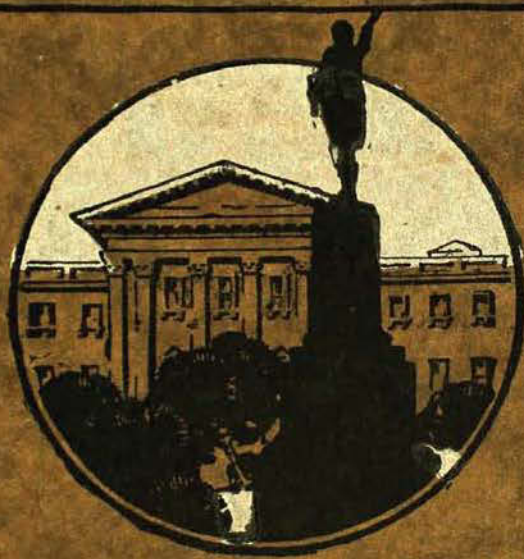


# *The* AUSTRALIAN MUSEUM MAGAZINE

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



**Sea-Cows. The Story of the Dugong**

*Ellis Le G. Troughton*

**Sea Anemones and their Associates**

*Arthur A. Livingstone*

**Water Supply of the Aborigines**

*W. W. Thorpe*

**Hidden Dwellers of the Tidal Flats**

*F. A. McNeill and A. A. Livingstone*

**The Habits of our Common Shore Crabs**

*Melbourne Ward*

**The Late John Hopson : An Appreciation**

*Anthony Musgrave*

**Feathers and Fins. The Birds and Fishes of Michaelmas  
Cay, Great Barrier Reef, Queensland**

*Tom Iredale and Gilbert P. Whitley*

Vol. III. No. 7.

JULY-SEPT., 1928. Price—ONE SHILLING.  
PUBLISHED QUARTERLY.



# THE AUSTRALIAN MUSEUM

## COLLEGE STREET, SYDNEY

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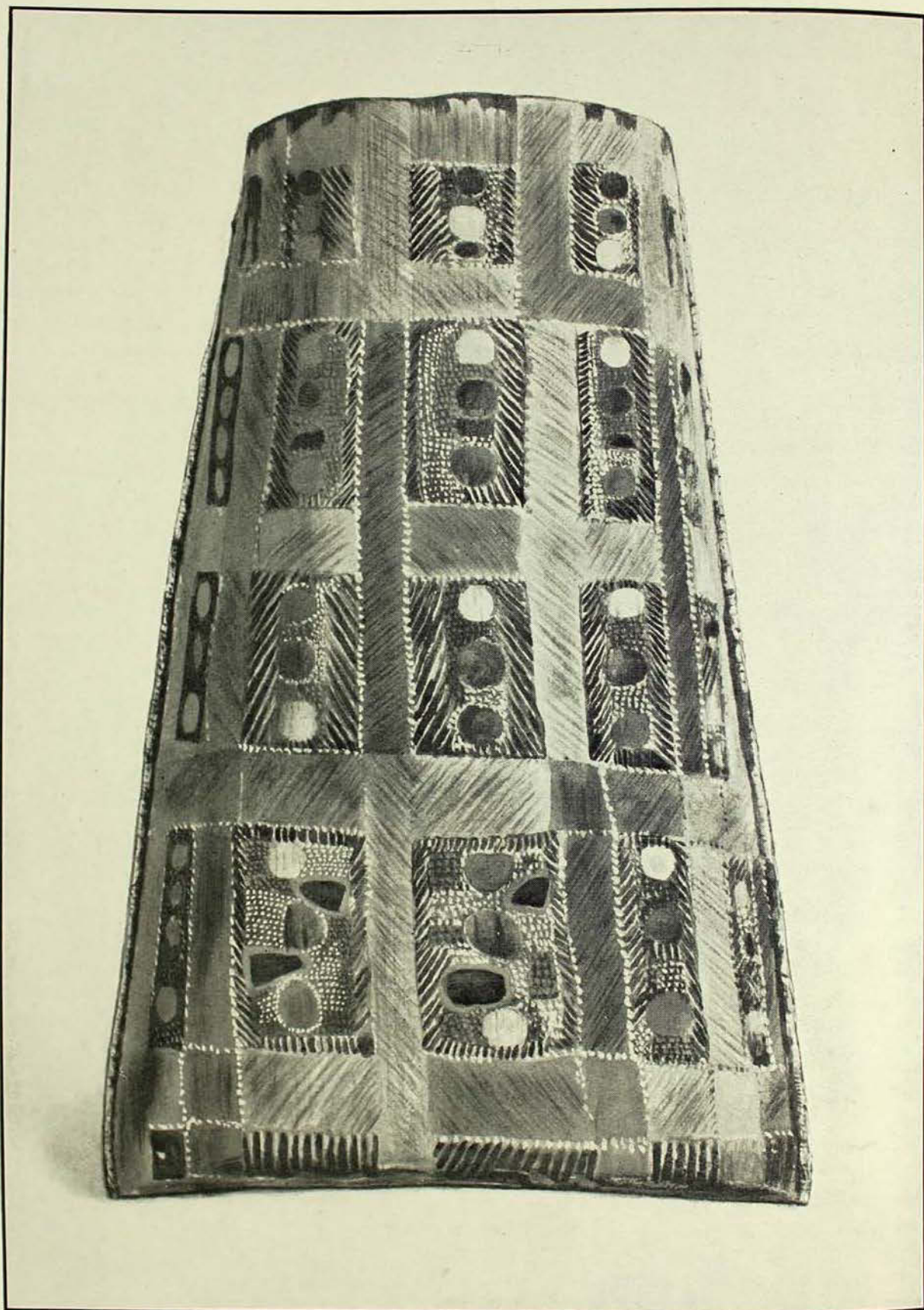
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Bark Water Bucket from Bathurst Island, North Australia. This vessel is made from one piece of bark which has been sharply folded, the sides being then sewn together, and the stitches covered with a resinous material to make them watertight.

[Ethel A. King, del.]





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JULY-SEPTEMBER, 1928.

## Great Barrier Reef Expedition.

SINCE the Great Barrier Reef Committee was inaugurated by the Royal Geographical Society of Australasia, Queensland Branch, in 1922, largely by the efforts of the Governor of Queensland, Sir Matthew Nathan and Professor H. C. Richards, much useful work has been done towards the elucidation of the topographical, geological, and biological problems presented by this great natural feature, which is without parallel in other parts of the world.

Marine biology, both in methods and results has made great strides in recent years, but the work has mostly been done in temperate seas, and it is a matter of congratulation, therefore, that, on the invitation of the Great Barrier Reef Committee, a well equipped expedition, organised by the British Association for the Advancement of Science, will presently be at work on the reef and will spend about thirteen or fourteen months in making a biological survey.

The expedition will be led by Dr. C. M. Yonge, Balfour student of the University of Cambridge, who will be accompanied by specialists in marine biological work, botany, surveying and other branches. A number of Australians will be associated with the expedition, and it is hoped that members of the staff of the Australian Museum will participate.

One of the primary objects of the expedition will be to enquire into the conditions which govern the growth of coral and the associated animals and plants, the quantity and

variation in the plankton, minute floating organisms which mostly furnish the food supply of larger animals, and the salinity, temperature, and other conditions of the seawater. Examination will be made of the bottom fauna and flora, and the zoning of life at various depths a knowledge of which is important in the interpretation of the results of boring in coral formations. The animals which live in and about the reef, fishes, molluscs, crustacea, echinoderms, worms, and others, will be collected and reported on by experts so that we may expect a substantial increase in our knowledge of the fauna of the reef.

Economic possibilities also will receive attention. The reef and its many islands have produced notable quantities of pearl and trochus shell, fish, bêche-de-mer, and turtle, and there are possibilities of establishing a sponge fishery. The question of increasing the yield of these various commodities by methods of cultivation will be enquired into, and also the extent to which they can be exploited without unduly decreasing the supply.

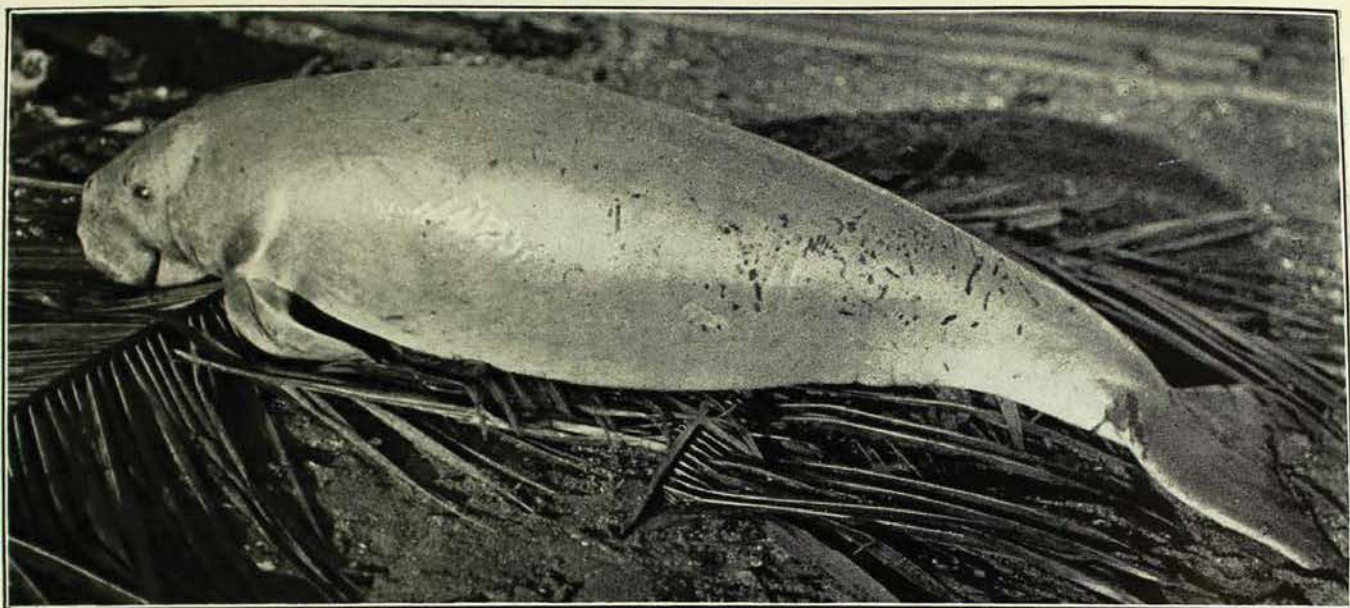
It may be confidently expected that this mass attack on the problems and possibilities of the Great Barrier Reef by the modern methods which have proved so successful in other parts of the world, directed as it will be by men who have the necessary training and experience in the laboratories of the Old Country, will yield important results from both the scientific and the economic point of view.



## Sea-Cows.

### The Story of the Dugong.

BY ELLIS LE G. TROUGHTON.



Australian Dugong or Sea-cow, *Dugong australis*. Adaptation to aquatic life has suppressed the hind limbs though internal traces remain, as in whales. Note the position of the nostril immediately above the muzzle, absence of a back fin, and the flexible appearance of the flipper, in all of which dugong differ from whales.

[Photo.—Captain Frank Hurley.]

WHETHER the sea was included in Hamlet's statement that more things were in heaven and earth than dreamt of in Horatio's philosophy, or not, new wonders have constantly been revealed since ancient times and, doubtless, under the searchlight of science, the sea will continue to yield its mysteries in years to come. Though it is mainly the home of cold-blooded fish and their humbler relatives, actually some of the most interesting denizens are warm-blooded animals which had common origin with land-living ones in the remote past. These warm-blooded seafarers are classed as mammals, which may be described as animals which suckle their young, and are covered with or show traces of hair.

There are fur-covered seals, and the Elephant Seal which, like a whale, relies for warmth upon an eiderdown of blubber as insulation against loss of body-heat and the

cold of waters which render hairy covering unsuitable. Seals and whales occur in most seas and some emulate their terrestrial brethren in disposition, such as the Leopard Seal, whose temperament, slashing teeth, and even spots match those of its feline namesake, and Killer Whales, which are the wolves of the sea, hunting in packs to the confusion of their huge relatives.

#### SEA-CATTLE OR SIRENIA.

The third group of aquatic mammals are known as sea-cows, in tribute to their bovine temperament as much as to their vegetarianism and mammalian habit of suckling the young. Here also, nature replaces the hairy ancestral covering with a thickened hide and coating of oily blubber, though fine hairs are discernible on the body and strong ones are set about the mouth. The flippers, more flexible and of looser elbow action than in



whales, enable the sea-cow to hold her nursing partly clasped to her breast when rising with head and shoulders exposed to suckle it ; also rising frequently to breathe, she is careful to see that the child gulps in fresh air.

to have inspired the ancients in weaving their legends of fair mermaids and men. Because of these ancient beliefs in sirens luring the unwary into danger or to mansions beneath the waves, sea-cows are known as the Sirenia,



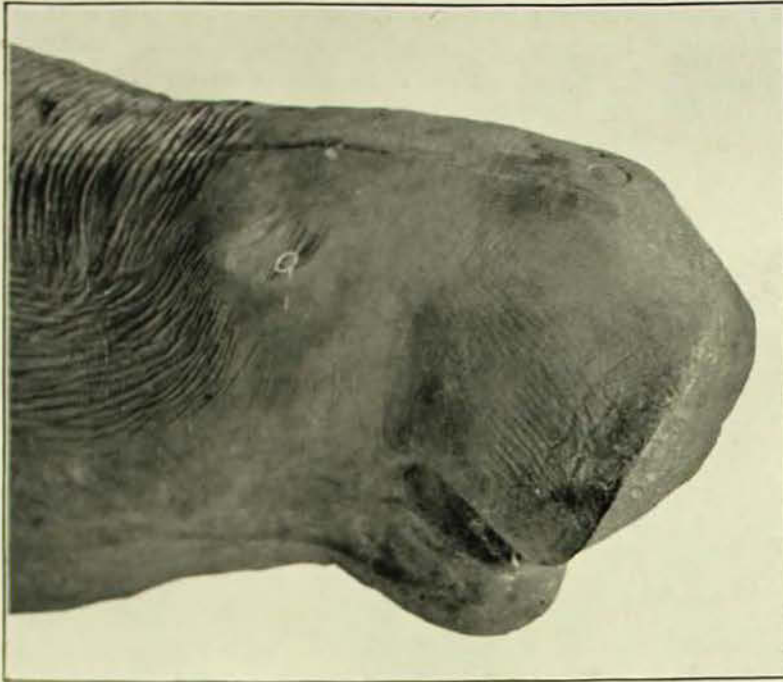
After scouting for signs, such as floating dugong-grass or tusk-marks where herbage has been rooted from marine meadows, the aboriginal hunter waits with poised harpoon-spear, or "wap," for the dugong to rise for breath. Blacks usually hunt in frail bark canoes ; their employment by whites who also use huge nets must eventually lead to extermination of dugong on our coasts if permitted for any length of time.

[Photo.—Captain Frank Hurley.]

The rounded heads of parent and offspring and their semi-human attitude at such times, coupled with sudden appearances on moonlight nights, and the display of a fish-like tail when diving, present weird sights said

though close examination shows them to have little in common with the modern conception of "surf sirens." The earliest myths may be traced to Arab seamen and Greeks watching the movements of dugong, while Megasthenes





Head of the plaster cast of the dugong recently acquired by the Museum. The nostril, closed by its valve-like flap, is clearly shown, as well as the comparatively small eye, and the ponderous, tough, and extremely mobile upper lip, which is capable of grubbing in sand and mud as well as manoeuvring food into the mouth.

[Photo.—G. C. Clutton.

recorded a creature with the appearance of a woman in the ocean near Taprobane (Ceylon). Enlarging upon this, other writers peopled the seas with fishes having heads like lions and other mammals, ideas inspired by the hair around the sea-cow's mouth. Thus also was born the conventional idea of a beauteous mermaid with flowing tresses and fish-like tail so firmly credited by early Portuguese and Dutch voyagers to the east.

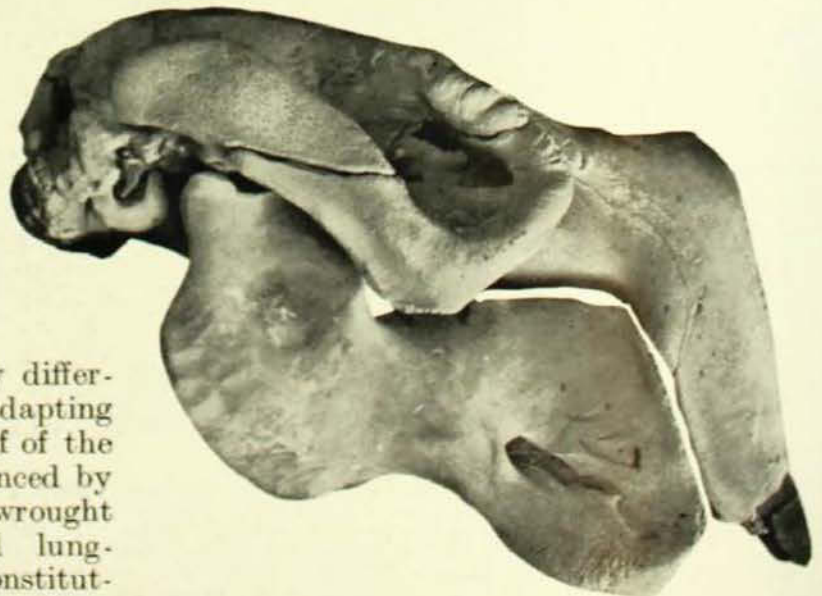
#### COMPARISON WITH WHALES.

Environment in time shapes widely differing animals to similarity of form by adapting them to its needs, and striking proof of the sea's power as a moulding force is evinced by the marked outward resemblance wrought between gill-breathing fishes, and lung-breathing whales and sea-cows. Constituting an order of mammals by themselves the Sirenia are as well fitted for aquatic life as whales, though not closely related and originating independently from different land ancestors. Although they resemble whales in having the fore limbs converted into flippers, in the loss of all outward trace

of hind ones, and in the tail being converted into a horizontal rudder, their general conformation differs markedly, and within the body, less influenced by environment, are definite proofs of separate origin. The head of a sea-cow departs but little from the ordinary mammalian type, as it is small in comparison to the body, and the nostrils, though also possessing a valve-like flap, are situated above the extremity of the muzzle instead of far back, as on the whale's huge head; the back fin commonly present in whales is lacking, and the bones are distinguished by their solid and dense structure, which is in marked contrast to the loose spongy texture of the bones of whales.

#### THE ORIGIN OF SIRENIA AND WHALES.

No doubt remains that both have evolved from land ancestors whose river-haunting relatives possessed long and very heavy tails such as seen in the beaver and platypus, and



Skull of the specimen which was cast in plaster. The general contour is suggestive of the ancient joint origin with elephants, though aquatic life has modified the nasal region to bring the nostrils on top of the head, so that they reach the surface first and involve the least exposure when the animal rises to breathe. Elephant relationship is indicated by the tusks, which are actually front or incisor teeth, instead of elongated canine or side-teeth as in boars, hippopotami, and flesh-eaters.

[Photo.—G. C. Clutton.



small hind legs ; as aquatic adaptation became more complete the tail increased in size, while the hind limbs shrank and withdrew further into the body, until in the living forms of both groups a few small bones, representing part of the pelvis, are the sole trace of hind legs.

Despite marked external resemblances thus achieved, the old idea that whales and sea-cows are closely related is no longer tenable, as proved by striking differences in the dental, digestive, and skeletal systems. Though it was once thought that both groups sprang from a common stock of hoofed quadrupeds, it was later realised that the teeth of some of the earliest known whales were unlike those of any hoofed animals and most like those of flesh-eaters, or possibly armadillo-like insectivores.

#### RELATIONSHIP OF THE SIRENIA AND ELEPHANTS.

As early as 1816 a great naturalist separated the Sirenia from whales, and in 1834, relying on numerous resemblances, associated their origin with that of the elephants which constitute a section of hoofed mammals known, for obvious reasons, as the Proboscidea. This theory of relationship was later strengthened by discoveries of many resemblances in anatomy, and the fact that in most sea-cows and all elephants there is a unique provision for the replacement of worn teeth by a progression forward of the rearmost molars. For instance, an elephant has six cheek-teeth on each side but only one tooth is ever completely above the gum, with another partly protruded and waiting to replace it, until in aged animals only one remains, a progression forward aptly likened by the late Charles Hedley to the action of chocolates in a slot-machine.

This convenient method of replacing worn out dentures is elaborated by some of the Sirenia, in which there is a steady progression forward of similar molars of unlimited number, compensating for the rapid wear and tear involved in eating aquatic plants with which a large amount of sand may be mixed. In the sea-cows known as Manatees, near relatives of our local Dugong, there is a tendency towards rapid wear and degeneration of the front cheek-teeth, but no skull has been found in which the growth of additional teeth had

ceased, and fresh ones are apparently produced throughout life, so that long-lived Manatees may have up to thirty molars or even more.

Living representatives of the many extinct forbears of the Sirenia include the American and African Manatees, the nailless Manatee of the Amazon and Orinoco, and the Dugong of the Red Sea and certain parts of the Indian and Pacific Oceans.

#### THE AUSTRALIAN DUGONG.

The vernacular and generic name has been derived from the Malay *duyong* and the Javanese *duyung* and the Australian dugong was separated as a distinct species from those of the Indian Ocean, Red Sea, and the coast of East Africa under the specific name of *australis* by Professor, afterwards Sir Richard, Owen in 1847. This action was based upon material secured on the surveying voyage of H.M.S. *Fly* in Endeavour Strait, northern Australia, and, though doubt has been expressed whether constant differences exist between the local and other forms, the use of Owen's distinctive name appears well justified.

On our coasts dugong are now confined almost to the tropics, though ranging from Moreton Bay in the east to Broome in the west, but there are skeletal remains to show that they extended further south in the past, the first record of this being contained in Collins' *Account of the English Colony in New South Wales*, vol. I, 1798 as follows:— "About this time [March 1795], the spirit of inquiry being on foot, Mr. Cummings, an officer of the Corps, made an excursion to the southward of Botany Bay, and brought back with him some of the head bones of a marine animal, which on inspection Captain William Paterson the only naturalist in the country, pronounced to have belonged to the animal . . . the Manatee." There is no doubt that they were dugong bones and this occurrence was later confirmed by the discovery of an almost complete skeleton about four to seven feet below swampland level during the excavation of Shea's Creek, Cook's River, Botany Bay, for the canal of the same name ; this skeleton is now in the Australian Museum.

The chief interest concerning these bones was the presence of cuts and scars considered



to have been caused by the stone implements of aborigines, and regarded as evidence of man's occupancy of this part of the coast at a comparatively early date. More dugong bones were discovered in a large aboriginal kitchen-midden on the Macleay River about one and a half miles from the ocean, similar implement marks proving that the old aborigines ate dugong and, more significant still, that persecution by them must have contributed to their restriction in range, since early settlers found only a few old bones.

#### CHARACTERISTICS, HABITS, AND FOOD.

Dugong differ from their American cousin, the Manatee, in having their nostrils on top of the muzzle instead of at the apex, in dentition, and by the tail being crescent-shaped instead of fully rounded, and the total absence of traces of nails on the flippers. They have, however, much in common in their food and habits, and both have been persecuted in the past for their oil for medicinal purposes, for their hides and their flesh, so that they are threatened with extermination should adequate protection be withdrawn.

Dugong are essentially sociable creatures, and assemble in herds of from six to forty or more individuals, in which females are always more numerous than males. Shallow seas, bays, and estuaries are frequented, where they browse, not upon algae as is often stated, but upon the *Zostera*-like marine grasses, chiefly *Posidonia australis*, existing in great abundance throughout the reef-flats of the inter-tropical coasts. When feeding their flippers are used in moving slowly about, and possibly, as in the Manatee, to help convey food to the mouth, as with huge hands in thumbless mittens. The extraordinarily mobile and greatly enlarged upper lip is of most aid in feeding, as it is sufficiently prehensile to seize the grass and thrust it back into the mouth, the action being aided by strong backwardly directed bristles on the lip. In the Manatee the upper lip is said to be quite prehensile, being able to introduce food without the aid of the lower lip, and the action in which the two lobes of the upper lip are diverged to enfold, and then seize objects such as lettuce leaves, has been likened to the action of the mouth-parts of a silk-worm. A well known author has accorded the main function of gathering the

slimy grasses to the large under lip, which was likened to that of a horse, but, though it doubtless assists greatly in cropping marine herbage it is quite evident that the main function is carried out by the upper lip, even if prehensile action is not so complete as in the Manatee.

Harmless, sluggish, and apparently more stupid than the average cow, dugong appear to have little in common with their domesticated namesake save in the habit of browsing, while a striking difference is that the two teats of the dugong are situated on the breast beneath the flippers, thus emphasising again the relationship with elephants in which the single pair of teats is placed between the fore legs, in contrast to the abdominal udder of cows. The ivory tusks found in dugong are also analogous to those of elephants in that both are front or incisor teeth, and not canines as are the tusks of wild boars or hippopotami. In the female dugong, as in both sexes of Manatee, these tusks are never protruded, which is quite remarkable considering that the males have projecting tusks which are slightly curved outwards and obviously much in use; there is an absence of enamel on one side of the projecting tusk so that it wears obliquely to the enamel on the other side, which maintains a sharp chisel-edge. The tusks are said to be used in rooting up sea grasses, and the marked wearing of their points suggests that marine growths are scraped from coral and rocks, but, if these teeth are of considerable aid in feeding, it is strange that their use has been lost to the female, and herein lies a subject for investigation by those in a position to study the interesting creatures in their natural haunts.

An Honorary Correspondent of the Australian Museum, Mr. N. S. Heffernan, late District Officer in the Solomon and Santa Cruz Islands, informs me that dugong are fairly plentiful in both groups, and that he has an impression, shared by natives, that they root in the sand and amongst coral for various kinds of shell-fish; this would account for the wearing of the tusks of males and suggest that the female is dependent on using her tough snout in a grubbing pig-like action. He also considers that only the lily-like roots of the dugong-grass are eaten, which would account for the floating grass used as a sign by the blacks.



## AFFECTION FOR MATES AND YOUNG.

Although the mother Manatee is sometimes accompanied by two young it was generally considered that the dugong has only one baby, but the late E. J. Banfield once wrote: "Many years ago, I was out among the isles with blacks when a female came to the surface with what appeared to be twins—one under each flipper. The blacks had never before seen such a sight, nor had I—they were astonished and often talked of it afterwards."

Usually there is one calf which is about three feet long at birth and is carried under one of the dam's flippers, where it is hugged affectionately to her side; outgrowing the maternal embrace it swims close beside, exemplifying by every movement its own helplessness and faith in the protective influence of the parent. Such habitual demonstrations of mutual affection are said to have strengthened ancient belief in mermaids. Equally appealing is the love of the adult dugong for its fellows, of which Banfield wrote: "I know very little about these innocent and quiet creatures beyond that they seem to have a sort of love for one another almost human in its demonstration. When one of a pair is killed, the bereaved lingers about the tragic spot for days, frequently rising to the surface, when the gulping sigh which accompanies respiration seems like an expression of keenest grief. This, no doubt, may be pure fancy, but it affected me so strongly that I discouraged the blacks as earnestly as possible from the sport of killing." Like the whales, the adult dugong has no voice, so that if the beautiful singing of sirens was based on the dugong, it must represent a highly coloured conception of the whistling sigh caused by air rushing through the nostrils, and not to any vocal exercises; it has been stated that dugong calves have a bleating cry, likened to that of young lambs.

In his *Creatures of the Sea*, Bullen quotes instances of the taming of Sirenians, as a further reflection of their higher land intelligence; he says that a past superintendent of the London Zoo once cared for a young Manatee in Surinam, which came to him as he waded into its pond, permitting him to hold it by his knees while it sucked at a feeding bottle, while another kept by a Spanish American governor for twenty-six years is

said to have behaved as sensibly as any land animal, and allowed the boys of the household to ride on it about the lake.

## ECONOMIC USES AND HUNTING.

The hunting of dugong for food by aborigines may hardly constitute a vital menace, but their employment to do so by Europeans, who also use large nets at times, would inevitably involve extinction from our shores if permitted indiscriminately. They are hunted for their flesh, which is both nutritious and tasty, and, when rolled and smoked can be converted into a substitute for bacon for which there was a ready sale some years ago. A more important product is the oil obtained from the blubber; this is cut into cubes and boiled in water from which the oil is skimmed and refined for medicinal use in the treatment of lung complaints and rheumatic troubles. It is estimated that a fully grown female in good condition will yield sufficient fat to supply from five to six gallons of oil. The hide, which is nearly an inch thick, makes very good leather when well tanned, and when cut up green and boiled can be converted into glue. Tusks attain a length of nine inches, and when polished make handsome carver handles, while the bones are said to provide the best charcoal for sugar-refining.

About the year 1860 the Medical Officer for Queensland lectured upon the valuable properties of dugong oil in regard to lung complaints and subsequently a leading firm of chemists ordered one thousand gallons at £3 3s. per gallon. This led to a belief that a valuable remedial agent for consumption had been found; it is, however, doubtful whether this oil has properties remarkably superior to many other animal fats and oils, and by 1895 the price fortunately fell as low as twelve shillings per gallon and it was difficult to obtain even a small bottle of the limpid oil. In July 1893, a herd in Moreton Bay is recorded as extending over a length of nearly three miles by a width of three hundred yards, and for some years fishing was carried out there and at Hervey Bay, but latterly at each place this has been spasmodic and not a paying proposition, for the good reason that the rate of breeding of these gentle creatures does not support ungoverned slaughter.

The main method of capture by whites is with strong coir nets of a yard mesh,





Shaft of a dugong spear known as a "Wap" by the blacks. The enlarged end of the hardwood pole, carved with frog-like figures, has a socket in which the base of the dart is jammed. Thus loaded it is thrown from canoes, or platforms built above browsing grounds, at dugong as they rise to breathe.

[Photo.—G. C. Clutton.]

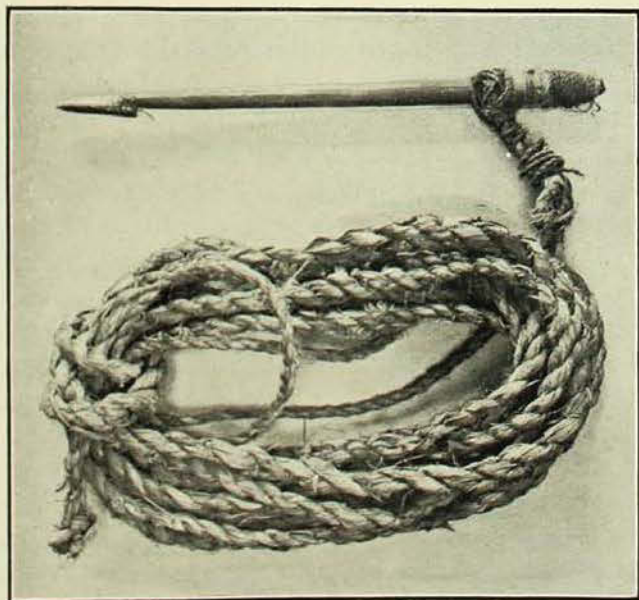
which are not usually more than three hundred feet long and twenty-five meshes in depth, and which are anchored at the ends and buoyed with floats.

About forty years ago, fishing was conducted, using a schooner as a floating station and smaller boats for netting, but for some reason, most likely the rapid diminution of the quarry, the venture did not prove successful.

The aborigines' methods of hunting, which must have been in use long before the advent of the whites, have been admirably detailed by the late Saville Kent and E. J. Banfield. According to the latter, blacks harpoon dugong as they do turtles, but greater patience and dexterity are required, as they are

wary and shy, and a paddle-splash or miss with the heavy harpoon sends the game away with a torpedo-like swirl. The black hunters scout in frail bark canoes for signs such as fragments of floating grass, following stealthily the feeding dugong and striking as it rises to breathe, the first aim being the tail, as, if struck, the animal is then apt to become entangled in the line. A wild rush usually follows, and the canoe bounces madly over the water as the line tightens, while the occupant steers it with paddles of bark until the prey weakens and another harpoon or a spear is thrust through the muzzle and suffocation results.

About Torres Strait and Cape York the blacks spear dugong from a light wooden staging temporarily erected over a feeding ground on which the hunter perches with rope coiled and spear ready, knowing that the dugong will return until fodder is exhausted; a wooden or stone image of a dugong often serves as a charm to ensure a catch. The spear is a twelve to fifteen feet pole with its head hollowed to receive a loose-fitting dart to which a long line is attached, while the other end is decorated with cassowary feathers, shells, or rattling seed pods. When a canoe is used, the man with the spear jumps overboard in harpooning the dugong and as the line runs out, he is careful to see that his head does not become entangled, an accident known to have caused death. Others then dive in and tie a rope round the animal's tail, and by diving when the creature tries to rise for breath quickly suffocate it, while it is stated by Banfield that the blacks towards Cape York will often plug the nostrils with their fingers.



Dugong dart and tackle. The bone barb is secured with gum-cement and sinew to a small shaft the other end of which is shipped in the socket of the large spear. As the dart pierces the body the spear flies off and the rough two-ply lance-warp is payed out, the hunter frequently diving in at the same time, when care is necessary, as blacks have been killed when the tackle has become looped about their necks.

[Photo.—G. C. Clutton.]

#### THE NEW MUSEUM EXHIBIT.

Some years ago a specimen was acquired in Queensland with a view to preparing a



gallery exhibit, but the thick hide rendered the mounting of the skin unsatisfactory. Recently, owing to the great interest and trouble taken by Mr. W. W. McCullough, the Superintendent of the Yarrabah Mission near Cairns, another was secured in Mission Bay, where it was put aboard Mr. A. McLeod's launch and, after further transport by Messrs. Cummins and Campbell, was generously carried freight free to Sydney by Howard Smith Limited, in the freezing chamber of the S.S. *Bombala*. Thanks to these worthy efforts a plaster mould of the complete animal was taken in the Museum workshops, by Messrs. G. C. Clutton and J. Kingsley, preparators. From this mould plaster casts have been taken which so closely represent the original that the mould of plaster drew hair from the mouth which later adhered to the first cast taken from the mould. The first two casts are to be coloured by the artist-naturalist Miss Ethel A. King from her original colour sketches from life, when they will present lifelike replicas of the original, one of which will soon be displayed in the Australian Museum. The other goes to the Queensland Museum in acknowledgment of the part taken by the Director (Mr. H. A. Longman) in arranging for the capture of the original. A striking feature of the specimen was a number of deep grooves or scratches in the skin, which might have been attributed to the action of tusks in fighting were it not known that all sea-cows are mild and inoffensive, seeming never to fight one another or show aggressiveness; the marks are actually due to scratches caused by sudden movement among sharp corals and jagged rocks, and possibly in squeezing through narrow fissures in reaching choice herbage. As Banfield charmingly puts it in his *Confessions of a Beachcomber* after referring to dugong as "great, unreflecting sportful water-babes . . . now we make prosaic bacon from the mermaid's blubbery sides . . . those alluring strains, so soothing, so sweet, yet so deceiving—those wet and tangled locks, where are they? Is the whole realm of nature becoming bald? The hair of the mermaid of to-day is coarse, short and spiky, with inches between each sprout. For a comb she uses a jagged rock, or cruel coral; for her vanity there is no semblance of pardon . . . her seductive plaint, has it not degenerated into a gulping

unmelodious sigh, as she fills her capacious lungs with atmospheric air?"

#### NEED FOR ENFORCING TOTAL PROTECTION.

Never a very large family, even in geological times, the Sirenia are now sadly depleted, and one of the most distinguished members, zoologically speaking, the Northern or Steller's Sea Cow, discovered by the navigator Behring in 1741, became extinct within thirty years of its discovery by man. The American Manatee was threatened with a similar though slightly retarded fate, until the Government, realising their scientific importance, passed protective laws with a penalty of \$500. In 1922 Banfield deplored the increasing rareness of dugong, which he attributed mainly to freebooting trochus and trepang fishing vessels, and wrote that Japanese luggers occasionally come to Dunk Island and "generally within a few minutes, two or three dinghies will be tossed into the sea for a dugong hunt . . . extravagantly fond of the meat they lose no opportunity in harpooning the harmless creatures."

Aborigines apparently assisted in reducing the dugongs' range prior to the advent of whites, so that these raids involve a real danger of a further drastic shrinkage similar to that which presaged the doom of dugong ancestors. Gentle vegetable feeders, they are at a disadvantage amongst aggressive foes, which even implacably exploit the parental love for offspring and mate; as Bullen says: "They are too gentle for their stern world, as much out of place as a herd of antelopes in a jungle peopled with tigers."

It cannot be over emphasised that their increasing scarceness, defencelessness, and slow rate of breeding render it essential that the protection at present afforded should be extended for all time and rigorously enforced.

It is sometimes urged, in a thoughtless way, that dugong should be thoroughly exploited commercially, while some regard the sight of any creature of material value enjoying its haunts in peace as wasteful, but surely they should not be exterminated in providing temporary advancement for avaricious or lazy people. If Australia is a trifle envious of the huge profits of whaling companies in Antarctic seas, there is consolation in the



thought that tribute is not exacted from blood money which sets a premium on the extinction of certain species. However, whales are beyond our jurisdiction over coastal waters, but dugong are distinguished dwellers on our foreshores, seeking only

sanctuary and to browse in peace; challenging man's right neither to soil nor sea, they merit an honoured place in the regard of nature lover and student because of the fascinating story unfolded by their ancestry and living form.



The complete plaster cast made from the mould of the original dugong recently received from near Cairns, Queensland. The work was carried out by Messrs. G. C. Clutton and J. Kingsley, and the cast will be subsequently coloured by Miss Ethel A. King according to her sketches of the original, which was a gun-metal grey above, and lighter grey below.

Photo.—G. C. Clutton.

## Notes and News.

Recent visitors to the Museum include Professor T. D. A. Cockerell, University of Colorado, United States of America, who is interested in all zoological work, but particularly bees and land snails; Dr. Eugen Paravicini, Natural History and Ethnographic Museum of Basel, Switzerland, on his way to collect zoological and ethnological specimens in the Solomon Islands; Professor S. E. Longwell, Middleburg College, Vermont, United States of America; Miss E. S. Williams of the Melanesian Mission, Raga, New Hebrides, who has made a close study of mat making, one of the chief industries of the group.

The news of the tragic death of Dr. J. V. Danes, formerly Consul-General in Australia for Czecho-Slovakia, who died recently as the result of a motor accident at Pasadena, California, has been received with deep regret. During his stay in Australia Dr. Danes was a constant visitor at the Museum, making much use of the library, and on two occasions he delivered lectures in our hall, which were much appreciated. Prior to, and also during his Consular appointment, Dr. Danes, who occupied the Chair of Geography in the Charles University, Prague, had done a con-

siderable amount of scientific research in Australia, the results of which were published in several papers and works.

News has been received that Mr. E. C. Andrews, Trustee, and Dr. C. Anderson, Director, have been elected Corresponding Members of the American Museum of Natural History, New York. Corresponding members are elected on the recommendation of the Scientific Staff of the American Museum in recognition of contributions to scientific knowledge, membership being for a period of five years, subject to renewal.

The popular lectures delivered in the Museum's Theatre have been well attended, as usual, some so well so that it was necessary to repeat them. Other lecture activities includes the series arranged, in co-operation with the Department of Education, for school children.

Apart from their official lectures the staff not infrequently assists various organisations outside the Museum and during the past few months Messrs. Thorpe, Kinghorn, Iredale and Livingstone have lectured before several institutions.





In a tank generously loaned to the Museum by Mr. Melbourne Ward, is a host of quaint marine creatures, which thrive and act as though in their normal surroundings. Sea anemones, particularly, are at ease in the artificially oxygenated water, and the study of their habits has contributed materially to the information contained in the present article. On the left is a fine specimen of the speckled anemone, *Oulactis muscosum*, and to the right are specimens of the green *Phymactis veratra*.

[Photo.—W. Kimble.]

THE striking coloration and beauty of form possessed by sea anemones found between tide marks along our shores have no doubt attracted the attention of many a questing visitor. Snugly hidden under a rocky ledge or issuing from a secluded crevice in a crystal clear rock pool these delicate, though hardy animals, lead a somewhat precarious existence, and when the tide rises high over their rocky shelters they are ever on the alert to clutch with their waving tentacles any vestige of drifting food.

All anemones are assembled under one heading or group called the Actinaria. This separation is really a branch of a much larger division known as the Coelenterata which embodies all types of animals possessing a hollow, simple, digestive cavity. The well known reef-building and solitary corals, as well as the jellyfishes, are classified in the Coelenterata and are therefore near relatives of the sea anemones. The corals, however, are the closest allies of the anemones and some of the solitary or simple corals, when fully expanded, so closely resemble anemones that detection is possible only after close scrutiny. The main characteristic

difference between a coral polyp, whether of the reef-building or solitary type, and a sea anemone, is that the former possesses a hard limy skeleton whereas the anemone is entirely fleshy, without any solid support.

#### STRUCTURE.

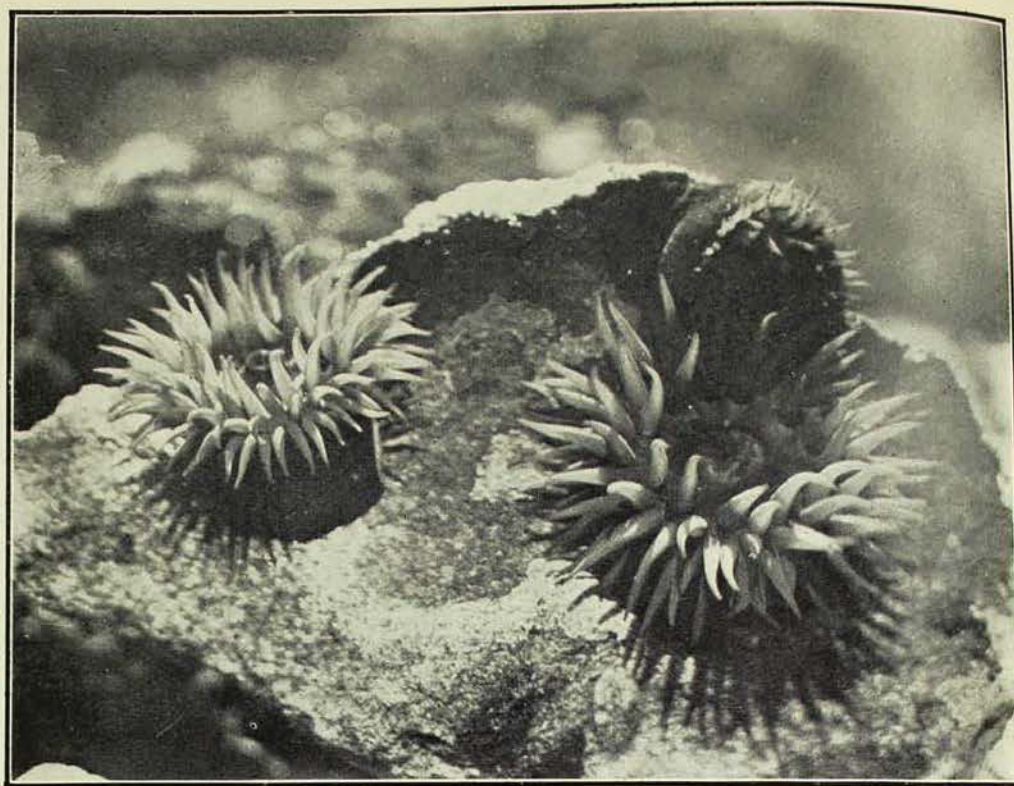
The general form and contour varies in the different species, but usually the body or column of a fully developed anemone is cylindrical. This is bedded down at the base by a large and powerful sucker, which prevents the animal from being dislodged by the action of the water. The sucker foot is capable of expansion and contraction and by this means a slow and laborious locomotion is effected. As a result of this, the creature's meanderings are considerably restricted. The mouth is situated at the free or unattached end of the body in the centre of an area known as the peristome. Surrounding the peristome are a number of tubular tentacles arranged in rows. These are of a highly contractile nature and very sensitive, and upon them rests the responsibility of furnishing the daily food supply.



Internally the animal is almost a simple sac, through the mouth of which the food is passed for digestion; after assimilation, the residue is passed to the exterior through the same aperture. The body cavity is divided into a number of chambers by definite vertical walls or partitions called mesenteries. These are of three kinds, each of different length, and besides acting as dividing walls, they serve to support the short gullet immediately below the mouth opening. In the substance of the mesenteries are to be found the reproductive bodies, and attached to their sides are the longitudinal muscles which are used in the contraction of the body.

#### COLOUR AND HABITAT.

The most conspicuous species found on the New South Wales coast is the Blood Anemone or Sea Waratah (*Paractis papaver*), so named on account of its brilliant crimson colour. During the warmer months it commonly disdains the shelter of the protective ledges, and is found in the shallow pools or even left exposed in the damp intertidal zone. This delicate creature could not be called large as anemones go, though it is one of the biggest to be found in the vicinity of Sydney. Fully developed specimens often measure as much as one and a quarter inches across the base, and almost as much in height when the tentacles are extended. These dimensions, however, are hardly comparable to those of our giant anemones on the Great Barrier Reef off Queensland, which may attain to a diameter of twenty-four inches. When not feeding, or when left exposed by the receding tide, the tentacles of the Blood Anemone are



The Blood Anemone, or Sea Waratah (*Paractis papaver*), in a fully expanded condition. Surrounding the central spout-like mouth is a series of very delicate tentacles, which are used to secure food and transfer it to the mouth. [Photo.—G. C. Clutton.]

completely withdrawn, and the creature resembles a blunt cone, but when submerged the near proximity of food will stimulate the animal and cause it to open and protrude its crimson appendages. In an extended condition the body is seen to be almost uniformly cylindrical, surmounted by the rather short tentacles, which rarely attain to one inch in length.

Some people consider the Blood Anemone injurious, and imagine it capable of inflicting very painful wounds. Such ideas, however, are entirely erroneous, though it cannot be denied that the anemone has in its tentacles little stinging cells with which it paralyzes minute living prey. These stings, although fatal to small forms of life, are, to the human being, entirely unnoticeable.

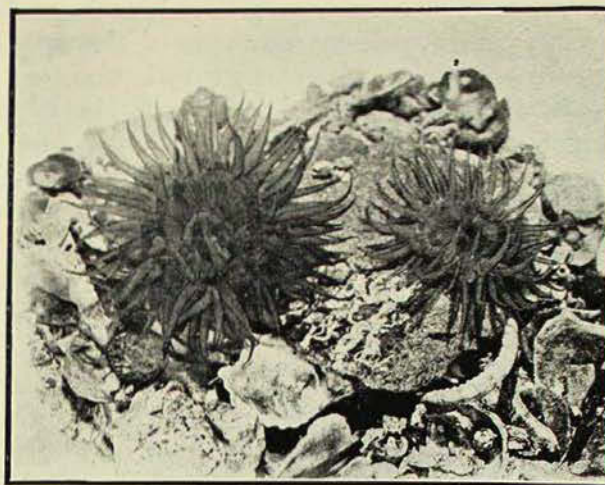
Another anemone not infrequently met with on our shores is the Green Anemone (*Phymactis veratra*). This handsome creature usually hides itself away in a crevice of the rocks, but when in the open it accumulates around itself a large quantity of broken shell and sandgrains. Its presence can, nevertheless, be detected by the often brilliant waving green tentacles which are ever



waiting to envelop unwary prey. *Phymactis* is like the Blood Anemone in that it is entirely harmless, and can be handled with impunity. Individuals of varying shades of green present a pleasing spectacle in a rockpool. Each specimen has its column of uniform colour, but this may be of any shade between a dark bottle green and a brilliant emerald. The tentacles are always of a lighter hue than the green of the body, and the area at their bases surrounding the mouth often has a brownish tinge. Structurally the appendages are rather elongated, and taper considerably towards their free extremities, which, in fully grown specimens, extend as much as three inches from their bases.

In tropic climes anemones grow to extremely large dimensions and are often most gaudily coloured. One described by Saville-Kent in his book on the Great Barrier Reef of Australia, a huge species of the genus *Stoichactis*, exhibits a most amazing riot of colours. The author quoted states that the spheroidal bead-like tentacles occur in irregularly mixed patches of grey, white, lilac, and emerald green, while the disc is shaded with various tints of grey. The mouth is described as being bordered with bright yellow. Such an amazing colour scheme as this would be entirely out of place in any locality other than a coral reef, where colour seems to have been painted by Nature's hand in so lavish a manner that almost every animal inhabitant possesses some gaudy hue to harmonise with its surroundings of brilliant coral.

Some other tropical species not only have colour schemes of infinite variation and beauty, but also structural patterns of graceful design and unique ornamentation, which attract not only the artistic eye but also many unsuspecting victims that seek too close an acquaintance. The Great Barrier Reef species *Actinodendron plumosum*, is well known for its graceful structure. In this form the tentacles are branched in such a manner as to give the entire animal the appearance of a harmless piece of seaweed, a deception which is accentuated as the anemone crouches deeply anchored in some sandy cranny between the coral fronds. So much outward likeness exists between an anemone of this species and a piece of growing weed, that the creature may quite



One seldom proceeds far along the seashore without seeing in some secluded crevice, below tide marks, an assemblage of green anemones (*Phymactis veratra*). So well and firmly established are they that no effort to dislodge them is ever successful, and if one is desired the only way is to chip off part of the rock to which the animal has attached itself.

[Photo.—G. C. Clutton.]

easily be overlooked by an unskilled collector. *Actinodendron plumosum* is possessed of powerful stinging properties, which have earned for it the reputation of being one of the most unpleasant anemones to handle. One authority has written that the sting is almost as severe as that of a nettle, while the resultant rash will remain visible for nearly a week.

#### ANIMAL COMPANIONS AND MESS-MATES.

Great interest lies in the fact that some anemones are invariably found in symbiotic association with other sea animals. Such relationship or association will usually be found to be constant, and the one creature is seldom found without the other. This curious mateship is instanced by a small tropical anemone which is always found attached to the shell used to house the hermit crab *Dardanus deformis*. It is said that the association is of mutual benefit; the crab obtains extra protection by the presence of the stinging tentacles of the anemone and shares the food it captures, while the anemone is borne from place to place to meet a greater amount of food than that which is ordinarily the lot of its less fortunate and more sessile relatives. The most curious and truly astonishing association of this kind on record is that of the tropical Indo-Pacific shore crab (*Melia tessellata*), and the little anemone *Actinia prehensilis*. Möbius, the naturalist who originally described this association, relates that every



specimen of the crab seen by him held in each of its nippers an example of the small anemone. Even when captured the crab would not loosen the hold upon its companion, and, indeed, the anemone could not be moved except by a force which necessitated the breaking of the crab's claw or the body of the anemone. The tenacity of the crab's hold on its associate was explained by a curious modification of the nippers, which are specially adapted for the accommodation of the anemones. Möbius observed that if an anemone was cut away or torn piece-meal from the crab, it would at once recognise the loss and become greatly perturbed over the robbery, not resting until a search for the lost one was carefully made. If broken, the fragments of the anemone would be assembled and arranged again in the claw as though it was as whole and useful as before.

Sea anemones, however, are not always selected by crabs as a subsidiary means of protection. It has been the writer's good fortune to witness a Port Jackson Spider Crab (*Hyastenus diacanthus*) in our Museum aquarium setting out on its back numbers of small anemones. These little fellows were obviously useless for protection and their purpose was soon observed—that of food collecting for their caretaker. If a

piece of food were given to any one of these anemones, no matter how carefully one tried to avoid the crab's attention, the presence of the food would somehow be instantly realised, and a questing claw would move over the back to collect the dainty morsel by tearing it unceremoniously from the enveloping tentacles of the unfortunate anemone.

Many of the giant anemones of the Great Barrier Reef have commensals such as shrimps and fishes. Thus the drab but nevertheless striking anemone, *Stoichactis kenti*, invariably has in association with it one or two gaudily coloured fishes of the same species, *Amphiprion percula*, and these, if disturbed, swiftly make their way through the mouth of the anemone into the shelter of its body cavity. In another instance a brilliantly coloured prawn (*Periclimenes brevicarpalis*) is found living in association with a green anemone host of the genus *Discosoma*. The probable reason for these peculiar associations is that the anemones tolerate their strange companions on account of the food prey their gaudy colours lure within reach of their tentacles. Most puzzling of all, however, is the fact that the commensals are immune to the stings of their hosts, and are able to sport at will among the tentacles without fear of harm.

## Review.

*On the Barrier Reef. Notes from a Nologist's Pocket book.* By S. ELLIOTT NAPIER. (Angus & Robertson, Ltd., Sydney; June, 1928). Demy 8vo. 173pp. 36 pls. 2 maps. Price 12/6. From the publishers.

Australians have a priceless heritage in the Great Barrier Reef of Queensland, and those who love and study nature find it a source of never ending wonders and delights. To attempt to initiate a stranger into its marvels by mere verbal description is an utter impossibility, whilst the most artfully produced pictures cannot do justice to the living colours of the inhabitants of its waters.

In the well produced book here reviewed, a journalist sketches a few of the high lights of nature which he could not help observing during a holiday in the Capricorn islets. As the title implies, there is no pretension to

scientific treatment of the subjects dealt with in this book, and the author frequently expresses his disdain for the scientific terms necessary for the accurate classification of natural history objects. In this way he has defeated the purpose of the book which, presumably, was to encourage an interest in the wonderful works of nature to be seen by visitors to the Great Barrier Reef. A more earnest writer would have endeavoured to paint word pictures that would attract and charm, whereas, were it not for the excellent photographs which adorn this book, an intelligent reader would have cause for disappointment on account of the rather superficial treatment of the subject.

The book is useful to the layman, in that it affords an accessible account of the fauna and flora of the southern regions of the Great Barrier Reef.—

G.P.W.



## Water Supply of the Aborigines.

BY W. W. THORPE.

IN parts of Australia where the rainfall is almost negligible, we find aboriginal tribes living and apparently thriving, and this fact has often puzzled the white man. How do the aborigines sustain life under these uninviting conditions? The fact that they do so is proof of the law of adaptation to environment; in other words

and break it off at the slender end. The next step consisted of chopping it up into lengths of two or three feet and placing the pieces on end to drain into a vessel. Root sections of about one and a half inches in diameter yield a better flow than thicker pieces. If very thirsty he will clean away the bark at one end and allow the water to



Coolamon or wooden trough, North Australia. Vessels such as this were formerly used over a large area of Australia.

[Photo.—H. Barnes.]

they are able to adjust themselves to this local aridity and by so doing survive.

During countless generations the aborigines have learned a great deal about water, and where to find it. Many a European has died of thirst in the bush when water was within his reach as it were, but being ignorant of its proximity, and how to obtain it, he has perished miserably.

### SOURCES OF SUPPLY.

Endowed by Nature with keen powers of observation, the aborigines found that certain trees could supply water, not in quantities it is true, but sufficient to stave off thirst until they could reach a rock waterhole or a river.

These trees are known as "water trees," and include the mallee, she-oak, kurrajong, and others. When seeking water from this source an aborigine would first dig around to expose a root a few inches below the ground, and break it off near the butt of the tree. He would then drag out as much of the root as his strength would permit

and drain direct into his mouth, using piece after piece until he has had enough. In the event of its being unlikely that water will be available during a further stage of his journey, he will take a long root along with him, first covering the broken ends with earth or clay to prevent loss of moisture *en route*. To obtain the maximum amount of water, the root, before being drained, is entirely denuded of bark.

The fact that more water is available in the hot weather would at first glance seem to be one of Nature's best provisions for her children, but the true reason is that evaporation being then at its maximum, the growing tree needs more moisture. The explorer Eyre saw some natives extracting water from tree-roots when the surrounding ground was dry as flour. Most of the water so obtained is palatable and cool, though that derived from some of the trees becomes clouded if left standing.

The mallee seems to be the favourite and most reliable of all the "water-trees," the water running out as soon as the root is separated from the trunk.





Skull water carrier, from the Coorong, South Australia. This is the upper part of a human skull from which the facial portion has been broken away. In use this opening is plugged with a tuft of grass to prevent the water from spilling.

[Photo.—G. C. Clutton.]

Then again, some trees store water between their buttress roots, or where the trunk divides. Sometimes a supply amounting to gallons is obtained in this way. This source of supply is likewise known to the aborigine, who makes it his business to climb up and look. In fact, water may be found in many places that would not occur to the mind of a city dweller. Cavities in decayed trees, or dead spout-like branches, are sometimes a source of supply. How would one set about getting it? The aborigine has devised the means. He would either take a hollow reed and suck up the water, or, make a ball of grass and attach it to a stick. This improvised mop he

would lower again and again into the aperture until his immediate wants were supplied.

A reliable indication of the presence of water is the habits of birds and animals, especially the birds. If we were travelling over a dry area and should suddenly come upon a number of small birds, especially of the finch family, we would be safe in assuming that water was not far away. As a matter of fact there are few birds which go very far from where they drink. All these sources failing the aborigine, there yet remains the nightly fall of dew. Arising at daybreak he would sally forth with a coolamon or wooden bowl and shake the grass and herbage to obtain a drink. Eyre





Aboriginal carrying a skin water bag, Glenormiston, West Queensland.

[Photo.—Dr. W. E. Roth.]

gives his testimony to the efficacy of this method when he states that he gathered a quart in an hour by this means.

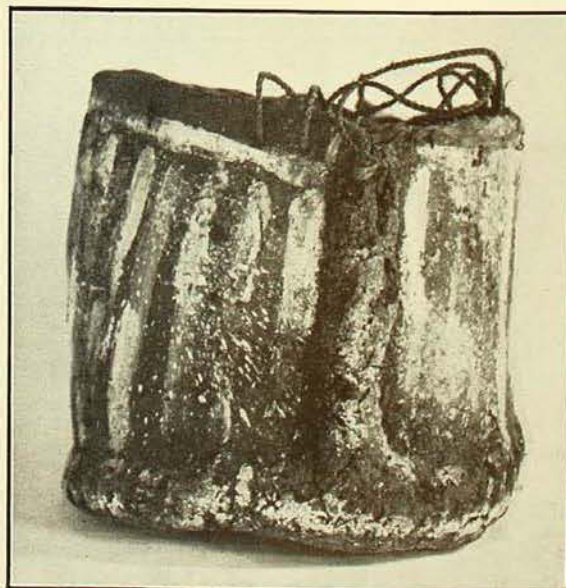
Other sources of water supply in the interior consist of rock holes and "soaks." Sometimes rock reservoirs are naturally formed, though many are made by the aborigines themselves. They are pounded out stage by stage, water helping to soften the stone. The process is repeated until a large reservoir is made, holding up to several hundred gallons. To protect these reservoirs from the sun and pollution by animals, they are covered with sticks and stones. A "soak" usually occurs in a situation where by digging water percolates through the sand.

The presence of water on the sea beaches is also known to the aborigines. It can be obtained on almost any beach by diligent digging, though it is necessary to excavate at some distance from high water mark to find it drinkable. This supply consists of

rain or filtered sea water. Beds of apparently dry creeks frequently contain water at a shallow depth.

#### WATER HOLDERS AND CARRIERS.

Having completed this short summary of the aboriginal methods of obtaining water, we will now consider the many vessels used for holding it for immediate use, and the different kinds of containers in which it was carried. One of the commonest water carriers is the coolamon. It is a boat-shaped bowl and is used over a wide area. In Queensland these vessels were used for various services. Beside being water holders, they served as cradles and seed-winning dishes. The bark bucket is another form of water carrier. In Queensland and North Australia they are made of a rectangular piece of *Calophyllum* bark sharply folded, the sides being sewn together and the stitches subsequently covered with a resinous material to make them water-tight. In north-west Australia the so-called bark bucket is circular and composed of two pieces of *Melaleuca* bark, one piece forming the cylindrical body, while the other forms the bottom of the vessel. These are also sewn together as before, and the stitches similarly covered with spinifex resin. Another kind of water carrier, formerly in use on the northern rivers of New South Wales and even to-day in many parts of



Water bucket of *Melaleuca* bark, Port George IV., north-west Australia.

[Photo.—G. C. Clutton.]





Palm spathe water carrier, Night Island, south of Cape Direction, north Queensland.

[Photo.—G. C. Clutton.]

tropical Australia, is that made from a piece of palm spathe, carefully folded at the ends and stitched.

On the Coorong in South Australia it was the custom to fashion a water carrier from the upper part of the human skull. In North Australia and Queensland *Melo* and *Megalatractus* shells were used as water carriers. The columella was carefully removed or perforated to serve as a thumb hole.

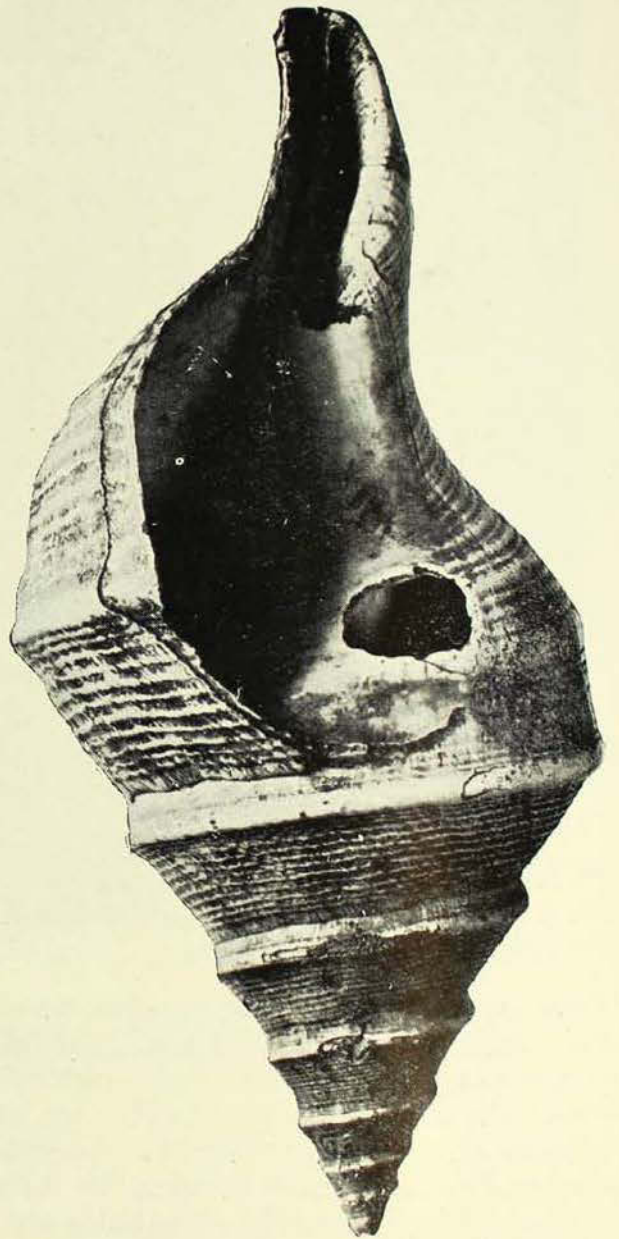
In the interior, skin water bags are often used. The head of the animal was first



Tree-excrecence water carrier. Night Island, south of Cape Direction, North Queensland.

[Photo.—G. C. Clutton.]

removed and the entire body and limbs extracted through the neck. Finally the limbs, tail ends and other apertures were closed by sinew lashing. The neck was left open to use as a spout for filling or pouring out the water. Skin water bags are also used to-day in Eastern lands.



A water carrier made from a Giant Whelk (*Megalatractus aruanus*). Wellesley Islands, Gulf of Carpentaria. In grasping the carrier the thumb fits into the hole pierced in the side of the shell.

[Photo.—T. Whitelegge.]

Perhaps the most curious water holder is the tree excrecence. In New South Wales and Queensland the gnarled protuberance so frequently seen on our eucalypts was carefully removed, and by means of charring the interior a very serviceable vessel was obtained. Gourds of *Lagenaria* and lengths of bamboo also served as water carriers in Queensland. It would appear



that our aborigines were unacquainted with cooking by boiling. Apart from the shell types of water carriers none of the containers could serve as boilers. Dr. Roth records the heating of water in a *Melo* shell on the Bloomfield River, Queensland, and water was sometimes made hot by placing heated stones in the vessel in which it was contained.

The Tasmanians, now extinct, made a bucket from a broad-leaved sea-weed, and their reservoirs consisted of wells dug in the moist ground.

In conclusion, it may be stated that the presence or absence of water enters largely into the aboriginal place-names of Australia.

## Reviews.

*Natural History Magazine*, Vol. I., No. 5, January, 1928. Published by the Trustees of the British Museum. Price 1/—.

This number of the popular quarterly issued by the British Museum (*Natural History*) is well up to the standard of previous numbers.

In a racy article Mr. M. A. C. Hinton describes his fine exploit in salvaging the school of False Killer Whales stranded on the shores of Dornoch Firth in the north of Scotland. This has been regarded as the rarest of cetaceans, but Mr. Hinton and his assistants were able to collect 126 specimens, of which two were sent to London in the flesh for casting, the rest being flensed and their skeletons prepared. As the whales were scattered up and down the Firth for a distance of thirty miles, the task was no easy one, but all difficulties were triumphantly overcome, and after six weeks' hard work the party had made a complete examination of a large school of whales (a feat probably never accomplished before) and had secured the largest series of Cetacean skeletons ever brought together.

Mr. R. D'O. Good contributes an interesting account of botanical exploration in the mountains of eastern Tibet and western China. In this region a few years back the peaceful scientific collector carried his life in his hand, for Forrester, leader of one of the expeditions, barely escaped alive, after all his collectors except one had been killed in an attack by unfriendly natives.

There is a short article by Dr. Errol I. White, describing the fish-beds of Dura Den in Fifeshire, one of the most prolific fossil fish deposits in the world, where on one

occasion over a thousand specimens were discovered on one square yard of sandstone.

Mr. J. Ardagh writes on "Portraits and Memorials of Robert Brown of the British Museum." This botanical genius accompanied Flinders on his voyage to Australia in 1802 and his collections of, and writings on Australian plants are justly famous. It is interesting to note that, as quoted in the article "his remains were consigned to the earth, surrounded by Australian flowers."

Mr. Gilbert J. Arrow contributes an informative article on mimicry in beetles, in which he points out that, though the classic examples of mimetic resemblance have been drawn from the butterflies, yet numerous and striking cases of mimicry are to be found in other insect groups, such as the beetles of the families Lycidae and Cerambycidae.—C.A.

*Coo-ee Talks*. By W. Robertson. Edited with a foreword by HERBERT BASEDOW, M.A., M.D., B.Sc., (Angus and Robertson, Limited, Sydney, 1928). Price 12/6.

*Coo-ee Talks* is a collection of short lectures delivered from a wireless broadcasting station. The author, a pioneer, had the good fortune to come into close touch with the aborigines when not only were they more numerous but they had not deteriorated as the result of contact with the whites. Hence he has a rich store upon which to draw, and he describes phases and customs of native life in a popular and conversational manner. The book contains many interesting anecdotes of early days, and has a considerable historical value.—W.W.T.



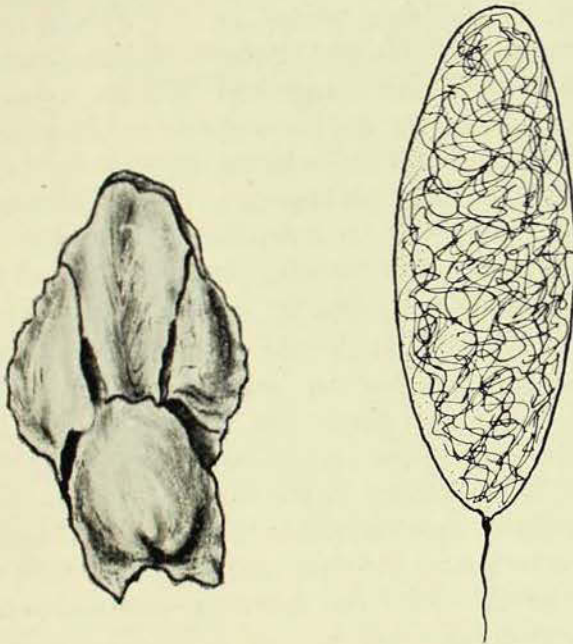
## Hidden Dwellers of the Tidal Flats.

By F. A. McNEILL AND A. A. LIVINGSTONE.

MANY quaint creatures on the shore live hidden from our gaze, and the seclusion of their existence robs many of us of the opportunity to become acquainted with their form and habits. Some have beauty of structure and colouring, while all have interesting life histories.

### MOLLUSCA.

Often when wandering among the shallow pools after the water has receded from a



Left.—*Philine angasi*, the whitish, fleshy, burrowing mollusc of the tidal flats. At the top is the shield-shaped head, and below the eminence at the hinder end of the animal is the hidden degenerate shell. About three quarters natural size.

[Joyce K. Allan, del.]

Right.—The egg mass of *Philine angasi* is a jelly-like flaccid substance and may be two inches in length. A fine white tangled egg-string is discernible internally.

[F. A. McNeill, del.]

tidal flat one notices delicate jelly-like forms anchored in the sand or entwined at their bases in a seaweed growth. These are masses of mollusc eggs, and many of these structures prove most baffling when an attempt is made to associate them with the surface-dwelling shellfish; it is then that the experienced collector delves in the sand in search of the possible owners.

One of the most intriguing of the subterranean molluscs is a form named *Philine*,

noted for its burrowing propensities. This creature occurs in colonies at a depth of four to six inches below the surface of the flat, and it is only by persistent excavating at various points in the mid-tidal zone that one happens upon it. The dead white and flattened appearance of the body render the creature easily recognisable when uncovered. *Philine* is related to the sea-hares<sup>1</sup> which browse on the beds of seaweed covering the greater part of the surface of the tidal flat, but it has diverged somewhat in structure from these more ornate cousins. A specialized modification of the body has been acquired whereby burrowing is accomplished without any undue hindrance. There are no apparent tentacles on the head, and its dorsal surface is formed into a broad elaborate digging shield, which is lowered so that the undersurface lies in the same plane or level as the fleshy mobile foot. Flaps or lateral extensions of the crawling foot envelop the back as in the sea-hares. The upper edges, however, instead of being free, are closely adpressed to the body, and have smooth simple edges. Hidden beneath the fleshy folds on the back is a simple degenerate shell, giving a clue to the animal's classification with the gastropod molluscs, exemplified by the better known garden and sea snails.

In places, such as the tidal flats at Gunnamatta Bay in Port Hacking, New South Wales, *Philine* is often to be found. During the late spring and early summer months its presence is indicated by the singular egg-mass it lays. The egg-masses are not uncommon in season, but are often passed unnoticed on account of their comparatively small size and semi-transparency. In shape one of these jelly-like flaccid masses is not unlike a spindle, and is anchored at one extremity to the sand by a thread-like filament. Close scrutiny shows the interior to contain a seemingly endless tangle of fine white eggstring, with thousands upon

<sup>1</sup> Sea-hares.—*Aust. Mus. Magazine*, ii., 1926, p. 432.

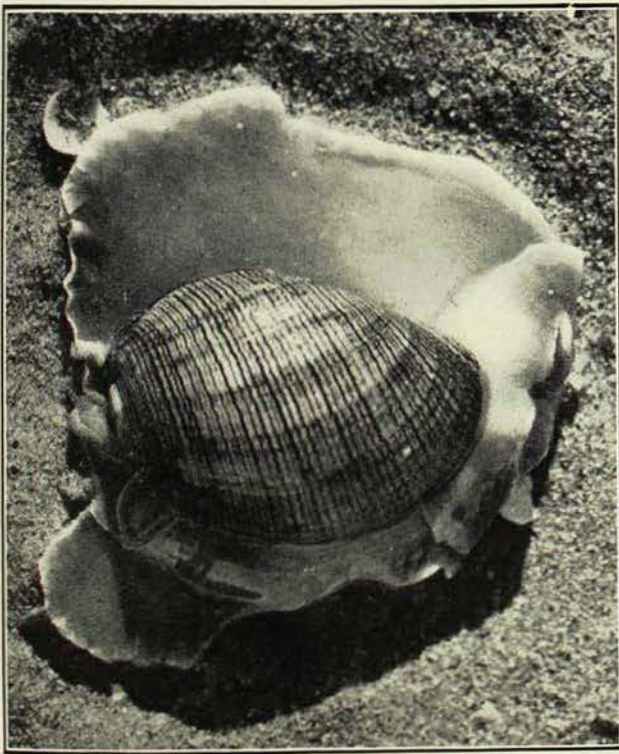




A single valve or shell of *Solen correctus*, the Razor Shell. This species has a shell which often measures three and one-half inches in length. Some foreign forms attain a length of eight inches.

[Photo.—G. C. Clutton.]

thousands of minute developing embryos dotted along its length. Later, the embryos break away from the egg-string, and in some egg-masses may be observed in their capsules, moving freely about in the interior. Fortunately for other hungry denizens of the tidal flat, and unfortunately for future generations of *Philine*, only a very minor percentage of the young ever reach maturity. In fact, marauders may become



When only partially expanded, *Hydatina physis* is a beautiful mollusc to behold. The folds of the great foot simulate in contour the petals of a rose. Natural size.

[Photo.—G. C. Clutton.]

busy before the minute embryos break away from the comparative shelter of the egg-mass. Such is the provision of mother Nature for breeding her children in a sphere where the struggle for existence is very severe.

The presence of another peculiar shell-fish living below the surface is indicated

by the stranded valves popularly known as Razor Shells or Chinaman's Finger Nails. In life a pair of these greatly elongated valves enclose an animal which embeds itself deeply below the surface of the tidal flat. *Solen*, as this form is called, is the most highly specialized burrower among the lamellibranch or two-valved molluscs. In it the breadth of the shell is equal throughout, and there exists no obstructive curves to impede rapid ascent or descent. Like *Philine*, *Solen* occurs in colonies in the same zone, and may burrow to a depth of eighteen inches. The mode of burrowing is peculiar, and is mainly effected by the modified, fleshy, expanded foot, which protrudes through the gape of the valves at the posterior end of the body. This organ is worked forwards into the sand or mud and the end expanded into a knob. Then by a sudden contraction the shell is drawn to the position previously occupied by the anchored end of the foot. During

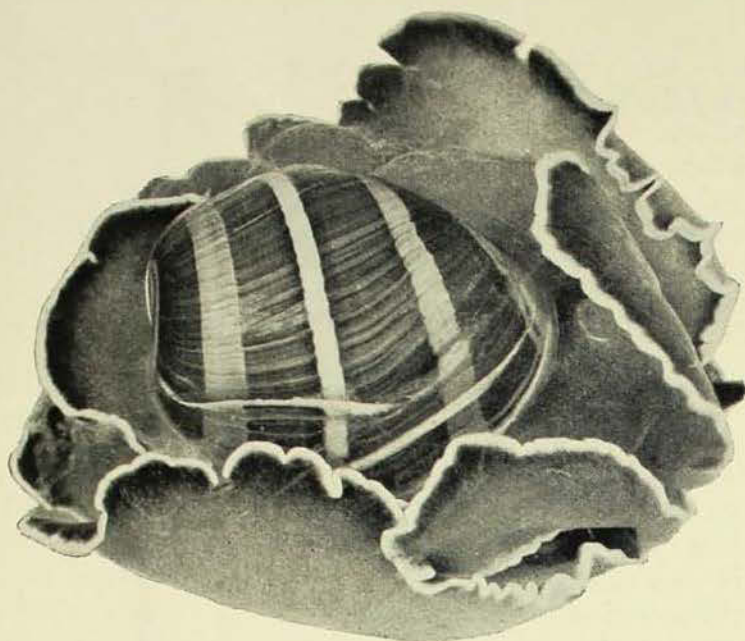
this process strong jets of water are being continuously expelled from one of the two siphons at the anterior end of the shell, so that the walls of the burrow are kept soft and forward progress is assisted. One writer likens the fleshy expansion of the foot of *Solen* to a mushroom anchor, and remarks upon its suitability for obtaining a firm grip of the sand. Although the burrow of *Solen* opens at the surface, and the creature comes to the mouth to feed, its pencil-like form is seldom seen on the flats. Somewhat of a swimmer, it may be tempted to undertake short excursions through the water, when the efficiency of the foot is displayed in another



The complete animal of *Solen correctus* viewed from the side, with the shells occupying their natural position. At the anterior extremity are the fused inhalant and exhalant siphons, while posteriorly is the expanding burrowing foot. Ap. approximately natural size.

[After Chas. Hedley.]





*Hydatina circulata* is another New South Wales species which vies with its ally for beauty of colour. The dark brown and white bands of the shell render this mollusc a more striking object than *H. physis*. Natural size.  
[Photo.—Thomas Dick.]

manner. With a series of flicks of this member the animal thrusts itself spasmodically though swiftly along. This practice sometimes results in misadventure, and it is then that an occasional live specimen is found on some inhospitable patch of the tidal flat.

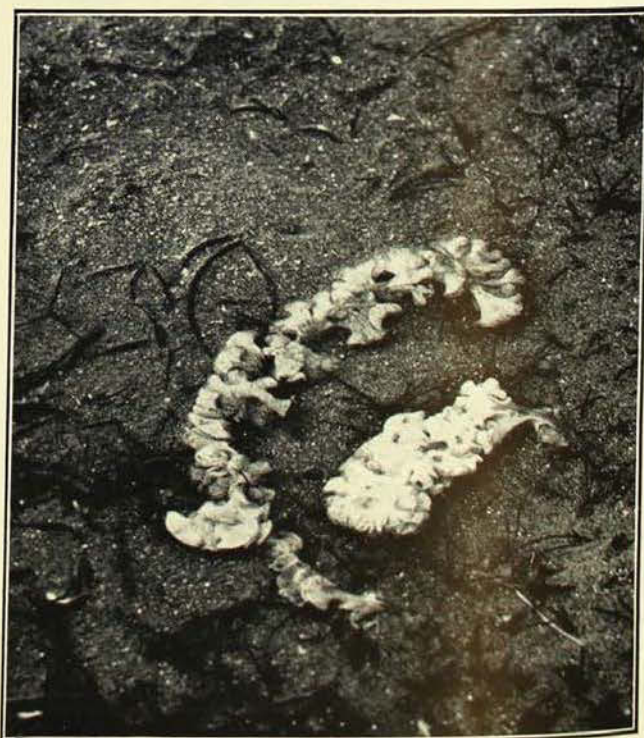
*Solen* is a favourite bait for Black Bream fishermen, and groups of these enthusiasts spend a profitable hour when the tide is out digging for this delicate enticer. As an article of human consumption the creature is not unpalatable, and in some European countries it is highly esteemed; it is seldom used in any commercial sense.

The form *Hydatina*, still another mollusc which leads a burrowing existence, is remarkable for its beauty of form and colouring. *Hydatina* is closely related to *Philine*, mentioned above, but has a prominent external shell which is more of the conventional gastropod type. The structure, however, is very thin and brittle, and seems scarcely adequate to protect or harbour the comparatively large animal it adorns. The greater mass of the body is a huge fleshy foot, thin at the edges and fluted. As in *Philine*, the undersurface of this organ is continuous with the shield-shaped burrowing head, which is provided above with two pairs of tentacles; the hinder of these are comparatively large and leaf-shaped.

The colours of *Hydatina* in life are a most pleasing combination. The cream ground of the shell is ornamented with narrow closely set bands of bronze brown, while the flesh of the crawling foot and head shield is a delicate flesh tint. Lending lustre to these colours is a narrow band of sky blue which edges the entire animal.

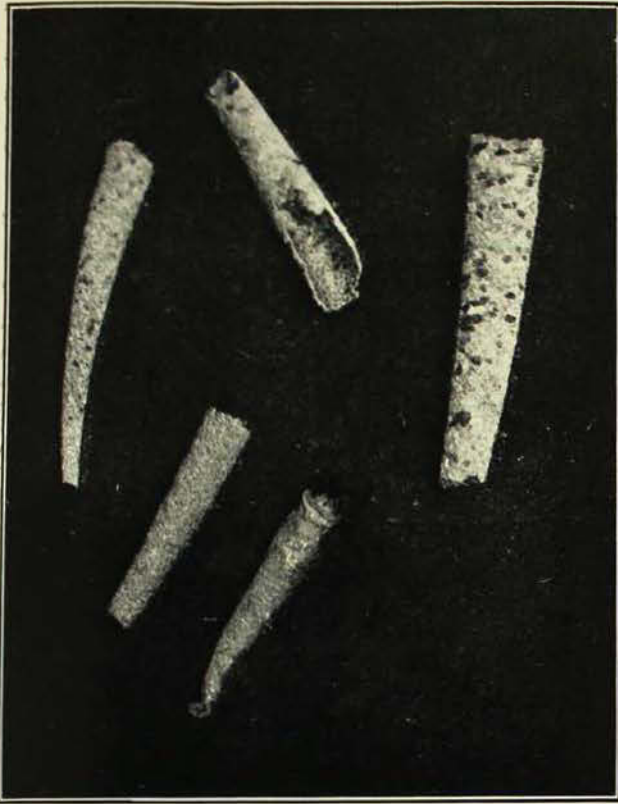
As it is normally only a shallow burrower, one sometimes happens upon specimens of this handsome mollusc when closely scrutinising the floors of shallow pools on the flat. Under such circumstances its presence below the sand is often betrayed by the striking blue fluted edges of the foot projecting slightly above the surface. This position is normal when the animal is burrowing or reclining just below the surface of the sand, the edges of the foot being folded up over the back of the shell. When the mollusc is disturbed by excavation the expanded body becomes partially contracted, presenting a barely definable mass of flaps and folds not unlike the petals of a rose.

An egg-mass of striking form and structural beauty is laid by *Hydatina*. This is sometimes dwarfed in form, but is usually elongated and composed of curved and fluted lobules arising from an ill-defined central



The egg masses of *Hydatina* have not previously been recorded. They are delicate in appearance, with numerous lobules arranged in the form of an eccentric spiral. About two-thirds natural size.  
[Photo.—G. C. Clutton.]





One complete and three incomplete sand-grain tubes of *Pectinaria antipoda*. The worm animal is illustrated at the bottom of the picture alongside the tube it occupied in life. About three-quarters natural size.

[Photo.—G. C. Clutton.]

column. At one end occurs an anchoring filament, and when the mass is seen floating it presents a remarkable resemblance to a length of fine lace or to the ruff as worn by the cavaliers of old. The substance of the egg-mass is of the usual gelatinous composition, within which is scattered myriads of tiny white or cream coloured eggs, the developing progeny of the adult *Hydatina*.

#### WORMS.

Many and varied are the sea worms which inhabit the tidal flat at Gunnamatta Bay. The Bristle-footed Worms are particularly numerous, either living freely or sheltering in tubes of shell grains or papery composition. The most outstanding of these denizens, however, is a small form known as *Pectinaria*. This worm is unique among its allies for the singular form and construction of its delicate tube of sand grains. Usually sheltering well below the surface of the sand,

it spends a life of comparative safety, and it would appear that its tube was formed into a solid wall from the sand grains immediately surrounding the body, instead of being constructed piece by piece as the animal grows. It is a revelation to examine the structure of the tube with a glass. It is curved and horn-shaped, the narrow end covering the tail of the worm's body, while the wider anterior end gives free egress to the protrusible head. The mosaic workers of even ancient Venice were not expert enough to piece and fit together the tiny fragments they handled into such a compact whole as does this lowly creature. The effect produced is most interesting, and when it happens that the sand grains used in construction are of various tints the result is most artistic. Cementing is effected by means of an exudation or secretion of a sticky fluid given off by the skin of the worm, and this is also employed in providing a smoother surface to the inside walls of the tube.

The *Pectinaria* animal has its head protected by a large and conspicuous bundle of golden chitinous chaetae or bristles. These are attached to the second body segment and are flattened, curved, and pointed. Being arranged in a single transverse row on each side, they serve as an operculum or lid to seal the tube when the necessity arises. The posterior or tapered end of the worm has undergone great degeneration. The segments are reduced in number far below the normal total possessed by other sea worms, and the extremity is provided with a small leaf-like "scapha" or flap to close the narrow end of the sand-grain tube. The worm is capable of carrying its tube about, though it is rarely seen on the surface of the flat. Sometimes the creature may rest just below the surface with its tube projecting very slightly above it. Feeding is aided by currents set up by the constantly moving cilia on the gill filaments near the head end of the body; these carry the food towards the mouth, and at the same time bring water to the gills and so oxygenate the blood.



## The Habits of our Common Shore Crabs.

BY MELBOURNE WAED.

TO those whose natural bent is towards a pastime study of the more lowly creatures that share this earth with us, the writer can recommend nothing more interesting than the interpretation of the lives of some of our commonest shore crabs. We are too wont to pass over unnoticed these fascinating creatures, and the regularity of their occurrence on every occasion we visit the coastal resorts has earned for them an undeserved contempt.

### THE SEMAPHORE CRAB.

On the mud flats and among the mangroves of the numerous river estuaries of the N.S. Wales' coast is to be found the Semaphore Crab (*Heloecius cordiformis*). When the tide recedes and leaves the mud bare, this quaint decapod comes to the mouth of its burrow to feed, make love, and otherwise fulfil the duties of its humble station. The process of digging is characteristically sedate. With the aid of the limbs on one side the crab gathers up a comparatively large clot of mud and bears it gingerly to the mouth of the partly formed burrow. Here a strong hold is taken on the edge by the disengaged legs and the cumbersome burden is gently drawn over the brink.

A moment's rest is indulged in before the clot is actively rolled to a safe distance a few inches from the burrow mouth. The last action is usually performed by passing the now compact mud across the front of the body to be grappled by the

limbs of the other side, and rolled and pushed along as the crab progresses with its peculiar sideways gait. Having disposed of one clot of mud the crab leisurely returns to repeat the performance, and the same regular actions continue uninterruptedly until the burrow is formed to its owner's satisfaction. Only a restricted period is available to the crab for feeding before the flow of the tide, and it now indulges wholeheartedly in these "fruits of its labours!"

Moving timidly about on the tips of its walking limbs, but always within easy reach of its safe retreat, it selects an area on which to squat, and then alternately reaches forward to scrape the delicate fingers of one nipper limb and then the other along the surface of the mud. In this manner is gathered up the microscopic provender



A typical mangrove swamp. In a quiet backwater such as this the Semaphore Crab, *Heloecius cordiformis*, finds sanctuary in the mud amongst the pneumatophores or breathing roots of the mangroves.

[Photo.—A. Musgrave.]

(animalculae and plant life) lately deposited by the tide. The food is passed to the mouth by the same regular movements, where it is





The Semaphore Crab feeding as it squats on its "haunches," with upraised eyes alertly guarding against any chance approach of its enemies.

[Photo.—M. Ward.]

cunningly manipulated by the intricately arranged five pairs of jaws and so prepared for assimilation.

Adorning the cupped finger tips of the crab are numbers of fine hairs, which have a sensory quality and make the discovery of food possible without recourse to sight. These functional hairs also occur on other parts of the limbs and body, and are common to all crabs.

The eyes themselves are on the end of long stalks, which are invariably held restlessly upraised, accentuating the tense expression of their owner, whose instinctive fear warns it of possible attack from predatory wading birds or other natural foes.

At intervals during feeding the male is noticed indulging in a peculiar gesture of the nippers, which may be likened to a beckoning or signalling motion, and has prompted the application of the vernacular name of Semaphore Crab. Suddenly raising itself from the mud, the creature throws its nippers to their full extent above the carapace and immediately lowers them again as it settles once more on its "haunches." This jerky flashlike movement may be repeated several times in quick succession, and is evidently directed towards near-by females. This sex is distinguishable by the comparatively smaller development of the nipper limbs, and, as no female crab is seen in company with a male during burrowing, it is assumed that the above quaint action of the male is an amorous salutation inviting the female to share its burrow.

#### FIDDLER CRABS.

It is interesting to note that the calling gesture of *Heloecius cordiformis* is also used by the other mud and sand flat crabs of the family Ocypodidae. As an example we have the Fiddler Crab (*Uca*), which occurs plentifully along the coast of Queensland and ranges a little southward of the northern border of New South Wales. The Fiddler may be said to usurp the domain of the Semaphore Crab as that species dwindles a little way northward of New South Wales. The male fiddler crab has one nipper enormously enlarged. It is often larger than the rest of the body and has been likened, with its movements, to the bow of the violin and similar musical instruments. The female crab has diminutive nippers equal in proportion to the undeveloped nipper of the male. These delicate appendages not only form a strong contrast between the sexes, but appear so feeble that they seem quite inadequate for their purpose. The enlarged male nipper is brilliant in varying hues of red and orange, which often vie in lustre with the sheen of the carapace; this is commonly iridescent, with often a mixture of "shot" green and purple colouring rippling over its surface in lighter or denser shades. Again, the carapace may be mottled with blue or grey on a brownish or black ground, while in some cases a general drab colouring of the body is encountered, and a species is rendered conspicuous only by its whitish, greatly enlarged cheliped. Charles Darwin notes in his *Descent of Man* that in some Brazilian *Ucas* the males are



The Fiddler Crab, *Uca marionis*, the "flower" of the Queensland mud flats. A male individual, disturbed from its feeding by the cameraman, and "caught" as it warily sidles away with gaping nipper and upraised eyestalks.

Photo.—M. Ward.





A small section of a mud flat colony of Fiddler Crabs, showing males and females near their burrows. The males stand defiant with greatly enlarged nipper upraised, while the more timid females scuttle for their burrows.

[Photo.—M. Ward.]

highly coloured and that these colours change in a short space of time.

So brilliant are the animals, that a mud bank covered with the moving crabs is transformed from an unsightly odorous mire into a bed of creeping flowers. They usually keep within boundaries to such an extent that we come upon a patch of yellow-nippered *Ucas*, then, a little further on, larger ones with red and yellow nippers, so that one can imagine the whole bank as having been laid out by some very artistic landscape gardener.

Like *Heloecius cordiformis*, the *Ucas* are burrowers, their numerous excavations riddling the banks on which they live, and many are the bloodless battles one sees over the ownership of these necessary hiding places. Two stalwart males face each other over the mouth of the disputed domicile, their very pose a threat. Then with cat-like tread they advance to attack, waving their great nippers in the familiar calling gesture. The last inch is covered in a lightning leap, and the great nippers are locked like the antlers of fighting stags; now the antagonists are truly pitted, and, with frothing mouth parts, they strain against each other. At last one becomes tired and retreats, followed by the victor, whose brilliant nipper waves a further challenge after the vanquished.

The burrows of *Uca* differ from those of *Heloecius* in the diameter of the interior.

Both types are almost vertical, but in the case of *Uca* we find the small entrance, down which the crab can just squeeze, widening out an inch or so to allow the large nipper to come into play. The advantage of this to a besieged occupant can be readily appreciated by those who try to dig out specimens. No doubt a crustacean trespasser would receive even greater punishment from below as it entered the narrow entrance. The burrows run down two feet or more, so that even at the lowest tide there are a few inches of water in them. However, the crabs are not wholly dependent upon total submergence for their supply of oxygen. If we examine a specimen of any of the several genera comprising the family Ocypodidae we find a small aperture on each side of the sternal surface between the second and third walking legs. These act as a means of respiration during the time that the crab rests on the exposed mud. Crabs in general obtain the necessary amount of oxygen to sustain life by inhaling water through apertures at the base of the nippers. The liquid passes through chambers on both sides of the body which contain the gills, plume-like fleshy appendages attached to the muscles of the limbs and mouth parts. These absorb the oxygen and the water flows out through paired exhalant apertures. Of course, to use this system the animal must be sufficiently submerged to cover the apertures, so that we can readily understand the ad-



vantage gained by the sternal respiratory system. The feeding crab settles the sternum well into the soft mud as it stolidly gathers its sustenance from the surface, and, by taking in water, which is strained by the stiff bristles surrounding the apertures, remains upon the exposed surface, out of its element, with ease. It is very seldom that one observes cannibalism amongst the *Ucas*, but some of the other crabs have been seen carrying off small struggling Fiddlers.

The reader must not think that these two types of crabs are the only decapod inhabitants of our mud flats, for, we have in addition to these, more inconspicuous species of the genus *Macrophthalmus*. As the name implies, these crabs have long eye-stalks which enable them to lie half buried in the surface silt and yet be cognizant of the doings of enemies.

The Semaphore and Fiddler Crabs are the aristocrats of the mangroves, and the members of the genus *Macrophthalmus* might be termed the Cinderellas, not only because of their modest habit of lying quietly hidden but also because of the unostentatious arrangement of their burrow entrances, so placed in the shallow valleys of the flats covered by a few inches of water that the most expert at times passes them by.

Unfortunately there is no vernacular name for this paragon of modesty. Two species inhabit the estuaries of Port Jackson. These do not move about the surface as much as *Heloeccius cordiformis*, but form shallow runways or trenches leading to the burrows, and spend much of their time seated in these slowly feeding, with eyes erected on the lookout for possible enemies.

#### SAND CRABS.

The above crabs, living as they do an amphibious life upon the mud flat, form an interesting transitional stage from the marine to the terrestrial. A further step shoreward is found in the related genus *Ocypoda* members of which are found living upon the ocean beaches and the adjoining sand dunes. These wastes are not ideal localities for weaklings, the lack of shelter and the activities of sharp-eyed sea birds and waders keeping the crustacean denizens continually on the *qui vive*. The permanent burrows of these crabs are to be found at some distance



A male Sand or Swift Crab, *Ocypoda ceratophthalma*, viewed from the front as it rests during the task of excavating a burrow. The greatly elongated stylets of the eyes are characteristic of mature individuals of the sex.

[Photo.—M. Ward.]

from the sea and are common on the less frequented beaches near Sydney, though I was surprised to find young individuals on the beach at Nielsen Park just lately. The excavation of these burrows is usually performed during the evening or early morning, the rest of the day being spent at the mouth of the burrow or out of sight within the lair, to which fastness the crab retreats at the slightest sign of danger.

That birds form the main enemies of the Sand Crab is very evident by its conduct, for although gifted with remarkable eyes, it does not recognise a stationary human, no matter how close. On the other hand a wind blown piece of paper sends it helter-skelter down the burrow. So limited is the range of vision that one is able, with careful stalking, to get within a few inches of the burrow mouth and observe the whole method of excavation.

Nothing is more pleasant than to lie in the sun close to a burrow, the glorious rollers of the mighty Pacific playing their age-old music on the strand close by, birds calling in the eucalypts back of the dunes, and white fleecy clouds sailing over a perfect blue sky, all lulling one and bringing contentment. However, when observing the habits of even crabs one cannot allow nature's symphony to interfere. And so we turn once more to our little *Ocypoda*, who, while the human observer has been transported to other realms of fancy, has been busily engaged with the improvement of its retreat.

The first time a crab comes out into the light of day, and into the presence of the observer who is doing his best to impersonate the Sphinx, it pauses, body raised on the very tips of the walking legs; the eyes stand erect



and appear to be about to jump off the animal with surprise. For some time it remains stationary, and, as the strange mountain does not move, the eyes lose their strained expression and the crab runs a few inches to cast the pellet of sand it has been carrying with its larger nipper and the first walking leg. The carrying of a pellet of loose dry sand is really a remarkable feat of compression and this is brought home to one when a similar attempt is made with thumb and first finger. The excavated pellets are cast so as to form a fan-shaped mound with its apex some inches from the mouth of the burrow. This ensures the worker against the action of the wind, which, if the sand were left too near the edge, would blow it down the burrow and so spoil the work of the crab. During the tedious operation of house building grains of sand become stuck to the eyes, and at such times the eye is laid back into the socket and the palp of the maxillipeds, a small finger-like extension which assists in the assimilation of food, carefully removes the obstruction with an action reminiscent of a cat "licking its chops."

Apart from the actual carrying out of the pellets the finishing off or smoothing of the walls presents a most interesting case of animal ingenuity. From our own childhood experiences of digging in the soft sand, we are aware of the unstable nature of the element, so it is with wonder that we look upon a small crab, which by diligence and patience, builds a tunnel at least three feet in length, and compresses its walls so that they remain firm. This is achieved by the larger nipper and the convex back of the body.

After the burrow has been sunk to the desired depth the crab returns to the mouth, and, with half its body hidden in the tunnel, it commences a careful patting or pressing of the wall directly in front with the large nipper. The action is from as far above the back as the animal can reach to below, and, although the area covered is only half the circumference of the burrow, quite a long time is taken in the task. Then, one side having been done, the crab screws itself round and does the other wall. When one section is finished the crab goes a little further down the burrow and commences again, and so section by section the wall is pressed and smoothed.

During the day, then, the Ocypods are in the dry sand, but in the evening they leave their retreats and are to be seen entering the surf or running about on the wet intertidal sand. A certain amount of food is taken from the wet sand, which is sieved through the mouth parts, microscopic animalcules being obtained in this manner. However, the crab plays no mean part in the cleaning of the beaches; its scavenging propensities lead it to a preference for dead fish, and other unfortunates whose bodies are left to decay on the more tropical sections, such as the islands of the Barrier Reef. Upon these islands the turtles afford the crustaceans a great delicacy. As you have read in a previous issue of the MAGAZINE,\* the turtle lays its eggs in the sand, where they incubate, and the crab burrows for these and feasts upon them with avidity.

One of the first enemies that the newly-hatched turtles must meet are these crustaceans, a large one of which would prove more than a match for the harassed chelonian.

The signalling gesture characteristic of its mud flat relatives is used at times, but not as frequently, and two bellicose males do not seem to get beyond the challenging stage of their combats. At times they get close enough to strike each other a few sharp blows with the chelae, but we do not see the interlocking of nippers as in *Uca*.

The large species, *Ocypoda ceratophthalma*, is provided with a sound-producing organ, consisting of a ridge of tubercles lying in an almost vertical plane on the internal surface of the hand, and a small opposed ridge on the base of the same limb; when these are rubbed together a grating sound is produced by this typical stridulating organ of higher crustaceans. Whether its use is a vindictive or amatory gesture is hard to say. Alcock of the Indian Museum found that by forcing one crab to enter another's burrow, he caused the occupant to give vent to its annoyance in loud grating, which probably was the very polite request that the intruder take itself hence as soon as possible.

The sense of proprietorship exists very strongly even under imminent peril; the pur-

\* Musgrave and Whitley—"From Sea to Soup," *The Australian Museum Magazine*, ii, 1926, p. 331.



sued crab will dodge and run until its own burrow is reached, or, if driven down a neighbour's refuge, it soon reappears with the indignant owner in full pursuit.

Reproduction takes place after the manner of other crabs, but the finding of a female "in berry" is a most uncommon achievement on our beaches; in fact, the only specimen I have taken with eggs is *Ocypoda urvillei*, a species inhabiting Lady Musgrave Island,

Bunker Group, off the coast of Queensland, which was collected during a recent visit to the locality.

In concluding this brief account of the everyday life of these interesting shore animals it is hoped that in future visitors to our mangroves and beaches will look with interest upon the tiny lives around them, and by careful observation learn more of the workings of Nature's labourers.

## The late John Hopson: An Appreciation.

BY ANTHONY MUSGRAVE.

THE sudden death of Mr. John Hopson, of Dalkeith, Ecclestone, New South Wales, renders entomology the poorer and robs naturalists of a staunch friend.

His name has come to be linked with that bleak region of mist and snow-gum, the now-famous Barrington Tops, for no scientific expedition to that interesting region has considered itself complete without him as guide. His farm in the Allyn River Valley provided the jumping-off point for many visitors to the Tops, and the sight of his familiar figure riding up the steep ascent to the Tops and leading his pack-horses, inspired in one a sense of security.

Members of the Australian Museum staff have been privileged to have him with them on four occasions. In December 1915 the late Chas. Hedley and the writer were members of an expedition to the Barrington Tops organised by the West Maitland Natural History and Historical Society, and led by Mr. W. J. Enright of that town. Mr. Hopson, or "Johnny" Hopson as he has come to be known to his associates, was one of the guides on that occasion, and we soon came to know and appreciate his skill as a bushman, and his quiet efficiency in every emergency. It was this expedition, which included among its personnel the well-known entomologists Messrs. H. J. Carter and T. G. Sloane, that led him to take an active interest in entomology. He set about forming a collection of insects of his district, and he soon became well known to entomologists in Australia by enriching their collections with many rare and new species garnered from the Fagus brushes of the Tops or the scrubs of the Allyn Valley. To testify to his success as a collector several species of insects carry as their specific name that of Hopson, and among

them may be mentioned *Cardiothorax hopsoni* Carter (1925), from the Barrington Tops, *Noto-nomus hopsoni* Sloane (1923) from Ecclestone, and *Hesperilla crypsargyra* subsp. *hopsoni* Waterhouse (1927), from Barrington Tops. His own collection, which he has generously bequeathed to the Australian Museum, contains many species determined by specialists of the various orders of insects, and includes many interesting and rare forms.

The expedition of the University of Sydney to Barrington Tops which was led by the late Prof. L. Harrison, considered itself fortunate in having him as "guide, philosopher and friend," for, when the stores and food-supplies became low, he made trips down the steep mountain side to his home. The members of that party were loud in their praise of his untiring and unselfish efforts on their behalf. Mr. T. G. Campbell of the Museum staff was a member of that expedition and has vivid recollections of Mr. Hopson's foraging exploits. The members of the Royal Australasian Ornithologist's Union camp-out on the Williams River at the foot of Barrington Tops, were delighted to have with them one who had been so prominently associated with the Barrington Tops and its natural history.

Mr. Hopson was a member of the Linnean Society of New South Wales, which he joined in 1918, and a life associate member of the Royal Zoological Society of New South Wales.

Visitors to the Barrington Tops from the Dungog side will miss his services as a guide, and above all his quiet but bright personality, which endeared him to all who knew him. He leaves a son and daughter to mourn his loss.



## Feathers and Fins.

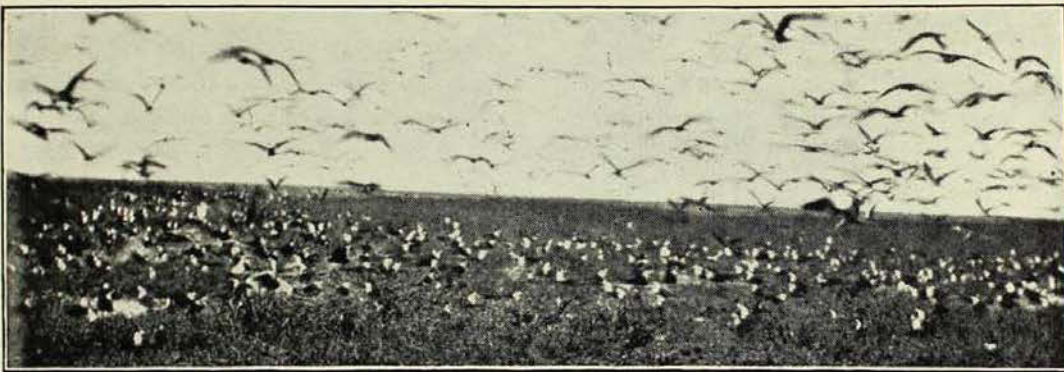
THE BIRDS AND FISHES OF MICHAELMAS CAY, GREAT BARRIER REEF, QUEENSLAND.

BY TOM IREDALE AND GILBERT P. WHITLEY.

THE fauna of an oceanic islet naturally divides into two, and only two, prominent groups, the feathered and the finny forms; one, the lords of the land-

in size as we approached. This soon resolved itself into a medley of soaring particles which seemed endlessly in action, never tiring nor decreasing.

Soon, however, the atoms of bird life which constituted this scene gave place one to another; as their journey ended, birds would settle down to attend to the wants of their vociferous young while others rose to forage anew.



Wideawakes (*Onychoprion fuscatus*). Unceasing vigil day and night they kept.  
[Photo.—Tom Iredale.]

let, and the others the kings of the sea. While the feathered creatures patrol the waves in search of their finny prey, the larger natives of the sea also engage themselves in pursuit of their smaller relatives.

### WIDEAWAKES AND NODDIES.

Upon landing, we discovered that the avian population was composed of two diverse elements: one, the active black and

### THE FEATHERED FOLK.

"You will recognise the location of the islet by an apparent cloud of smoke on the horizon." Such was the advice given us as the launch bumped its way across the intervening sea, but before we had determined the exact site we noted strange dark coloured birds flitting along near the surface of the water. These at first recalled the Mutton Birds of the south, but their more ragged, quicker flight, and pale coloured head-caps distinguished them as Noddies. Almost immediately we picked out a cloud no bigger than a man's hand, but developing



White-capped Noddies (*Megalopterus minutus*). In possession of their former nesting sites, although the machinery had been placed thereon.

[Photo.—Tom Iredale.]



white Wideawakes; the other, the dull-coloured and sluggish Noddies. Though grouped together by scientific folk, these might have been avian prototypes of the "somewhat different" comedians oftentimes seen on the vaudeville stage. In nearly every detail they showed notable contrast: flight, possibly food habits, young, general customs, speech. Whereas the one was ever in motion, the other sat motionless for a length of time; while the restless one strayed hither and thither even on the ground, the sedate species stolidly stuck to its selected site and, when that was usurped by stacked timber, perched upon the wood covering the original spot. The young were similarly mannered: scarce out of the egg, the baby Wideawake, a little speckled fairy, scuttled to a hiding place, crouching low neath the shelter of a few blades of grass; its sombre cousin nearby moved not, nor did it attempt to conceal itself, defying fate with unruffled indifference. The Wideawakes seemed to feed their young day and night every few hours, whereas the Noddies appeared to give their infants one good solid meal in the morning and another in the evening. Whereas the Wideawakes were so noisy all the time and even after dark that they deservedly merited their name, the Noddies sat mutely or rarely uttered a sound: the young Wideawakes called loudly, while the young Noddies generally squeaked.

In the early morning, it was a delightful sight to see the birds returning from their food forage. Seaward a small object might be discerned which quickly developed into a miniature aeroplane travelling at a bewildering pace, and a Wideawake would flash by, to settle directly at the side of its young one as gently as a zephyr-blown leaf. A Noddy would also appear, but more slowly and clumsily in comparison with its elegant friend, and would circle round to land. Again, without appreciable effort, the Wideawake would glide upwards into the same perfect flight, while the Noddy rose with noticeable labour, and consequently carefully selected a site from which to launch itself aloft.

Even to the eggs the differences persisted, those of the Wideawakes being boldly marked, those of the Noddies dull cream with insignificant blotching.

#### HABITS.

As suggesting the mode of evolution of habits, those noted in connection with the Noddy may be cited. As above stated, this bird would not desert its chosen site, even when timber was placed thereon, and it may be due to this curious intensity of purpose as regards this nesting site that the habit of nesting in trees has developed; with this habit of course was correlated the necessity for motionlessness on the part of the newly hatched young, as, if it had continued the restlessness natural to its relatives, it would never have survived.

#### THE SIGN OF THE CROSS.

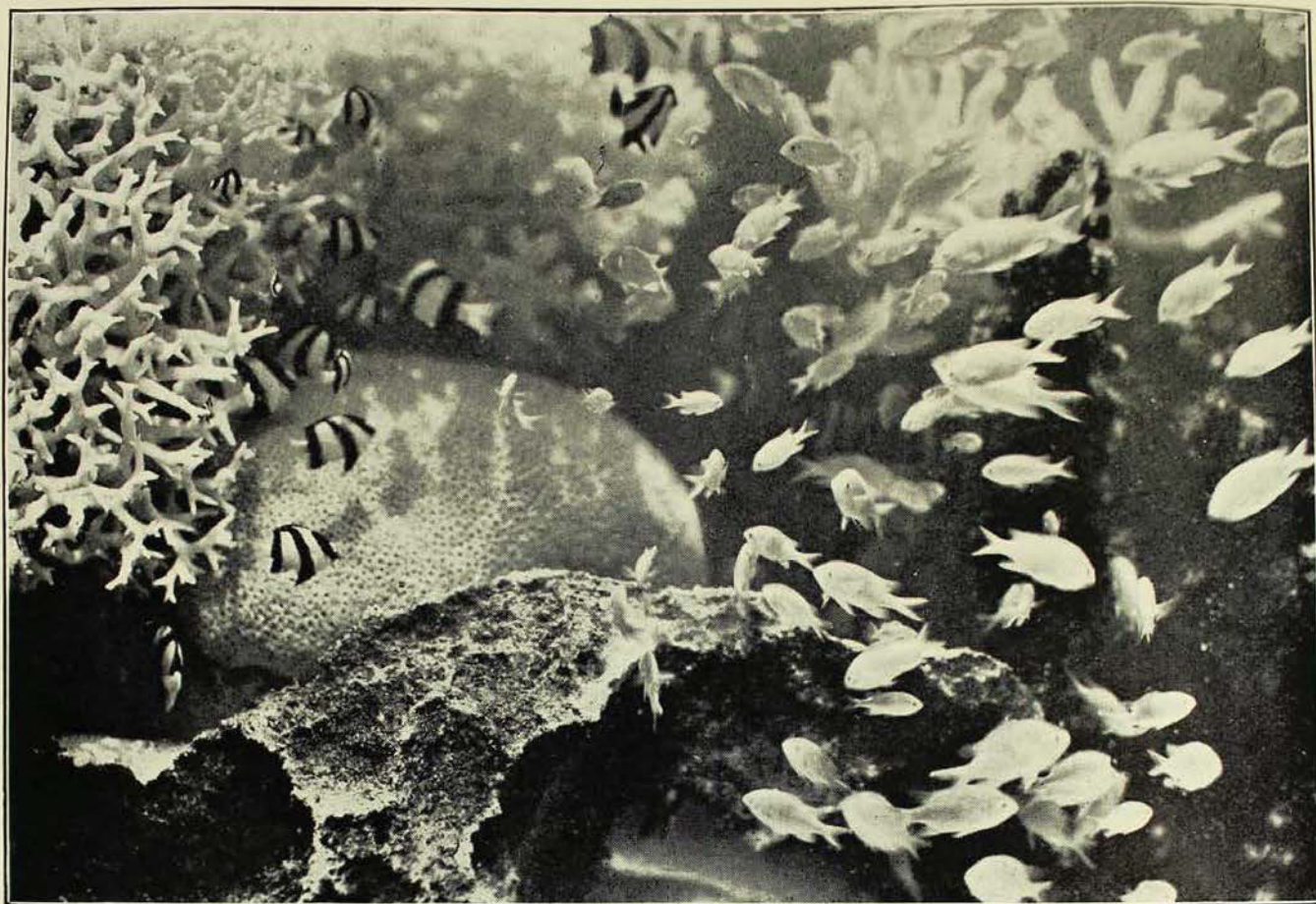
One of the most interesting visitors was the Frigate Bird, which generally arrived above the islet about dusk. Poised motionless, like the Sign of the Cross against the azure sky, the figure became suddenly transformed into that of the Avenging Angel, as, closing its wings, it dropped in murderous attack upon some unsuspecting cousin, returning, laden with spoil, to its clamouring offspring. To save itself from the anger of its aggressor, the defenceless victim would offer its harvest, which was thanklessly accepted.

#### THE FINNY FOLK.

Far from the noise and congestion of city life, we were better able to appreciate the charms of sea and sky as we lived and worked on our little island. To the accompaniment of a muffled booming of surf over the Outer Barrier, the sun arose in a cloudless sky and signalled to our tiny colony the beginning of another day. A swim in the lagoon practically completed our toilet and we embarked without delay upon the duties of the day. Walking round the islet, as one promenades the deck of a ship, we found many curious and interesting specimens, each round seeming to be rewarded by some new object. In this way we obtained thousands of tiny shells, cuttlefish "bones," botanical specimens, and fishes and other marine animals which had been washed up from time to time, frequently making quite an interesting collection before breakfast.

Through the heat of the day, when distant islets appeared by mirage as if sus-





The little blue and white striped fishes (*Tetradrachmum aruanum*) prefer for shelter the pinkish coral on the left, leaving to their more venturesome greenish cousins on the right (*Chromis lepisurus*) the larger stocks of coral which grow in deeper waters.

(This submarine picture was obtained at Port Moresby, Papua by Captain Frank Hurley).

[Copyright.

pendent in air just above the sea, we worked from shore or boat, and waded amongst the coral reefs when tides permitted.

Where the wavelets lapped the sand, many small greyish fishes swam gracefully in search of food and flocked to a given spot in a few seconds if a tit-bit to their liking were dropped into the water. These were Darts (*Trachinotus*) and it was interesting to watch their agility, as, swimming quickly through the shallowest parts, they barely escaped being washed ashore. Darts were once common in the surf near Sydney, but bathers and other disturbing influences have caused them to forsake these haunts.

No sharks of large size were seen at Michaelmas Cay, but a small species with black-tipped fins and some Ocellated Cat Sharks were commonly observed a few yards from shore and, like the Darts, probably acted as scavengers. Aborigines who visited us said that man-eating sharks did not come to Michaelmas Cay, a piece of in-

formation which was much appreciated when we went swimming.

#### CORAL FISHES.

An effective way of obtaining small fishes, crabs, molluscs, and other bizarre creatures is to remove large masses of coral from the water and put them in a boat. These animals then drop from the nooks and crannies in which they have been hiding and are easily secured by hand. It is sometimes possible to predict the sorts of fishes which will be found in various kinds of coral. Wading in shallow water, a collector espies a modest coral flushing rose among the brilliant colours of its surroundings. Picking up the colony, he is surprised to see, clinging by their spiny fins to the dainty coral fingers, little fishes, gaily striped with dark blue and white in bold contrast. How easily caught are these dainty Demoiselles, removed from the water in their coral shelter, so reluctant to leave the fairy grotto which has always been their home!



A Staghorn Coral nearby, its lemon-tipped branches boldly spread in proud display, sheltered an olive-greenish little fish, quaintly marked with silvery streaks and with a saddle-shaped blotch near its tail; it was not found amongst any other kind of coral at Michaelmas Cay. May it not be that, in the course of countless ages, certain fishes have come to select certain types of corals as their favourite hiding-places and have arranged partnerships with them which have survived to the present time? Mr. Melbourne Ward has independently observed the same phenomenon in the crabs of the Great Barrier Reef, so that an interesting line of investigation is opened up which should prove an attractive branch of marine ecology.

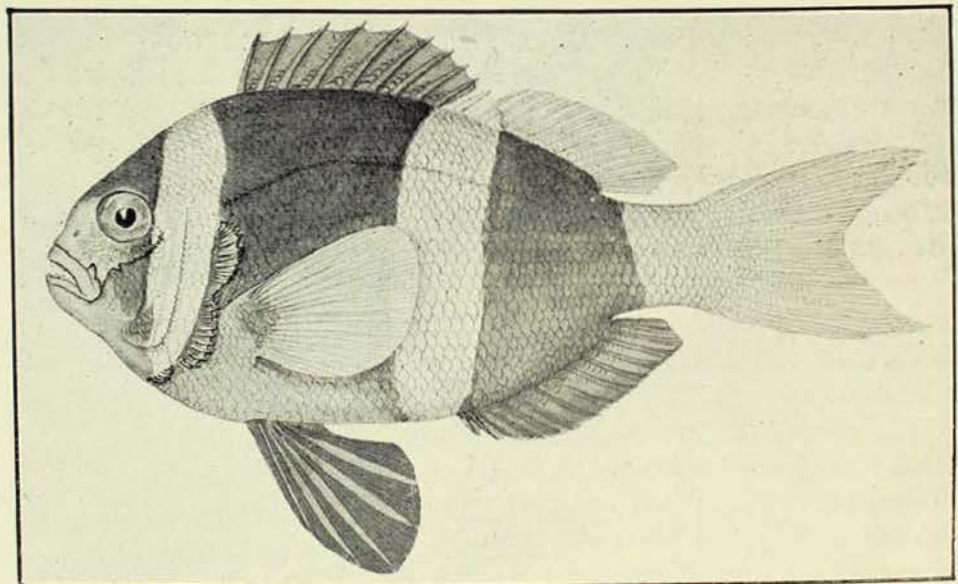
Clad in a suit striped with scarlet and white, the little Anemone Fishes are amongst the most conspicuous of the animals of a coral reef when swimming, but, when frightened, they hide in the ample folds of the giant Sea Anemones which are found on coral reefs. Any tiny soft-skinned animal performing this rash act would be stung to death by the microscopic poison-darts in the anemone's beautiful tentacles, but our little

Anemone Fish is proof against any harm of this sort and, according to some observers, actually enters the mouth and stomach of the anemone when, at the time of high tide, it is fully expanded.

#### AFTER DARK.

At sundown, a curious phenomenon was observed as a dusky haze spread itself across the eastern horizon. This, our host, the late Charles Hedley, explained, was the shadow of the earth cast upon the tropic sky. Turning westward as the sun dipped below the mainland, we saw the mountains beyond Cairns dyed a gorgeous purple, dominated by the splendid immensity of Bellenden Ker.

Anticipations of night fishing, even without a boat, held attractive possibilities, so a collector with a net and another with a lamp waded in the sandy shallows intent on finny prey. Garfishes were commonly seen stretched along the surface like floating sticks, and as inert, until, when disturbed, they leapt into the air or cut their way through the water like knives. When a net was placed beneath one, it would jump and could then be caught "on the hop" before it re-entered the water. In this way were the needs of science and gastronomy served. The Darts, whose graceful forms had been so much admired during the daytime, were still active, the smaller ones frequenting the waves washing the shore, the larger ones, more difficult to catch,



**Anemone Fish (*Amphiprion papuensis*).** This species shelters in the large sea-anemones of Queensland and New Guinea. Drawn from the type, nearly natural size [G. P. Whitley, del.]

favouring deeper water. The grey form of a shark was outlined for a moment against a green wave-crest as it sped by, chasing some plump mullet which leapt madly as they strove to escape their pursuer.

In the rays of the lamplight, strange forms were seen in their watery world, and one almost felt transported from this earth to another planet. Under these conditions, human ideas concerning form and shape seemed phantom theories. Mark Twain, describing flying-fishes as he saw them, likened them to silver fruit-knives; fishes by night are shreds of mercury, streaks of grey, sparkling spots of luminescence, or shadows seeming to lack substance. Bream or parrot-fish, sardine or coral cod? In



their own element, they alone knew. Soundless distances deceived; bodies floated in suspense, rose or sank by their own volition, and seemingly defied all laws of gravity. Speed was not gained by laboured effort or quickened gait, but seemed more dependent upon piscine caprice than swish of tail or flick of fin.

A stingray slid along the bottom, gazed with stony eyes at the net which threatened it, and, in a flash, was gone. Coral fishes nonchalantly drifted by in the shallow water or quietly browsed at the bottom, but all

displayed amazing alacrity whenever disturbed.

Above were hundreds of seabirds, dimly discernible, their feathery wing-beats and mournful cries sounding very eerie in the dark. On the sands, some oecypode crabs were busy making their burrows or feeding; others, looking like little ghosts, regarded the curious fishermen with their stalked eyes uplifted in surprise, whilst many scurried in various directions like little scuds of foam blown swiftly by a bracing breeze.

And then, like Pepys, to bed.

## Review.

*Environment and Race: A Study of the Evolution, Migration, Settlement and Status of the Races of Man.* By GRIFFITH TAYLOR, D.Sc., B.E., B.A., F.R.G.S. (Oxford University Press, 1927). From Angus and Robertson Ltd. 26/-.

Professor Griffith Taylor, Head of the Department of Geography in the University of Sydney, even in his student days was distinguished for his bold and original ideas. This characteristic is apparent in his latest work, which is the outcome of studies extending over several years, the results of which have appeared in part in various journals.

Professor Taylor accepts the principle that organic evolution has resulted largely from variation of environment, which has also been a prime factor in controlling migration in animals and in man. Hence he devotes considerable attention to discussion of the changing environment in Quaternary time, which he regards as not only a determining factor in the more recent phases of human distribution, but also as affording a clue to the difficult problem of racial affinity.

Following Dr. W. D. Matthew, who regarded Asia as the main theatre of mammalian evolution, from which came successive waves or migrations as a result of climatic and other environmental changes, Professor Taylor applies and extends this theory to the particular case of Man. A consequence of this view is that the most primitive races are now found farthest away from the centre of evolution, and the author shows that the present distribution of human races favours this conclusion; he makes out a strong case

for the view that the folk now inhabiting Central Asia are a superior type in an anthropological sense.

To our readers the chapters dealing with Australia will no doubt be the most interesting parts of the work. The Tasmanians and Australian aborigines came from South-east Asia by way of the now submerged Sunda and Sahul Lands, crossing the intervening strip of ocean (which during the Great Ice Age was no wider than sixty miles) in canoes or rafts. The Tasmanians presumably crossed before the Australians, whose culture is of a higher type.

Part III. is devoted to a discussion of the settlement of Australia by the white race, and the author takes here a position which many have regarded as unduly pessimistic. Professor Taylor, however, supports his views in a telling manner by his analysis of the geographical and physical conditions, particularly the incidence of rainfall, which is the life blood of pastoral and agricultural industries. Professor Taylor claims that, judged by geographical standards, 42 per cent of Australia can be described as arid, and that no arid or tropical regions resembling our empty spaces have been settled by any noteworthy white population; he fails to see why Australians should be expected to settle them. Nevertheless he recognizes that we have a fine heritage in Australia, even though only about one half of the continent is suitable for successful white settlement.

This inspiring and scholarly work will, we feel sure, be widely read and discussed.

C.A.