollows well up on the rocks. It is only covered by the highest tides and sometimes only by the spray of them. It is well on the way to becoming a land animal; the land snail is a periwinkle which has completed the change.

The general internal structure of the whelks and periwinkles is much the same, the internal organs being gathered together in a twisted hump which is covered by the shell. The tongue is a long ribbon working to and fro behind the mouth opening. It is covered like a file with rows of teeth—an enormous number of them; some species of sea snails have over 500,000 teeth. The foot on which the animal glides is just a flat creeping disc, and the creatures move by a series of wave-like undulations which flow along it.



Chitons (*Sypharochiton pellis-serpentis*).

In company with limpets and tubes of *Galeolaria* occur these quaint "mailed" molluscs. They are everywhere to be found clustering together in small depressions on the rocks, from about the mid to the upper tidal zones.

Photo.—A. Musgrave.

LIMPETS.

The limpets are proverbial for sticking to the rocks, and, as a matter of fact, no amount of ordinary pulling in a straight line will remove one from its holding. The central part of the foot is raised from the rock by muscular action, forming a kind of sucker with a partial vacuum between the foot and the rock, and, since the edges of the foot fit the support perfectly, the external atmospheric pressure helps the animal to resist being detached. The limpets are always easily known by their dome-shaped or tent-shaped shells, a shape on which the battering waves can get no purchase to dislodge them.

The limpet, which also has a ribbon tongue, is a vegetarian and feeds on the green sea growths on the rocks. A remarkable thing about these animals is their homing instinct. A limpet hollows out a depression in a rock to accommodate itself nicely, and, though it leaves this at feeding time in search of food, it will return again and again to its old home, and never seems to settle in the wrong hollow by mistake.

CHITONS.

Occasionally gliding over the rock, but more often as still as the stone itself,

may be seen those curious molluscs, the chitons, often called mail-shells. Instead of one solid shell like a limpet, these animals have developed a hard calcareous armour composed of eight separate transverse pieces, which fit one over the other something after the manner of tiles on a roof. You can see this well if you detach a chiton from its rock and place it on its back, when it will proceed to roll itself up into a ball with the shell on the outside. A leathery band or girdle runs around the outside of the eight plates. The chitons have no eyes or tentacles, whereas the periwinkles and their kind, have two tentacles and also eyes on very short stalks, at the base of the tentacles.

The chitons are vegetable feeders, living on minute seaweeds and those very tiny marine plants called diatoms. If you place one of these molluscs on a piece of glass wet with sea water and watch its movements from the underside, you will see that its foot extends nearly the whole length of its body, while the mouth is plainly visible just above the foot. Behind the mouth is a long, toothed, ribbon tongue like that of the periwinkle.

In spite of its very simple appearance the chiton has a well developed three-



Mussels (*Brachydontes hirsutus*).

Portion of a colony fitted together into a mass of epidermis and byssus (hairy filaments). This species is to be found clustering on wharf-piles or in rock crevices in sheltered waters. The top of the picture shows a number of barnacles.

Photo.—A. Musgrave

chambered heart and a very fair nervous system. It has no brain, though; the centre of the nervous system is a thick nerve ring in the region of the gullet. The larvae of the chiton are free swimming creatures, though the adult animal cannot, of course, swim at all.

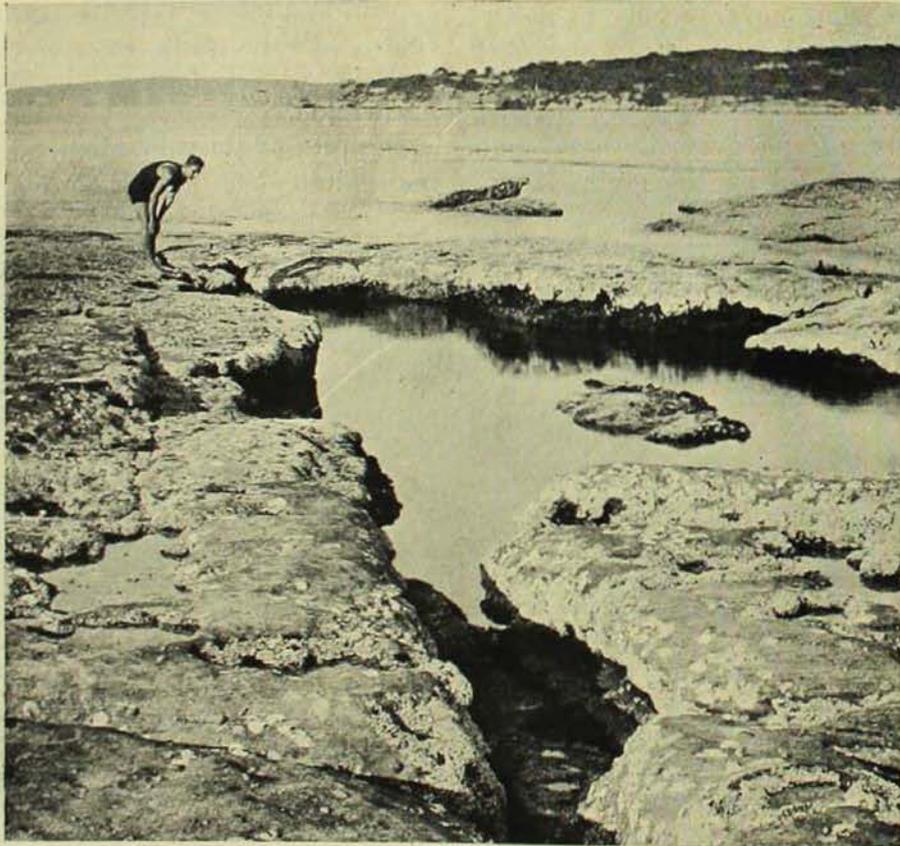
MUSSELS.

We now come to a bivalve or two-shelled mollusc, the mussel, which you will find on the lower rocks or around the piles of wharves. The mussel is a very near relation of the oyster, but it is superior to the oyster in that the adult animal has powers of locomotion; the larval forms of both are free swimming. The foot of the mussel, by which it walks, is a most remarkable organ. It is a continuation of the front part of the body and is not unlike a tongue in shape. It is thrust forward out of the slightly open shell, and near the base of the foot there is a gland which gives

out a sticky, silky secretion, which hardens into a kind of thread when produced. The animal gets along by projecting its foot forward, fastening the end of the thread produced from the gland to some suitable spot, and then, bringing back its foot suddenly, it pulls on the thread and hauls itself along through a fraction of an inch. Each time it repeats this motion it fixes an extra thread, and, when it has moved sufficiently, this bundle of threads, known as the byssus, serves to anchor it most securely to its support. The byssus can be cast off if the mussel wishes to move on at some future time.

THE OCTOPUS.

It seems rather curious to call the octopus a shellfish, yet it really is a mollusc and is related to the whelks, periwinkles, and snails. But it has carried its development so far that the shell is a mere apology for a shell, a rudiment only. It serves merely to con-



Reef-building annelid worm (*Galeolaria caespitosa*).

White masses of annelid worm tubes cover the rocks from about the mid-tide zone to the limit of the neap tides. In the quieter waters they thickly encrust the rocks and wharf piles, presenting the appearance of coral, but are less abundant on the open coast where adverse conditions apparently restrict their growth.

Photo.—A. Musgrave.

nect up various muscles, for it is internal, not external like a periwinkle's shell. It is like the beginning of an internal skeleton, whereas the shells of the animals I have described are external skeletons, not merely houses. The shell of a cuttlefish, a first cousin of the octopus, is more pronounced; it is often found washed up on the shore—a white, leaf-shaped body with a hard projecting guard on one side and soft laminae on the other.

The octopus is a hideous brute, and you can always find him at dead low tide crawling or lurking about in the shadow of the rocks, particularly towards evening, for he does not love the strong light. His staring, deep golden eyes are quickly seen, and they are most wicked looking things. The octopus has the power of flooding his skin with blushes of different colours to correspond with his surroundings. His eight long arms are covered on the underside with a double row of suckers, no less than 240 to an arm, which give him tremendous power when he grips a victim. The arms are also used for creeping and slow swimming. Rapid swimming is done backward by forcible ejection of water from a tube in the body which points forward.

In the centre of the circle of arms is

a pair of thick fleshy lips which hide a powerful pair of jaws shaped like a parrot's beak. Behind the beak is an extraordinary tongue, part of it soft and fleshy and capable of appreciating the flavour of its food, the remainder covered with strong file teeth to tear the food up.

The head is connected with the bag-like body by a kind of waist, and it is just behind this waist that the funnel tube lies which the octopus uses in rapid swimming. From this tube he can also, if attacked, eject a quantity of black inky fluid, which completely hides him, but he is not so prone to doing this as is the cuttlefish.

The female octopus makes an excellent mother. She lays about 600 eggs at a time on the walls of the cave where she lives or on the seaweeds around, and during the 7 weeks of hatching she guards them most faithfully. The young ones are sociable, and swim about on the surface together, but as they grow older they become solitary in habit.

The octopus is hunted fiercely by the sharks and porpoises, and should one escape it is usually with the loss of several of its arms. In this case the disabled victim retires to a cave for a few months and grows new members to replace those which have been lost.

Mr. O. W. Tiegs, M.Sc., Lecturer in Zoology, Adelaide University, recently spent some ten days in our library consulting works on the metamorphoses of insects.

Mr. A. C. Mackay, F.R.G.S., of the Austral Guano Company, which holds a lease of Walpole Island, about 150 miles south of Noumea, New Caledonia, has presented to the Museum some interesting specimens found on the island. These comprise clam shell ornaments, left behind by the former inhabitants, and remains of the extinct horned turtle *Miolania*, which was previously known only from Australia, Lord Howe Island, and Patagonia. This extension of its known range is of considerable scientific importance, and Mr. Mackay is to be congratulated on his find.

Some members of our flora and fauna which are not appreciated in Australia are in great demand in other parts of the world. Mr. C. E. Pemberton, of the Hawaiian Sugar Planters' Association, has spent some time here collecting seeds of the Moreton Bay fig, which is highly esteemed in Hawaii for afforestation purposes. Mr. Pemberton has also been very successful in procuring a series of beneficial insects, including the wasp, which is essential for the fertilization of the figs. Mr. E. W. Rust, of the Californian Department of Agriculture, who, like Mr. Pemberton, has come to Australia in quest of beneficial insects, recently visited the museum and inspected the entomological collection.

Rats and Fleas in Their Relation to Plague.

By E. W. FERGUSON, M.B., CH.M.

Principal Microbiologist, Department of Public Health.

It is a truism that has been demonstrated on many occasions that we often know little about the creatures that are our closest associates, and it has needed the discovery of their character as disease carriers to stimulate the study of their life histories. The discovery of the rôle of the mosquito in malaria, of the house fly as carrier of typhoid and dysentery, has resulted in a flood of light being thrown on these insects and their allies. In a similar way our information in regard to rats and fleas has followed on the discovery of their connection with human plague.

Plague is a febrile disease caused by a minute germ or bacillus. In man the disease may occur in one of three forms—Bubonic, Septicaemic or Pneumonic. The bubonic form follows on the inoculation of the virus and depends for its character upon the arrest of the plague bacilli in the nearest lymph glands. The swollen and inflamed glands constitute the "bubo." If the bacilli succeed in passing this barrier they may proceed to multiply in the blood stream, this constituting septicaemic plague. This form is a terminal one in fatal bubonic cases, but a case may become septicaemic from the first. In the pneumonic form the disease is located in the lungs, and causes death in hundred per cent. of cases. This form of plague is highly infectious.

The full knowledge of the manner in which bubonic plague is transmitted and the part played therein by the rat and rat flea is a quite recent acquisition. The association of the rat with plague was however at least suspected by the ancients, as is shown by the Biblical account of the outbreak of plague amongst the Philistines on the removal of the ark of the covenant. It was for Dr. Ashburton Thompson of Sydney to demonstrate that on epidemiological grounds the disease could only spread from rat to man through the agency of

infected fleas, though previously it had been shown that fleas were capable of conveying the plague bacilli. The Indian Commissioners on Plague were finally able to set the matter at rest by direct experimental evidence.

The main facts are simple and are now a matter of common knowledge. In a new locality plague is introduced by infected rats who spread the disease among the shore rats. In these animals plague takes the form of a septicaemia, that is to say the bacilli or germs are present and actively multiplying in the blood; as many as 100,000,000 bacilli may be present in 1 cubic centimetre of rat blood, and it is not a matter for any wonder that bloodsucking insects like fleas soon become themselves infected. In turn the fleas infect other rats and, given the chance, are capable of infecting human beings.

In human bubonic plague there is no evidence that one person is infected from another, in each case the source of infection is traceable back to the flea and from the flea to the rat.

RATS.

There are many kinds of rats in the world, but practically only two species are of importance in relation to plague. These two, in common with the mouse, are close associates of man, and with him have travelled throughout the world. The two kinds are commonly known as the brown or sewer rat (*Rattus norvegicus*) and the black rat (*Rattus rattus*), though the latter is more often grey or brown or even rufous in colour, and various subspecies have been described. The two species differ in structure and in habits. The brown rat is the larger and heavier species with coarser hair, shorter head, and smaller ears and shorter tail, whilst the black rat is a more slenderly built animal with very long tail and long ears. The brown rat, as its alternative name implies, is a denizen

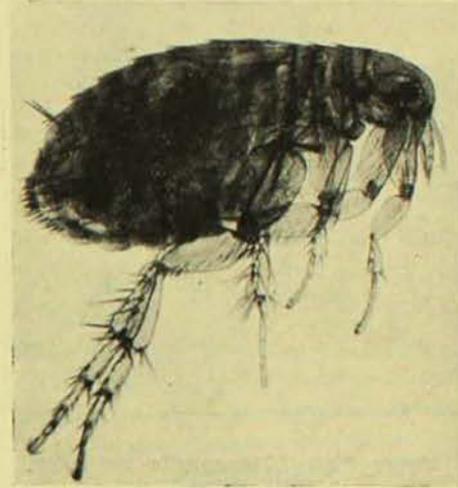
of the underworld, it is the rat of sewers and basements. The black rat on the other hand prefers the upper stories and roofs, and has even in places taken on a more or less arboreal existence. It is also the ship rat, though both species may be so carried.

The rat is a voracious eater and catholic in its tastes; nothing that is in the remotest sense eatable comes amiss to a rat, though probably by nature they are grain feeding. The life history of the two species is similar. In Sydney both species probably breed all the year round, though there are no data available to calculate the number of litters a rat may have in one year. It is known, however, that these animals breed at an early stage, and litters follow one another at intervals of weeks. The number per litter varies, but in Sydney the average per litter for *R. norvegicus* is 8.05 and for *R. rattus* 6.66.

It has been said that both species are spread all over the world. Though in the main correct, this statement requires qualification, as the two species are at the present day not equally distributed; in general it may be stated that the brown rat is the rat of the temperate zones and the black rat that of the tropics. Probably both species originated somewhere in central Asia and became habituated to their present mode of life in and around the tents of the nomadic Tartar tribes with whom they lived. This is in the main pure speculation, but there is definite historical evidence of the time of their invasion into Western Europe. The black rat came first, arriving in England somewhere about the twelfth century, and is said to have been brought back by the Crusaders. The advent of the brown rat into England is comparatively recent, these rodents making their appearance during the time of George I. They are supposed to have come to England in ships. In England, as elsewhere on the continent, they rapidly displaced the black rat, which, however, at the present time is re-appearing in the big seaport towns. In the tropics the black rat has held its own, while in subtropical centres as at

Sydney, both species are represented in approximately equal numbers.

Both species suffer from plague, but in most of the tropical countries where plague is endemic to-day, the black rat is the reservoir. Other animals also

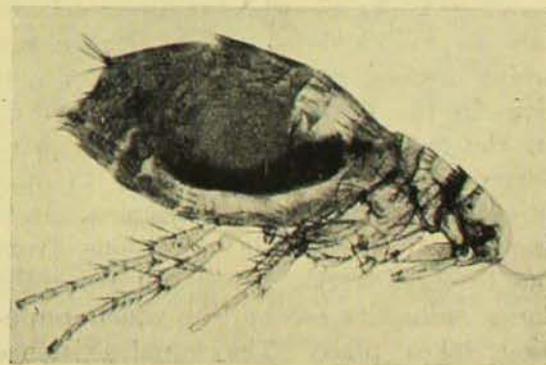


Indian Red Flea (*Xenopsylla cheopis*).
Photo.—R. Grant.

suffer from plague, for example, the Californian ground squirrel and the Targan or Mongolian marmot (*Arctomys bobac*), which was held to be primarily responsible for the calamitous Manchurian pneumonic outbreak in 1910.

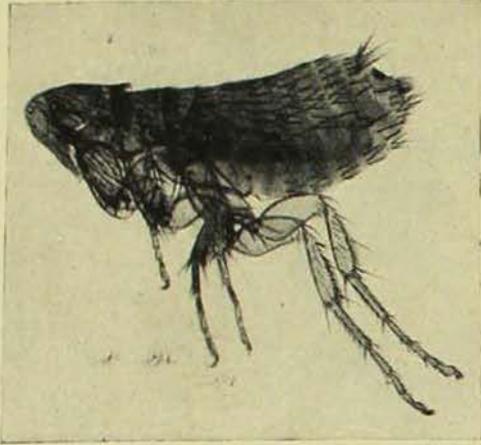
FLEAS.

Eleven different species of fleas have been shown to be capable of carrying plague. Most of these, however, are only of local interest or else do not readily bite man. Two are, however, especially inculcated; these are the Indian Red Flea (*Xenopsylla cheopis*) which is the rat flea of the tropics, and



European Rat Flea (*Ceratophyllus fasciatus*).
Photo.—R. Grant.

the European Rat Flea (*Ceratophyllus fasciatus*), the former being by far the more important. In Sydney three species of fleas occur commonly on rats—*Xenopsylla cheopis*, *Ceratophyllus fasciatus* and *Ctenopsylla musculi*; the lat-



Mouse Flea (*Ctenopsylla musculi*).
Photo.—R. Grant.

ter is the mouse flea, but is equally common on rats.

In our knowledge of the bionomics of fleas we are principally indebted to the Indian Plague Commission and to the work of Mr. Bacot of the Lister Institute.

All fleas are dependent upon blood for their existence; most are connected with some particular host, but there is considerable variation in the degree of restriction to their host, and in the absence of the special host many species will undoubtedly attack other animals, including man.

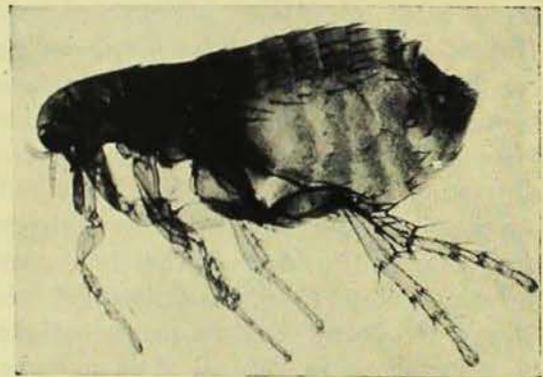
Fleas pass through four distinct stages—egg, larva, pupa and adult. The eggs are deposited by the female while still on the host, and roll off mostly into the bedding material, where they hatch in two to twelve days. The larvae are white, legless, segmented maggots, and live in the dust of floors, crevices, or in the open, sandy localities being preferred. The larval stage varies in duration according to circumstances, lasting under favourable conditions from one to three weeks. When full grown the larva spins its cocoon, in which pupation takes place. The pupal existence varies tremendously, and fully formed fleas may remain for long periods in

their cocoon before emerging. As a rule, however, the life cycle is completed in under four weeks.

The adult life under favourable circumstances is a long one. Bacot found that the human flea (*P. irritans*) was capable of living to 125 days without feeding, but kept under cool, moist conditions. Under similar circumstances the European rat flea (*C. fasciatus*) lived 95 days, the dog flea (*Ctenocephalus canis*) 58 days and the Indian rat flea (*X. cheopis*) 38 days. This period was greatly increased when the fleas were fed daily, the maximum life being for the various species as follows:—

| | |
|-----------------------------|-----------|
| Human flea | 513 days. |
| European rat flea | 106 days. |
| Dog flea | 234 days. |
| Indian rat flea | 100 days. |

Conditions of moisture and coolness are, however, indispensable, as in hot



Dog Flea (*Ctenocephalus canis*).
Photo.—R. Grant.

weather the duration of life without food is but a few days.

The question of how the flea conveys infection to man has been the subject of a large amount of investigation. The Indian Plague Commission came to the conclusion that infection took place through the rubbing into the wound of the infected faeces of the flea. Bacot and Martin showed that infection could also take place directly into the wound. These authors showed that the proventricular valve at the entrance to the flea's stomach became blocked by a clot containing millions of the plague germs, and that after a time the clot softened in the centre and, while inter-

fering with the valvular action, allowed regurgitation of the contents of the stomach laden with plague germs into the puncture. It is stated that fleas may remain infected for as long as 20 days.

The occurrence of Bubonic plague in man is thus directly consequent on the presence of infected fleas and rats. If there are no infected rats the fleas are harmless, if there were no fleas, infected rats would be harmless. The flea is the direct medium of communication from rat to man.

Plague is distinctly a seasonal visitation and the season of maximum incidence in both rat and man corresponds with the season when rat fleas are most abundant. In Sydney this falls in February and March. Weekly counts of the different species of fleas taken on rats have been made at the Department of Public Health since 1909 and these show a marked increase in the numbers of the Indian rat flea caught in February and March.

I do not propose to discuss here the

various methods of rat and flea destruction, but it may not be out of place to stress the necessity for every individual in the community doing his or her share in the campaign for the control of these pests.

The Health authorities can deal with areas in which plague is known to be existent, but they cannot undertake the task of destroying the whole rat population. The duty of rat destruction on any premises must fall upon the owner or occupier. If premises are rat-free and rat-proof no anxiety need be felt, but it is well to remember that any faulty construction will be found out by rats and full advantage taken of it.

Cases of human bubonic plague are preceded by rat plague, but too often it happens that the first notification of the existence of plague in a locality is revealed only by the discovery of a human case. Here the public can aid the authorities by reporting the fact as soon as any mortality is noticed among the rats.

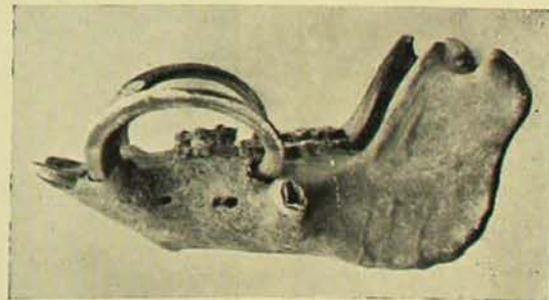
Pigs' Tusks and Armlets.

A. R. McCULLOCH.

Societies for the Prevention of Cruelty to Animals are strictly modern outcomes of civilisation, and have no counterpart among savage peoples. Primitive man cares nothing at all for the feelings of the lower animals, and not infrequently even binds and tortures his fellow man when he feels in need of some extra entertainment. Such agonies as he inflicts upon his pigs in order to secure their malformed tusks for his personal adornment therefore cause him no qualms of conscience, his only concern being lest they damage their offending teeth before they have reached their full and painful development.

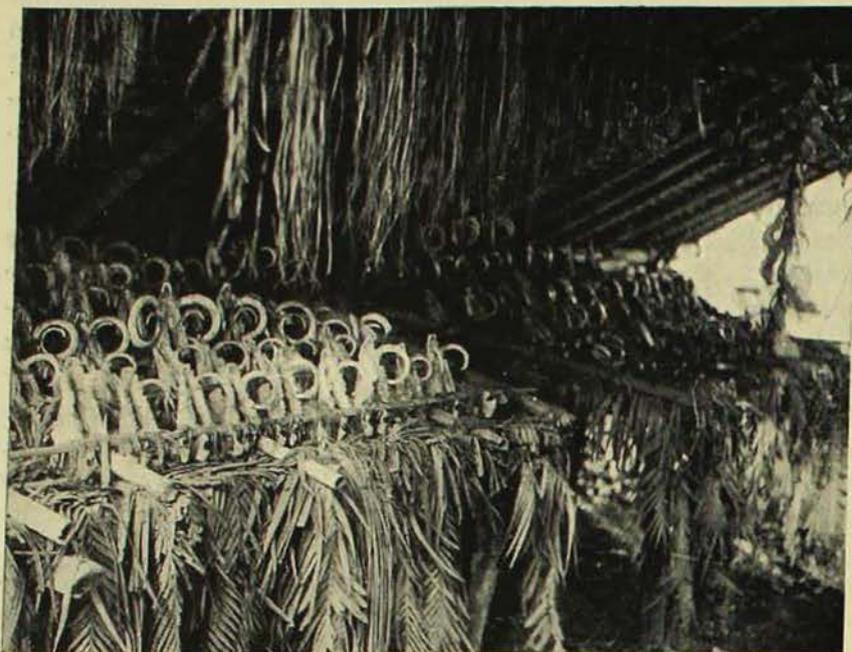
A boar's skull is provided with a pair of tusks in each jaw, which normally meet in opposition, and by grinding one against the other, are kept short and serviceable. In order to keep them efficient, and to counteract their wearing,

Nature has caused them to grow continuously throughout the life of the pig. It follows, that, if, through any cause, any one of the four tusks be not duly ground away by its opposing fellow, it will become abnormally long; and since



Lower jaw of a pig, with circular tusks. The opposing upper tusks have been removed so that the lower tusks grow without hinderance, curve round and re-enter the jaw. The point of the left tusk has encountered a molar tooth and unable to grow forward has pushed the root out through the side of the jawbone.

Photo.—H. Barnes, Junr



Pigs' tusk house in "Sing Sing," or ceremony, ground, Wala, New Hebrides.

Photo.—A. R. McCulloch.

its basal portion is strongly curved within its socket, that curve is maintained in the overgrown portion.

Our native friends of the South Sea islands take advantage of this peculiarity by extracting the tusks from the upper jaw, which leaves those of the lower free to grow unobstructed. And they keep the unfortunate pig in an enclosure either in or near their houses, and feed it and otherwise take every precaution that it shall not break its tusks in any way. As a result the tusk grows into a complete circle, and its hard ivory point re-curves upon the jaw and forces its way through the living bone. Even worse! Often it strikes the hard molar teeth, which, being unable to give way as does the softer bone, press upon the tusk so sorely that its very growing root is forced backwards

and outwards through the side of the lower jaw. The accompanying illustration shows just such a mandible, in which the curled tusk of one side has penetrated completely through the jaw-bone, while that of the other, being partly obstructed by the molar teeth, has driven its base through the outer side of the mandible. Such tooth-aches as must have been suffered by the unfortunate boar which was forced to pro-

vide this specimen must surely be unequalled.

But tooth-ache or any other agony the pigs may suffer is of no moment to our native brother so long as he procures the circular tusks to wear upon his arms, his chest, or even suspended from his ear-lobes. Such tusks form an important part of his life, being significant of his status and manhood, and a dozen



Houses surrounded by a "pig-fence," Aitchin, New Hebrides.

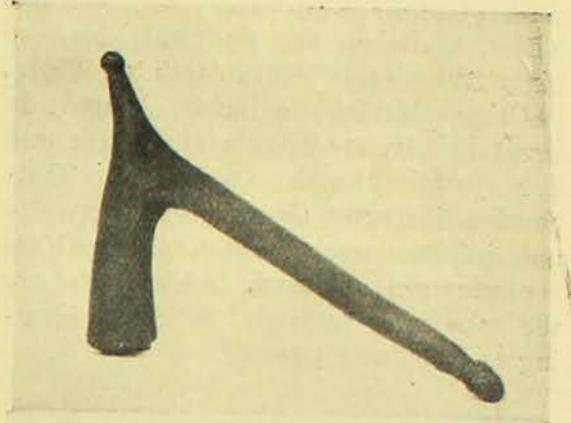
Photo.—A. R. McCulloch.



Headman on pig-killing altar, Dip Point, Ambrym, New Hebrides; he is wearing two pig's tusks as breast ornaments.
Photo.—A. R. McCulloch.

other things associated with ceremonial rites which appeal to his nebulous mind as of greater or less distinction.

Thus chieftainship is not hereditary in Espiritu Santo as in the



Wooden pig-killing implement, 'ndete; Malekula, New Hebrides. The pig is despatched by a blow on the forehead with the mallet head.
Photo.—A. Musgrave.

south of the New Hebrides group, but if a man kills eleven pigs with circular tusks, he becomes a high chief, and takes his rank accordingly into the next world. Moreover, it is customary to kill pigs in honour of the dead, either to raise the rank of the deceased or to commemorate his recent death. In Malekula, New Hebrides, a special instrument called *ndete* is used in this ceremonial killing. A tusker is dragged forward and dispatched by a blow on the forehead with the blunt end of the instrument.

Toilet Articles from Ancient Egypt.

BY WILLIAM W. THORPE.

In Egypt, the custom of discolouring the eyelids and brows dates back to the very earliest times. A moistened powder composed of either antimony, malachite, preparations of lead, or manganese oxide, was used. Some Egyptians preferred the charcoal derived from burnt almonds, but each medium had for its objects the emphasising of the eyes, and the production of a supposed stimulus that the darkened or tinted area added to these organs. The moistened substance was applied with a reed or pin before a polished copper hand-mirror, or painted on by another person. The general term for these eye-paints was *kohl*, and various vessels were used to hold them.

A series of four receptacles are herewith pictured, made of alabaster, a

translucent mineral composed of sulphate of lime. These were used for holding *kohl* and other cosmetics; three are from the period of the First Dynasty, and according to the accepted ancient chronology were in use about 5,000 B.C. The fourth and smallest pot, still containing powdered lead carbonate and a piece of malachite, dates only to the Twelfth Dynasty, 3,400 B.C.

It stirs the imagination to reflect that these articles were perhaps the cherished possessions of some Egyptian belle who had her little day some thousands of years ago, and that they may have contained the war paint which served to enthral some gallant of old Nile, "sighing like furnace, with a woeful ballad made to his mistress' eyebrow."

All the specimens were found, along

with other tomb furniture, in the cemeteries of Lahun and Sedment, between sixty and seventy miles south of Cairo.

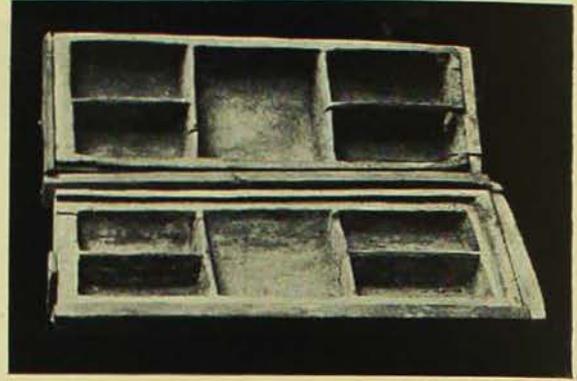
Other boudoir adjuncts, found in great variety, are caskets and boxes used for jewellery and cosmetics. Their construction often shows great ingenuity and intricate workmanship. Hinged receptacles are unknown, but curious are the substitutes employed to make opening and shutting possible.



Four alabaster cosmetic pots used to hold eyepaint or "kohl." Two of these contain malachite and other pigments, and some are about 7000 years old.

Photo.—A. Musgrave.

The wooden casket, or trinket box figured, closes by the sliding of the two parts together, much after the principle of a modern school pencil case. The lid portion forms nearly half of the casket and the whole, when closed, is almost circular in section except for the margin of added wood to strengthen the region of the slide grooves. Each part contains five cells or recesses, these openings being in apposition when the casket is closed. The reason for this added



"Vanity box" from ancient Egypt, over 3000 years old, used for holding trinkets and ornaments.

Photo.—A. Musgrave.

space in the lid is not apparent, for, if the objects in either half project, the lid would not slide. It may be, that the articles placed in the upper half, were such as would stay in place undisturbed.

The body of the receptacle and its divisions have been cut from the solid. The ends of the lower half, likewise the lateral margin, have been attached to the body with wooden dowels. A small knob forms the handle for sliding the two component parts together.

This casket dates back to the period of the Eighteenth Dynasty, about 1600 B.C., and is from Sedment.

We are indebted to the public spirit shown both by Mr. Ernest Wunderlich (Trustee), and his brother, Mr. Alfred Wunderlich, for these interesting objects lately added to our collections. The joint gift from which these articles were chosen, contained over one hundred specimens, and was unearthed by the British School of Archaeology in Egypt during the season 1920-1921.

Migratory Locusts.

BY G. H. HARDY.

The short-horned grasshoppers which are so destructive to vegetation in various parts of the world are known as migratory or plague locusts. In Australia we are, to our sorrow, familiar with these swarms, which are at times so extensive that trains are held up, the numerous crushed bodies of the insects rendering the rails greasy. Just re-

cently the grasshopper pest has been particularly bad in the Singleton district in this State, and at Gawler in South Australia.

The migratory locusts breed prolifically only within restricted areas and it is from these areas that they swarm, covering vast tracts of land, destroying vegetation and laying eggs anywhere in

soft ground whether it be suitable for the development of their off-spring or not.

The newly hatched larvae from each egg-mass move in a group; when two groups meet they join together into a larger one and they build up numbers in this way till larval swarms are formed. At night the larvae climb plants and pass the time in a state of semi-coma. Next morning, when the temperature is sufficiently high, the larvae are restored to normal activity, and, having partaken of breakfast, they again come to earth, and soon a general movement in one direction is in operation; they do not usually feed during these rambles. With the cool of the afternoon the larvae retire to some place of rest on vegetation, and, before passing to a state of repose for the night, they indulge in a full meal.

If the day remains sufficiently cool, the larvae will content themselves with feeding and spending the following night in the same spot. If the weather is moderately warm, the swarm will proceed with its wanderings, but, should the sun be hidden behind a cloud sufficiently long to allow the necessary drop of temperature, it will rest once more and possibly feed again; when the cloud has passed and the sun returns the larvae start on their march afresh. On very hot days the swarm will often cease travelling during midday and the larvae will cluster close together, hiding from the scorching sun.

This nomad life goes on until after the final moult, when the locusts become adult and the tribe ceases to wander on foot; for a few days the newly winged insects are incapable of long flights. During this period the locusts devour vast quantities of food and a fatty substance is built up in their bodies.

When they are fit for flight, one here and there begins to take wing for short distances, and one such disturbance, affecting other locusts, causes still further movement until at last the whole swarm is flying in the same direction. When two flying swarms meet they repeat the tactics of the larvae by mix-

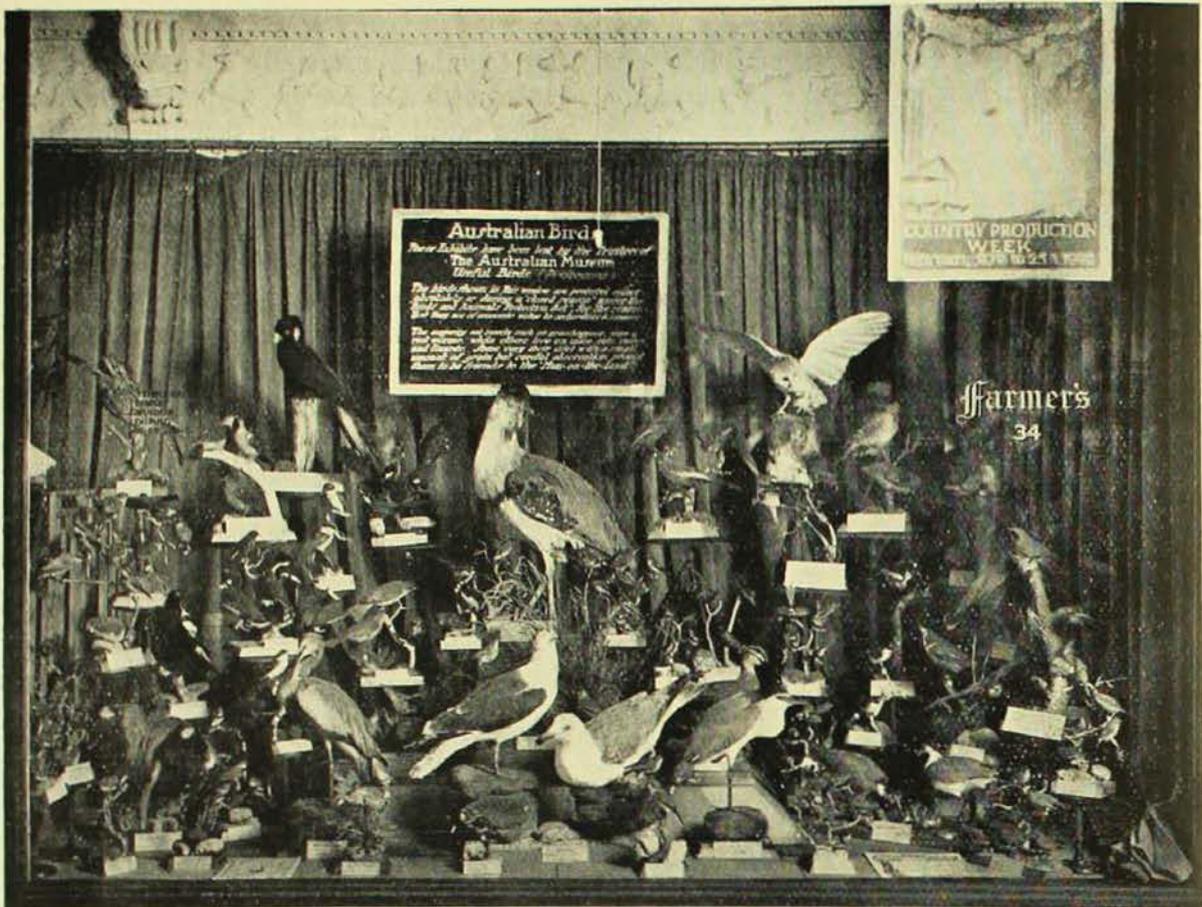
ing together; gradually a vast multitude is formed and longer flights are undertaken until at last a definite direction evolves and the locusts desert their breeding region, leaving a few scattered remnants where once they were in countless numbers. The emigration from the breeding ground is often so complete that only single ones from many groups are left behind, and these are nearly all weaklings or parasitised.

The migrating adult locust has its body cavity largely occupied by air sacs, which are only temporary organs and reach their highest development at the first period of migration, disappearing towards the last when the developing reproductive organs take their place. Whilst these air sacs are large the insects are incapable of taking food in any quantity but subsist on the fatty substance referred to above, and the damage they may do to crops is brought about by their cutting the stems. Later they devour all before them.

This break in the feeding leaves no trace in the line from their source of dispersal to the site of the damaged crops. Before their breeding localities and habits were known the locusts appeared to have come from out of the nowhere and ravished the country in one direction.

It has been a difficult task to track the locusts to their breeding ground, but this has been accomplished and their destruction in the larval form has met with success; the migratory locusts are now so well under control in several countries, more particularly the United States of America and South Africa, that millions of pounds are saved annually.

Mr. George Milburn, of Nottingham Downs, Queensland, has presented a number of bones, mainly vertebrae, of the extinct, carnivorous, marine reptile *Cimoliosaurus*. Remains of a smaller species of the same genus have previously been found in an opalized condition in the opal deposits of White Cliffs, New South Wales, but the fossil is known mainly from the Cretaceous of Queensland.



Useful (protected birds), exhibited during Country Production Week. Many of these are insectivorous and are regarded by the man on the land as his best friends.

Photo.—E. A. Bradford.

During Country Production Week, held under the auspices of the Country Promotion League, from February 20th to 25th, the Museum exhibited in the windows of Farmers', Limited, a large series of birds, comprising the species which are useful to farmers, and also those which are destructive to stock, crops, and fruits. The exhibit was a prominent feature of the Week, and attracted a considerable amount of attention.

Mr. C. Hedley, Principal Keeper of Collections, left Sydney by the R.M.S. Makura on March 16th for an extended trip to North America. Mr. Hedley proposes to do some exploring in the Rocky

Mountains region, and, if conditions are favourable, will visit Alaska.

Our lecture session opened this month, when Dr. J. S. Purdy, Metropolitan Officer of Health, discoursed on the "Extermination of Vermin and the Prevention of Plague and other Insect-borne diseases." On April 13th, Dr. W. A. Sawyer, of the Rockefeller Foundation, who has been in Australia for some time conducting the Hookworm Campaign, will lecture on "The Story of the Hookworm." We are very fortunate in being able to secure the service of such eminent specialists as lecturers on subjects of such vital interest to the community.



Destructive (unprotected birds), exhibited by the Museum during Country Production Week. These birds are in many instances destructive to crops and useful animal life, although one cannot say that any bird is harmful all the time everywhere.

Photo.—E. A. Bradford.

EXTENSION LECTURES.

In 1905 the Trustees of this Museum inaugurated a series of popular science lectures. These early gallery demonstrations, as they were termed, proved so attractive and were so well patronised, that when additions were made to the building in 1910 a lecture theatre was provided. Though the seating capacity of this theatre is 250 the audience is invariably in excess, and additional seating accommodation has to be provided, on occasions it has even been necessary to repeat the lecture.

With a desire to render a still greater public service it has been decided to ex-

tend these lectures to suburban and country centres. It is realised that many of our citizens are prevented by distance from sharing in the good things provided for the metropolitan resident, and it is to remedy this that this innovation has been introduced. The services of the lecturer are free, the Museum will provide them, but it is expected that local residents will make arrangements for the hall, lantern, and generally do their part to make the scheme a success.

Secretaries of Schools of Arts, Literary Institutes, Parents' and Citizens' Associations, and kindred bodies are invited to apply to the Director for further information which will be gladly supplied.

Breast Ornament.

BY WILLIAM W. THORPE.

When the H.M.A.S. *Brisbane* called at Rabaul, New Britain, during September of last year, Mr. Linacre, in charge of Native Affairs, presented to the commander and officers of the ship, an elaborate breast ornament.

This example of local handiwork has been loaned to the Museum, and has been placed on exhibition in the Melanesian Room. The general shape is triangular, length $22\frac{1}{2}$ inches by $7\frac{3}{4}$ inches across the top; and the ornamentation consists, for the major part, of canine teeth of the island dog. In constructing this ornament the teeth have been perforated, and attached in rows to a plaited fibre string base. At the angles and upper centre of the breast plate are small pendants with similar teeth and shell sections. On the breast portion there are twenty-nine rows, and the number of teeth altogether used total five hundred and twenty. As only four canine teeth occur in an individual, at least one hundred and thirty dogs have been accounted for. When worn by the chief, it is suspended from his neck by the attached finely plaited cord. It was considered of great value, and no doubt formed an heirloom of much importance.



Dog-tooth ornament worn by native chief in the New Hebrides. Over 130 dogs have contributed their canine teeth to the formation of this striking object.

Photo.—G. C. Clutton.

The principal items in our next issue will be:—

“A Museum Group in the Making.”

A. R. McCulloch.

“The Islands of New South Wales and their Birds.” A. F. Basset Hull.

“Ocean Island.” T. J. McMahon, F.R.G.S.

“Bird Notes.” J. R. Kinghorn.

These will be profusely illustrated by a fine series of photographs.