

The AUSTRALIAN MUSEUM MAGAZINE

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



From Sea to Soup	<i>A. Musgrave, F.E.S. and G. P. Whitley</i>
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C. Anderson, M.A., D.Sc.

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THE AUSTRALIAN MUSEUM

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The Ravi, or Papuan club-house, exhibit. The ravi was described by the late Allan R. McCulloch, who conceived the idea of this exhibit, as being, in addition to a club house and fortress, a native museum and the stronghold of the village sorcerers.

In the foreground may be seen a warrior in gala attire. The skulls shown in the racks are those of former enemies, beneath are rows of strangely carved boards to drive away evil influences, and near them are skulls of pigs and crocodiles. In the centre are displayed masks used in ceremonies which have for their object the increase or maintenance of the food supply.

The scene represents two cubicles typical of the many comprising a ravi.

[Photo,—G. C. Clutton.



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VOL. II., No. 10.

APRIL-JUNE, 1926

Editorial.

IN this issue we have occasion to refer to the construction of a case to enclose the ravi exhibit, and to express our gratitude to certain public-spirited donors who subscribed to the cost. It is very gratifying to find that there are men in the community who are prepared to assist us monetarily in our work of serving the public, for this is not the first occasion on which we have been placed under obligation in this manner. The cost of obtaining the material for the three Lord Howe Island groups, which are amongst the most attractive exhibits, was largely defrayed by donations from the late Sir James Burns, Trustee, Sir Hugh Dixon, Mr. William Dixon, and Messrs. Orwell and A. E. Phillips. To Sir Hugh, Messrs. Robert and William Dixon, and to Mr. Anthony Hordern, we are also indebted for assistance which enabled us to secure valuable collections which otherwise would have been beyond our reach. To the munificence of our President, Mr. E. Wunderlich, F.R.A.S., we owe the three fine aboriginal figures which are now being prepared for exhibition.

With the example of these generous donors before us we look forward with confidence to the future, and hope to deserve and obtain similar support from wealthy and open-handed citizens.

Dr. G. Brown Goode, of the Smithsonian Institution, Washington, in his classic article, "The Principles of Museum Administration" concludes as follows:—"If it be possible to sum up in a single sentence the principles which have been discussed in the present paper, this sentence would be framed in the words: The degree of civilization to which any nation, city, or province has attained is best shown by the character of its public museums and the liberality with which they are maintained."

In Dr. Goode's own country, America, the citizens are exceedingly liberal in their support of museums and kindred institutions. As a rule American museums have as endowment large funds mainly subscribed by members of the public who are interested in the work of the museums and realise its importance. As an example we may take the case of the American Museum of Natural History, New York, which for the seventeen years 1908 to 1924 received as private gifts to endowment and to scientific work a sum approximating to £2,471,700, including £610,500 from the Trustees and £1,861,200 from members and friends. In the same period contributions and appropriations for all purposes reached the total of £3,893,260.

In our much less populous and less wealthy

country we do not hope for such splendid endowment, but we cannot help thinking that more adequate support, both by the Government and by the public, may be confidently expected.

There are several directions in which money, if available, could be spent by the Museum to good advantage. Many years ago the celebrated Wellington Caves were explored under the auspices of the Trustees and large collections of the fossil remains of marsupials and other animals were obtained. Unfortunately many of these were fragmentary and gave but a glimpse of the structure and dimensions of these interesting extinct animals, and hopes have been entertained that more complete specimens may yet be found, which will enable us to make reconstructions of these dead and gone inhabitants of Australia. There are still many fossil bones in the Wellington Caves, which are now being opened up, and, with more modern methods and appliances, better results in collecting and preserving these relics of ages past might easily be obtained.

At the meeting of the Board of Trustees held on Friday, 5th February, Mr. Ernest Wunderlich, F.R.A.S., newly elected President for 1926, took the opportunity of expressing his thanks to the Trustees for having in his absence elected him to the chair. This he considered a great honour. Mr. Wunderlich recognised the high qualifications of his predecessor in the office, Dr. T. Storie Dixon, who had done so much for the Museum during his many years as President and who had wished to retire. He would strive to emulate Dr. Storie Dixon and would ask his colleagues to be indulgent.

Speaking of the term of office before him Mr. Wunderlich said he would devote as much time as he could spare to the affairs of the institution. In his travels he had visited many museums and had found that they indulged in extensive propaganda particularly in the form of lectures, post cards, and leaflets. If, said Mr. Wunderlich, a museum is to receive public support, it must show that it is a live institution.

Dr. Storie Dixon congratulated the Board on having Mr. Wunderlich as President. He was an active business man, and an institution such as the Australian Museum required sound business men to control its

Another repository of fossil vertebrates is Cuddie Springs, near Brewarrina, an extensive swamp, where several well preserved specimens have already been found, although the deposit, which is believed to be rich, is scarcely touched; the Trustees contemplate testing the ground in the near future.

Exploration of fossil deposits is an arduous and expensive operation, but if it be done at all it must be done well. The Trustees would be very glad indeed to associate the name of the donor with a fund established for the purpose of developing such deposits.

Apart from scientific exploratory work there is that of research which is related to it. The ample provision of funds for such duties and for the publication of results upon completion, would be an inestimable blessing to research students and the nation.

May we not, then, express the fervent wish that someone will arise from our midst and grant us such an endowment as will permit of investigations being undertaken in a manner worthy of their importance?

finances. On behalf of the Board of Trustees he had the greatest pleasure in welcoming Mr. Wunderlich on his return from abroad.

Amongst recent additions to our collections special mention must be made of the fine busts of the Trinil Ape-Man (*Pithecanthropus erectus*), Neanderthal Man, and the Crô-Magnon Man. These are the work of Professor J. H. McGregor, of the American Museum of Natural History, from which institution they were acquired by exchange.

During the visits of H.I.J.M.S. *Iwate* and the mercantile training ship *Taisei Maru* it afforded the officers of this Museum considerable pleasure to conduct parties of the ships' companies through the galleries explaining to them different matters of interest. Our visitors were greatly interested in our fauna.

Captain Frank Hurley, the well-known explorer, and a leading exponent of camera art some time ago presented a series of beautiful enlargements illustrating various stages in the preparation of sago. These he took whilst in the Delta region of the Fly River, Papua. They have been placed on view on the case containing the ravi exhibit referred to elsewhere in this issue.

From Sea to Soup.

An Account of the Turtles of North-West Islet.

BY A. MUSGRAVE AND G. P. WHITLEY.

IN November, 1925, the authors were members of a party organised under the auspices of the Royal Zoological Society of New South Wales, which visited North-West Islet in the Capricorn Group, off the Queensland Coast. The island is about a mile long and about three miles in circumference, is well wooded, and is girt by a coral reef six miles in length and two in breadth. A fine sandy beach runs around the island, interrupted only at the northern and southern ends, where there are outcrops of coral-sand rock. Nineteen days were spent there in biological inves-



Looking towards the Turtle soup Canning Factory, North-West Islet at low tide. Among the bushes that fringe the beach the turtles dig their nests.

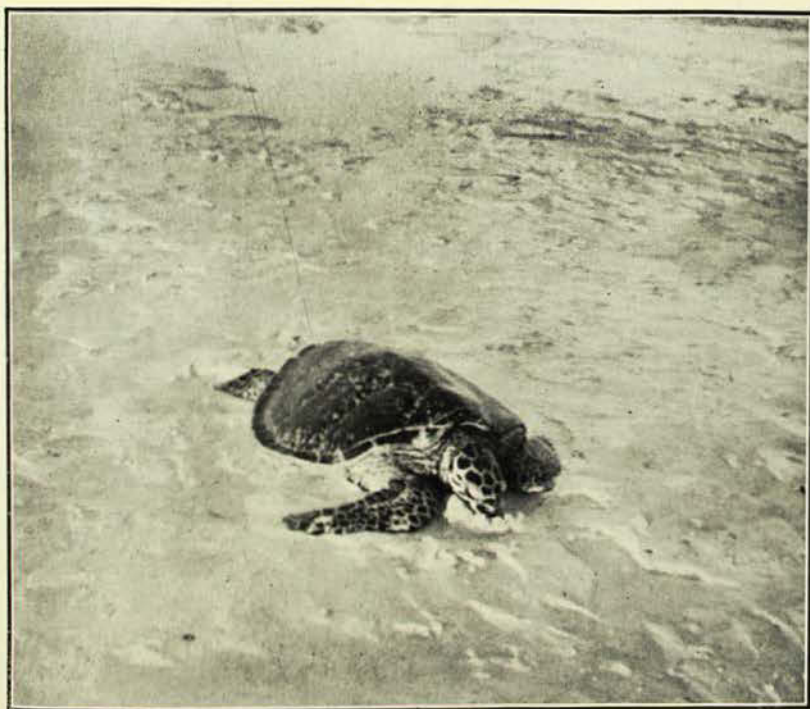
[Photo.—A. Musgrave.]

tigations, and the following notes on the turtles, based chiefly on personal observations, were made during our stay.

Three species of turtles were encountered on North-West Islet, the Loggerhead, *Thalassochelys caretta*, the Hawksbill or Shellback, *Chelone imbricata*, and the Green or Greenback, *Chelone mydas*. Of these the last named was by far the commonest.

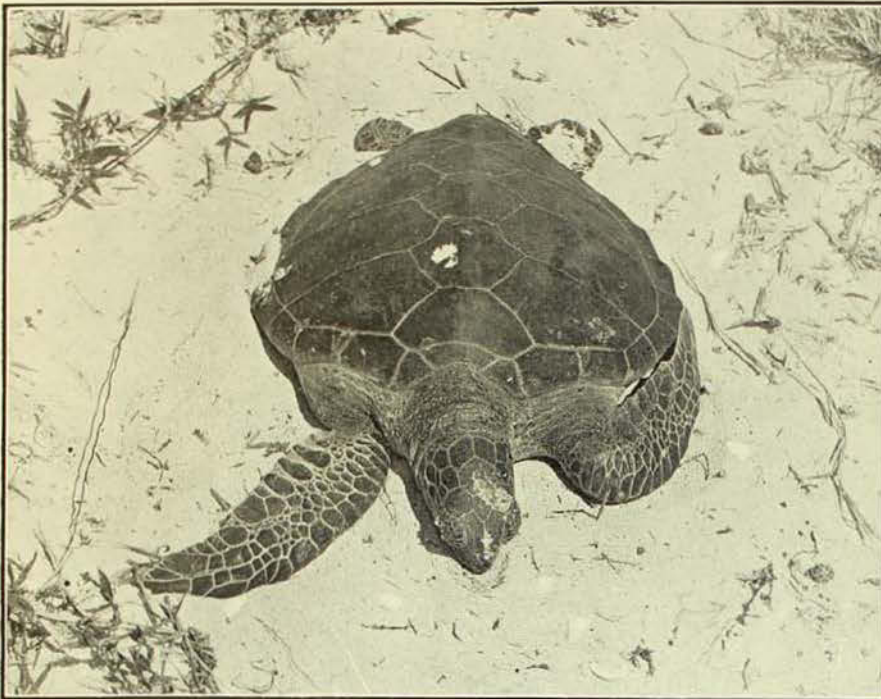
THE LOGGERHEAD TURTLE.

The Loggerhead is one of the largest of the turtles. It differs from the Greenback by having a much larger throat and head, which latter is provided with a strongly-hooked beak. Five or more pairs of costal shields are present in the carapace or dorsal shell. A few came ashore at North-West Islet and several skulls were found on Tryon



A Hawksbill Turtle or Shellback, speared by the turtle-hunters on the reef. This species produces the tortoise shell of commerce. Note the overlapping plates of the carapace.

[Photo.—Otho Webb.]



A young Green Turtle. In this species the plates which form the carapace are united at their edges and do not overlap. This is the soup-producing species.

[Photo.—A. Musgrave.

Islet. It is a carnivorous species.

THE HAWKSBILL TURTLE.

The Hawksbill, or Shellback, as the turtle-hunters call it, occurred on the coral reef surrounding the islet, and several were speared. On one occasion we saw one swimming in a coral pool near the edge of the reef; it travelled quickly through the water and, when turning, appeared as if revolving on a pivot. It resembles the Green Turtle in having four pairs of costal shields, but differs from it in having the shields imbricate or overlapping, hence its specific name, and in possessing a beak-like mouth from which it derives its vernacular name.

Its carapace is splashed with the rich brown, black, and yellow colours characteristic of the tortoise-shell of commerce, which is furnished by this species. It is carnivorous, too, in its diet. We saw none of this species ashore at North-West Islet.

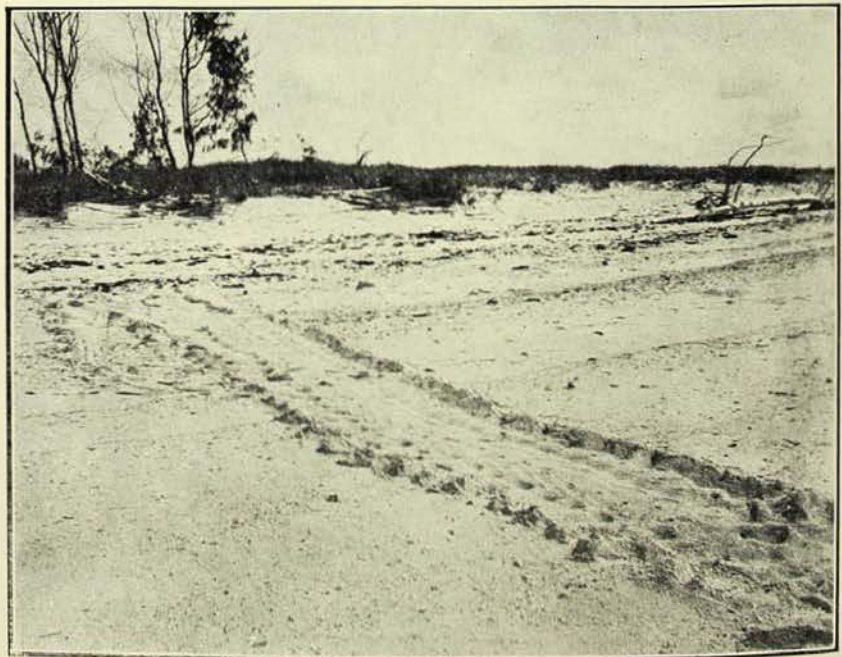
According to Surgeon-Lieut. W. E. J. Paradise, R.A.N., the Hawksbill lays small eggs not much larger than marbles on Thursday Island, and perhaps breeds southward as far as Low Island, Queensland.

THE GREEN TURTLE.

The Green Turtle, or Greenback, is the species which for ages past has supplied the world's banquets with turtle soup. It is a heavy creature, and weighs about three and a half hundredweights. One measured on the islet was four feet in length from the nose to the tip of its tail, and three feet four inches across the rounded carapace, while the ventral shell or plastron measured two feet six inches. The fore flipper was one foot eight and a half inches, and the hind flipper one foot three inches.

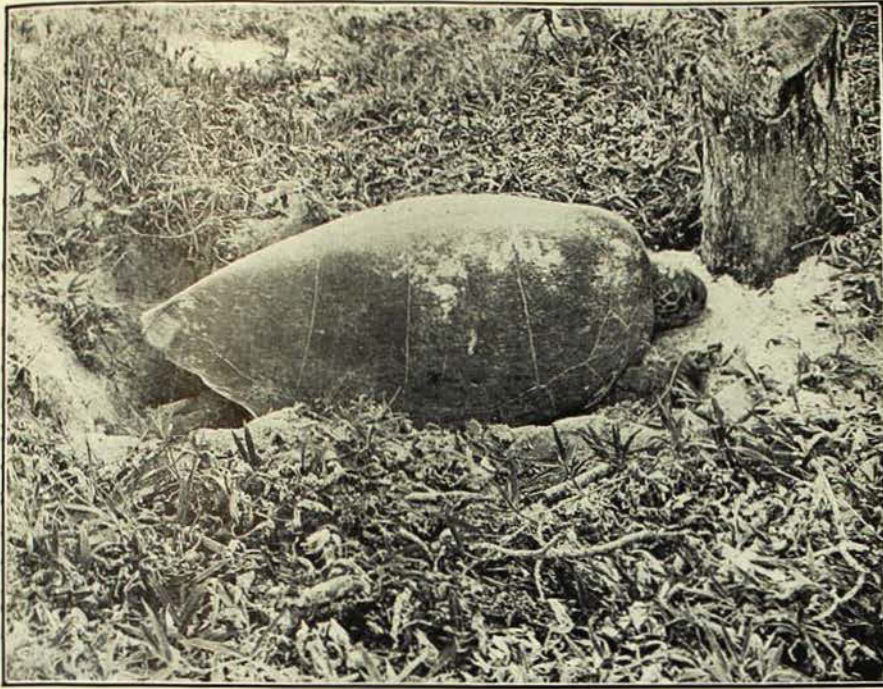
THE NEST.

At dusk the female Green Turtle swims



A turtle-track on Masthead Island, Capricorn Group.

[Photo.—A. R. McCulloch.



Green Turtle laying her eggs.

[Photo.—A. Musgrave.]

and brush it aside with a hand-like action, until eventually, a shaft about thirteen inches in depth, seven and a half across, and ten in length is prepared.

Sometimes she encounters the roots of the Beach Oak (*Casuarina equisetifolia*) which necessitate her altering the nest site. One turtle, which was disturbed while in the act of excavating her nest, made three attempts before finally settling down to lay her eggs in a depression only a few feet from the first and second holes.

The actual process of egg-laying was witnessed by two members of the

close to the beach, occasionally raising her head, either to breathe, or to see that no enemies are about. Suddenly she chooses a landing place and shuffles ponderously up the sloping sandy beach. As she jerks her heavy body forwards she leaves behind her a broad scalloped track; her sharp pointed tail as it descends with each movement, makes a little depression in the sand. On reaching the margin of the scrub, where the Beach Oaks and *Tournefortias* grow, she commences to excavate a large depression to accommodate her body before digging a pit for the reception of the eggs.

The front flippers first come into play, alternately scooping the sand back in showers, and then the hind flippers are used until a depression about five and a half feet long by four and a half feet wide, and deep enough to accommodate the body is excavated. A mucous fluid washes the sand from her eyes as she works. In making the egg pit the broad hind flippers dig vertically into the sand, and alternately scoop it out

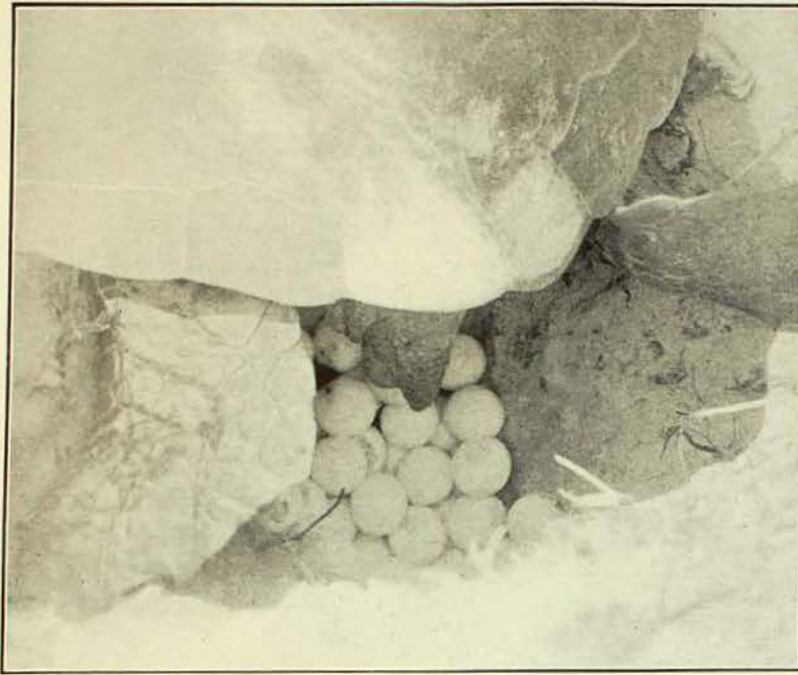
party, Miss Hilda Geissmann and Mr. C. Coles, and brief articles have been written by them for the Queensland papers. We give Miss Geissmann's account :*



Green Turtle laying her eggs. The ovipositor is shielded by means of the hind flippers.

[Photo.—Hilda Geissmann.]

**The Queenslander*, January 16th, 1926.



Green Turtle laying her eggs. The hind flippers are drawn aside to show the ovipositor and eggs.

[Photo.—Hilda Geissmann.]

"The egg chamber she excavated was eighteen inches across at the bottom, widening to about two feet at the top. After this was ready she folded her flippers over the hole and prepared to lay her eggs. This she did with great deliberation, dropping eggs, round and white, very like ping-pong balls in appearance. These fell at the rate of four or five a minute just at first, but gradually increased in speed. When she was finished she slowly covered the eggs with sand, shovelling it in with her hind flippers and patting it firm. Then she turned and used the front flippers, her great body scraping and pressing until all was to her satisfaction."

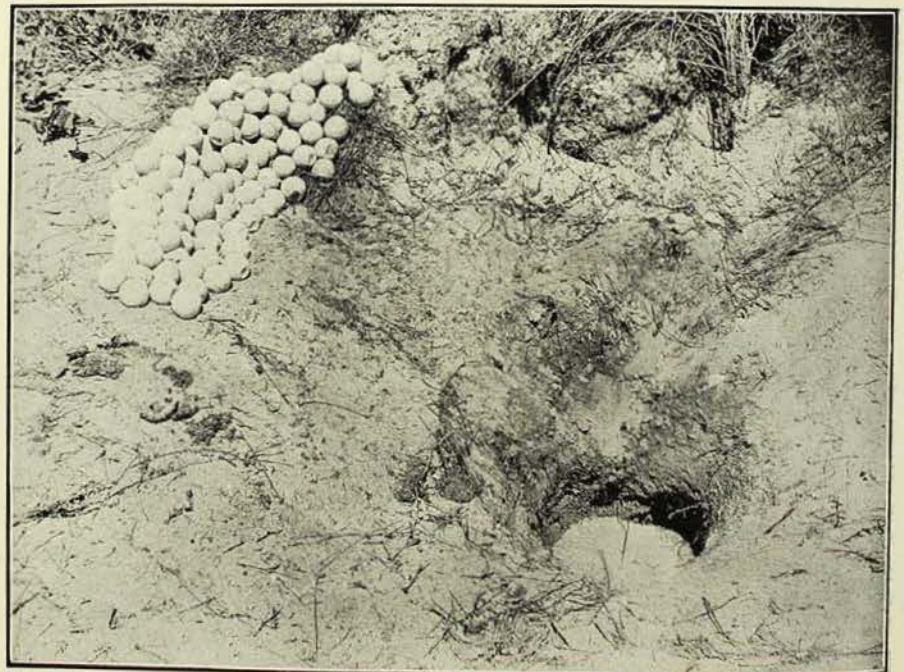
THE EGGS.

The number of eggs deposited in each pit varied somewhat. Thus Miss Geissmann removed from the nest upon which she made her observation 105 eggs, from another Mr. Coles counted 133, while a third yielded 153. Turtles'

eggs are said to be unpalatable as food; the white is always glairy and slimy even when boiled, and the yolk is said to taste gritty.

On the completion of oviposition the egg pit and the body depression are filled in, and the turtle makes for the sea once more. Her track down the beach somewhat resembles that made when coming up to lay, only that the tail now drags along the sand making a continuous furrow. The angle of the grooves made in the sand by the flippers as they lever the animal along, are the principal guides in telling whether the tracks lead to or from the shore. The turtle-hunters say that every female lays several times during a season, which lasts from about the end of November to January.

The turtle-hunters informed us that the eggs hatch in six weeks and the young on emerging are about twice the size of half a crown. Many lose their lives before entering the water, as they have to run the gauntlet of hungry gulls which patrol the beach, and in the water voracious fish



Egg-pit of Green Turtle and 153 eggs removed from it

[Photo.—A. Musgrave.]

await their coming. The ultimate destination of those which survive is unknown, and conjecture is impossible since the species is so widely distributed over the world. The age to which they attain is also unknown, though it is believed that they are extremely long-lived creatures.

TURTLE SOUP.

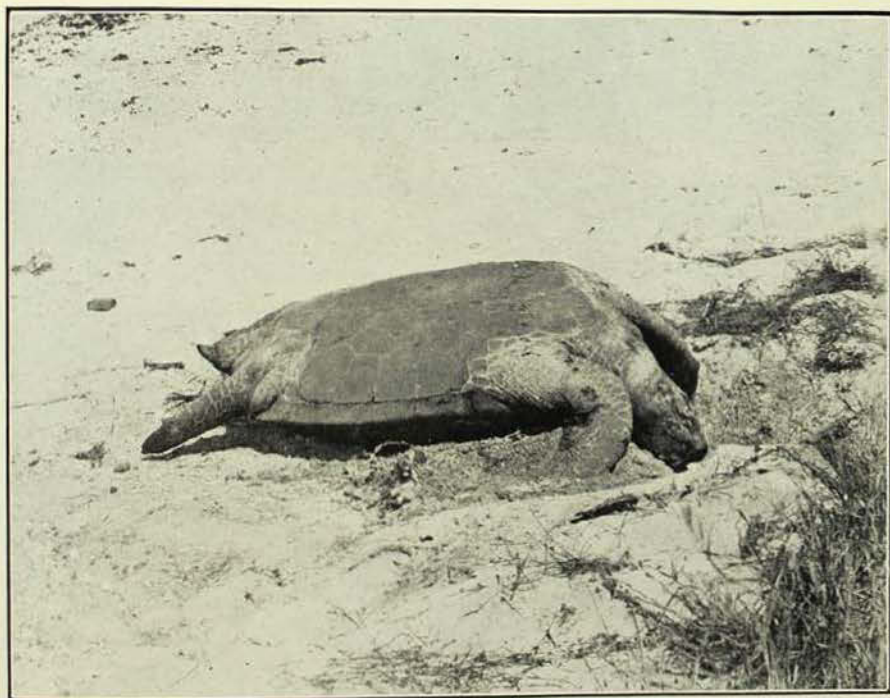
Turtle-hunters patrol the beaches of the islet nightly, turning over all the turtles they find *en route*, and leaving them out of reach of the tide. There they are helpless, and lie on their backs, their flippers scooping up the sand with great force, until exhausted. They are often left in this position for a whole day or more, in the heat of the tropical sun, and their



A member of the party riding a Green Turtle down to the water's edge. The end of the front flipper has apparently been eaten by a shark.

[Photo.—A. Musgrave.]

plight as they lie with drooping heads, often gasping for breath, is one which cannot fail to excite one's pity. The ladies of the party often gave them water to drink, or put bags over their heads for shade.



Green Turtle turned over by turtle-hunters. In this position it is helpless and unable to escape.

[Photo.—A. Musgrave.]

Later, several members of the party left the islet in a boat carrying a load of turtles to Rockhampton. The unfortunate animals lay on their backs arranged around the decks between the deckhouse and the railings, ever and anon emitting long-drawn sighs or slapping their flippers against the decks or their plastrons. The hold, too, was full, and on the trip over several died. With their eyes exuding long trails of mucus, and so distended with blood that they protruded beyond the orbits, these helpless creatures aroused our sympathy. During a night spent on the boat, the turtles kept up an

incessant tattoo against the sides of the deckhouse, making sleep an impossibility.

The turtles are killed by decapitation, and later butchered. First the lower shell or plastron is cut around and lifted off like a lid. Then the limbs and flesh are removed; the head and entrails, including the ovaries with their numbers of unlaidd eggs, are buried in the sand. The shells and flesh are loaded into a punt, and towed to the wharf near the canning shed, where fifteen men are employed. Here the meat is cut off the bones and boiled slowly in large wooden vats overnight,

forming the soup which passes into a galvanised iron tank where it is flavoured with pepper, onions, arrow-root and other herbs. It is poured into sixteen ounce tins and sterilised for forty minutes before being sealed up. The tins are then labelled and ready for sale. Twenty - two to twenty-five turtles, a

good days' catch, produce about nine hundred tins of soup. Last season (1924-1925), thirty-six thousand tins were prepared.

Besides soup the turtle furnishes many by-products. The flesh of the breast, called calipash, is dried and used to make mock-turtle soup. That of the flippers is called calipee, and is sold dried and makes excellent eating when cooked, having the appearance of fried fish and tasting almost exactly like veal. The green fat of the turtle is rich in flavour, and lubricating oil is extracted from it, while fertiliser is made from the shell and bones.

The male Green Turtle and the Loggerhead are not used for soup-making, since their flesh is coarser. The Hawksbill is also

inedible and only of value because of its shell.

During our stay on the islet turtles were put to another use. By kneeling on their backs and clinging to the edges of the carapaces, we were able to ride them down to the beach and into the water; though slow upon land, they soon upset us in the water, and, notwithstanding their bulk, swam gracefully away.

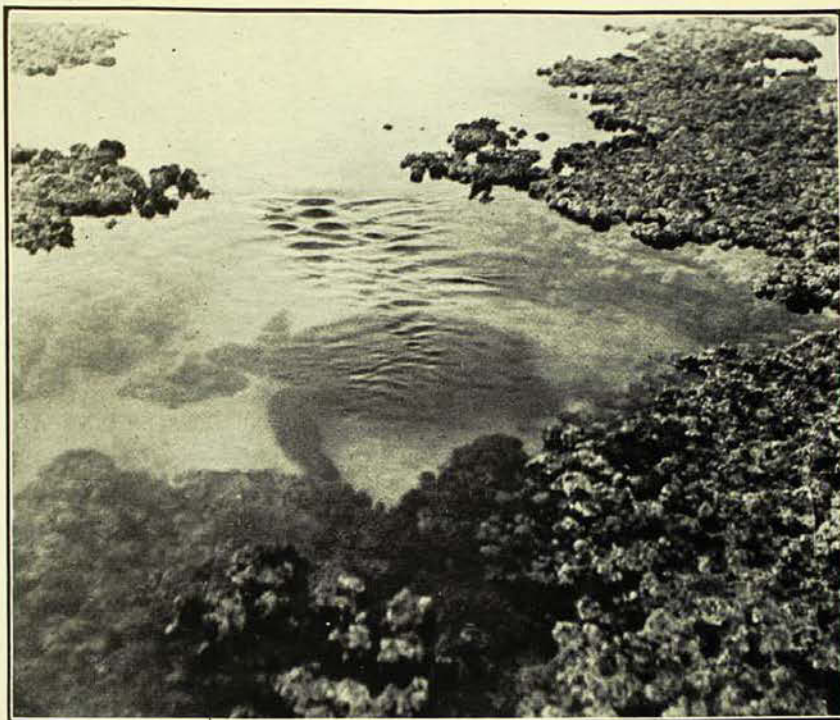
The turtles themselves are protected from their enemies by their shells, but their flippers are sometimes bitten by sharks.

Each of the twenty-five odd turtles which are killed daily during the breeding season, is the potential mother of about one hundred and fifty young, so that unless drastic measures are taken, the species in the long run will become extinct. One has only to consider the case of the dugong to

realise the likelihood of this happening.

The lack of water on the islets of the group is the salvation of many turtles, for it is first necessary to set up buildings with roofs to run off rain water into tanks before canning operations can be conducted. Turtle-soup canning, too, is possible only from the end of November to January, the hottest months of the year, when the need for water is at its greatest, for the Green Turtles come ashore to lay their eggs only during these months.

It is inevitable, however, that, while only the females are killed and the males escape, the balance of nature must eventually be upset, and a valuable Australian industry cease to exist.



Green Turtle swimming in a coral pool at Masthead Island, Capricorn Group.

[Photo.—A. R. McCulloch.]

The Pearl of the Pacific.

By A. F. BASSET HULL,
Honorary Ornithologist.

L YING to the N.E. of Sydney, about 1,100 miles by the direct steamer route, and situated between $20^{\circ} 10'$ and $22^{\circ} 26'$ S. latitude, the French island of New Caledonia faces the Australian coast between Rockhampton and Bowen, Queensland. It is about 200 miles long by from 25 to 30 miles wide; is very mountainous, and entirely surrounded by coral reefs enclosing shallow lagoons and channels, dotted with many islands. The climate is milder and more equable than that of the opposite mainland of Australia; the scenery is varied and in many places very beautiful, and the extraordinary mixture of races composing the inhabitants furnishes the visitor with an endless source of interest. The native Kanakas of numerous tribes, the Loyalty Islanders, the Javanese, Tonkinese, Japanese and Chinese imported labourers, the sprinkling of English,



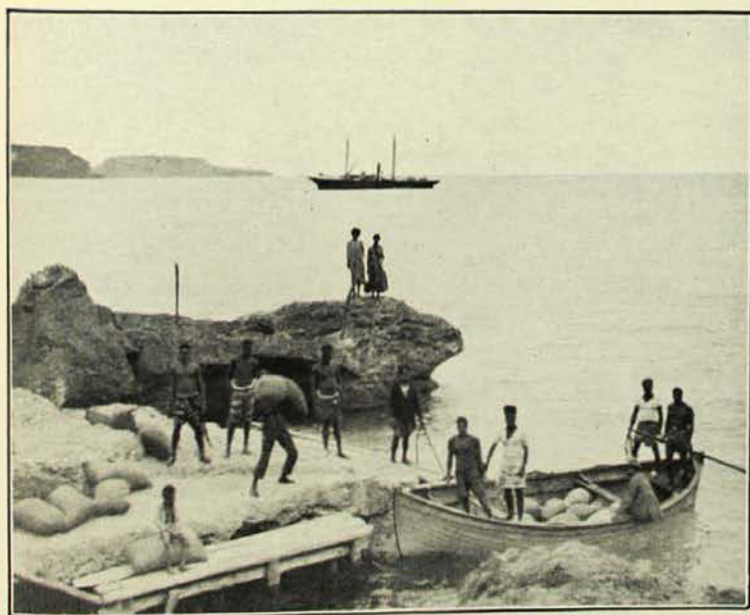
Kanaka's hut in the village of We, Loyalty Island.

[Photo.—A. F. Basset Hull.]

Australian and other white races all mingle in the capital, Noumea, and the other towns with the citizens of the French Republic who control and administer the Colony. In a grand total of under 50,000 inhabitants the

Europeans do not exceed 14,000, and therefore it may easily be realised that in variety of colour the people are as striking as the scenery.

In August of last year I visited Noumea and those more settled parts of New Caledonia within reach by trafficable road. The town is situated at the foot of steep and rugged mountains; fronts a spacious harbour enclosed by several islands with narrow passages between and possesses many attractive gardens, parks, and reserves along the extensive sea front, together with a very fine cathedral. As a collecting ground for the naturalist it offers an immense field for marine investigation; shells, corals, fishes, crustacea,



Landing place at Mare, Loyalty Island, the "Jeanne Elisabeth" formerly H.M.S. Dart, in the distance.

[Photo.—A. F. Basset Hull.]

echinoderms, and many other forms are present in quantity to satisfy most observers. In the open tea-tree or Niaouli country of the foothills there are not many birds, excepting the introduced Indian Mynah, which is present in large numbers; but in the semi-tropical brushes of the gullies, the coconut plantations and the mangrove swamps along the shores there are many brilliant kingfishers, parrot finches, fruit pigeons, horned parrots, and other forest loving species. Several species of hawks and kestrels hover about the cleared spaces, and within twenty miles of the town the curious kagu is still fairly numerous. I saw no gulls and very few terns, but was informed that on some of the islands to the north of the colony large numbers of seabirds are to be found breeding.

My principal objective being the study of the loricates or chitons, most of my time was spent amongst the rocky points and coral reefs along the beaches of Anse Vata, a few miles from Noumea, where, with the assistance of one Tupau, a Loyalty Islander who spoke fluent French and pidgin English, I accumulated numerous interesting species, several of which are new to science, and most of them attractive in colour and sculpture. The tides rarely exceed one metre (3.28 feet) so work was possible to a limited extent even at "pleine mer" or high tide, while the period of slack at low tide was generally much longer than on our coast. Under a blue sky, in a genial sunshine, tempered by gentle breezes, and with countless loose stones and lumps of dead coral to turn over and examine, the collecting conditions were ideal. Some days the "take" was so great that the cleaning and preparation of specimens occupied the evening hours until nearly midnight.

I took advantage of an opportunity to visit the Loyalty Islands, a group of three large and several small islands lying to the eastward of New Caledonia, and also belonging to France. Our old friend the late H.M.S. *Dart*, now the *Jeanne Elisabeth*, shorn of all her graceful topmasts, trades between Noumea and the Loyalties. Tupau and I took passage by the old *Dart* and fifteen hours' steaming brought us to the island of Maré, Tupau's birthplace, where we spent one day collecting on the coral rock of the coast. Loricates do not love



Rock at Chepenehe, Lifu, Loyalty Island, showing levels of three "uplifts."

[Photo.—A. F. Bassett Hull.]

coral, so I was not surprised to find only two species there, one of which is extremely numerous, clinging to the weathered surface up to and even above high water mark.

The Loyalty Islands form an interesting example of the "raised coral" formation, several uplifts having been required to raise the land to its present levels. The latest uplift is shown in the illustration and some little distance from the present shore line the previous uplift is marked by cliffs of thirty or forty feet in height, hollowed out by the action of the waves when they formed the seashore, and now marked by numerous stalactites resulting from the solution of the lime by the action of carbonic acid, the plateau above the cliffs being covered with dense vegetation. Further inland are the cliffs and plateau of the preceding uplift. On the island of Lifu, to which we proceeded on the following day, there are four distinct uplifts, the levels of three of which can be traced in the illustrations

I stayed four days on Lifu while the *Dart* proceeded to the northernmost island of Uvea. Lifu yielded five species of loricates, one of which was obviously an importation from New Caledonia, being found only on stones brought over as ballast and dumped at the water's edge.

The birds of the Loyalties include some fine large fruit pigeons, one of which I saw living in captivity at the house where I stayed. This bird laid an egg while I was there, the eleventh in regular succession during the season. This is remarkable in

view of the fact that in its natural state the bird would lay and incubate only one egg.

I drove across the island from Chepenehé, the official capital or residence, to Wé, a distance of about twenty miles. The way to Wé was over a moderately good road for the greater part bordered with dense tropical vegetation, the tops of the trees and palms over-arching and forming a veritable tunnel of greenery, cool and grateful. At Wé I enjoyed the hospitality of Dr. and Madame Tivolier, comparatively recent arrivals from Paris, who are both charmed with their

is very fine, the lofty rugged mountain towering abruptly from the narrow beaches seamed with gullies down which foaming cascades gleam white amongst the dark foliage and red rocks. The Island of Pines lies far to the southward, but the intervening waters are dotted with palm—or pine—clad islets, rocks, and reefs. I looked on the scene with longing for an auxiliary cruiser and days untrammelled by thoughts of business in Sydney to cruise over those rich fields of rock, reef, and yellow sands in search of nature's treasures stored there for the gathering. Some day I will return and explore these regions under less restricted conditions.



View from the resident doctor's house, Wé,
Loyalty Island.

[Photo.—A. F. Basset Hull.]

surroundings and charming in their attitude to visitors. The beautiful outlook from their residence is shown in the illustration. Here I rejoined the *Dart*, and after calling at another point on Lifu we returned to Maré and thence back to Noumea, the whole trip to these islands occupying nine days.

The eastern coast of New Caledonia is generally steeper and the reefs are closer inshore than on the western coast. As one passes southwards from the Loyalties and enters the Havannah Channel the scenery

Back to Noumea amongst the cheerful and friendly French inhabitants, I went for some trips by road in the excellent motor cars obtainable at a price that would cause a Sydney taxi-driver to turn pale. For a little over 100 miles an excellent road traverses the island northerly to Bourail, crossing a mountain range where one looks down into deep ravines filled with verdure, and skirting many miles of white beach, blue lagoon, and distant reefs lined with the white foam of the breakers. Everywhere one sees little heaps of road metal ready for the repair of the roads, an occasional road repairing party under charge of a sleepy guard, but nowhere is the penal aspect of the colony obtruded upon the visitor. True that transportation ceased thirty years ago but there are still some of the old hands left on Ile Nou, and there are some more or less political exiles enjoying comparative freedom under the sheltering palms, but of gloom and misery there is no outward indication.

Owing to the favourable exchange rates the Australian visitor can enjoy living in the most luxurious style at a very low cost. Added to the exchange advantage there is the fact that the customs duty on French goods is merely nominal, and the collector can get his requirements in the way of material, photographic goods, etc. much cheaper than in Sydney.

They call New Caledonia "The Pearl of the Pacific." Well, I have not seen *all* the islands of that Ocean, but I am prepared to concede that it is at least one of the biggest pearls I have yet seen.

The Heath Wren (*Hylacola pyrrhopygia*).

By P. A. GILBERT.



The female Heath Wren going to the nest. During the brooding season she mostly carries her tail drooping.

[Photo.—P. A. Gilbert.]

IT is a somewhat remarkable fact that the Heath Wren, although widely distributed and moderately common, is one of the least known of our birds. Several reasons could be given for this unfamiliarity with such an attractive species. The nature of its habitat is, in the main, the causal factor of its concealment; then it is secretive in its nesting habits, and its fondness for the well disposed cover of undergrowth finally places it beyond the prying eyes of the occasional investigator. The Heath Wren

does not force its presence on us as many other birds do, its mode of living being such that we are compelled to seek it in its wild surroundings.

I am now writing of a bird which hitherto has been vernacularly called the Chestnut-rumped Ground Wren. I make no apology for using the name Heath Wren; possibly I will be excused for so doing, by all who prefer a simple descriptive name. The purpose of the MUSEUM MAGAZINE I take to be, primarily, the fostering of a love of nature

by describing its beauty and its mystery in simple terms, therefore, I feel I am on safe ground in choosing to adhere to popular terms, which also possess, apart from their aptness, a charm of their own. If the name suits the bird and the bird suits the name, why should we bother about other considerations?

In New South Wales the Heath Wren is found along almost the entire heath brush. It extends, in places, to or beyond the mountains. On the southern highlands near Moss Vale it is established in suitable localities. To the south of Sydney, the Heath Wren is freely distributed over the uplands of our National Park, which is one of its



A typical habitat of the Heath Wren, Engadine, New South Wales.

[Photo.—P. A. Gilbert.]

strongholds, and from here it reaches to the Victorian border. In the north it is found in the Kuring-gai Chase, and thence it is frequently seen in such country till the wide area of heath between the Clarence and Richmond Rivers is reached. The Heath Wren particularly favours sparsely timbered spurs and ridges of the Hawkesbury sandstone formation, where heaths, boronias, and banksias thrive amid outcrops of rock and rubble. Very often the most unpromising haven, by appearances, is actually the homeland where this species can be studied to advantage. Walk to one of these spurs early in August and hide near one of these sandstone outcrops. If the day be

bright and calm, and the right locality has been selected, you will presently hear a refrain which will strike you as strange and new. Beginning softly, the song will gradually swell in volume till the air rings with melody. At first it may sound like a full voiced canary, or it may seem like a polished skylark — say Shelley's skylark — till a better understanding convinces you that you have not heard the like before. Listen intently, and as the song moves onward you will probably recognise bird notes similar to some which you have heard before.

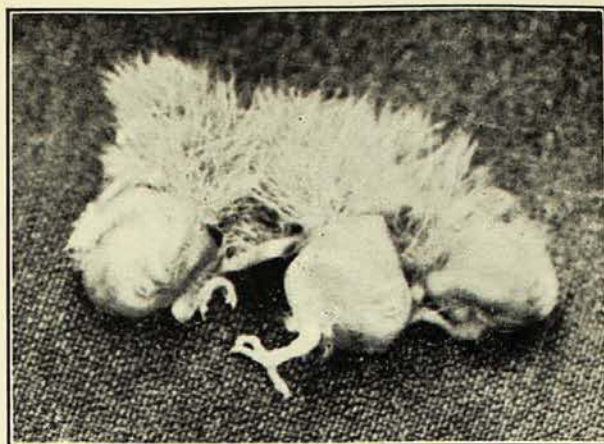
A beautiful songster appeals even to the most casual listener. What would be his admiration for the rendering of a bird, which graciously weaves the songs, calls, and alarm notes of other birds into that of its own sweet song? The Heath Wren does this, for he is a song-mimicker of the highest attainments. He begins by singing a few bars of his own song, then with a grace note he carries his movement to the songs to be mimicked, which he renders with great smoothness; so smoothly in fact that it requires a keen ear to detect the connections. The fantasia of the Heath Wren is woven with varying intonations of the borrowed songs, first crescendo, then diminuendo, supplementary notes being inserted to preserve the rhythm. Sometimes a westerly breeze toys with his song, helping to produce

a cadence of entrancing effect; the next moment a boisterous wind breaks it into tantalising discords.

Unlike the Lyre-bird and other feathered imitators which whistle their mimicry, the Heath Wren sings it, wherein lies its beauty. An accomplished male Heath Wren was heard to mimic the following birds in one continuous song:— the Coach-whip or Eastern Whip-bird, Black-faced Cuckoo Shrike or Blue Jay, Yellow-faced Honeyeater, Tawny-crowned Honeyeater, Brown-headed Honeyeater, Brown Thornbill, Yellow-tailed Black Cockatoo, Fantail Cuckoo, Dusky Wood Swallow, Spinebill, White-naped Honeyeater, Grey Thrush (including the notes of the young

bird), Rufous-breasted Whistler, Yellow Robin, Crimson Rosella, and Firetail Finch in this order. It may be left to my readers, who know all or any of these calls, to imagine the gaiety of this song. The female is also a songstress, very little inferior to her consort; but it is while she is building her nest that he sings his superb music.

The nesting period begins in June, and, in favourable seasons, ends in November. The nest is a domed structure, six and a half inches long by four wide, substantially built of coarse bark, strands of grass, rush, and other wiry growths. Fine bark or feathers are lavishly used in lining the nest. The female does all the building, and usually takes three weeks to finish the edifice and lay her eggs. The nest is placed on, or several inches from the ground, frequently in a thicket of Dwarf Apple, sometimes under a dead branch, or occasionally at the foot of a stunted Grass Tree. Three eggs are laid, which require fifteen days incubation. The young occupy their cosy home for fifteen or sixteen days. They are very much like their parents when ready to quit the nest, brown on the head and back, pale buff on the breast and abdomen, and chestnut on the rump. The predominating note is "zweet



Young Heath Wrens, four days old, showing naked bodies and remarkable clothing of down on the head and neck.

[Photo.—P. A. Gilbert.]

zweet," which enables the young to keep in touch with each other. The same note is used by the parents to warn their charge of possible danger. All forms of insect life, in different stages of development, are devoured by the Heath Wren. And here I close this brief outline of a typically Australian scrub bird, whose presence enlivens lonely places, and fills one with rapture in listening to its wonderful song.

A holiday party of naturalists visited North-West Islet on the Great Barrier Reef recently and many photographs of the animal and bird life were taken, some of which appear in the present number of the MAGAZINE. Large collections of specimens were made by Miss E. E. Chase, B.Sc., of Sydney University and Messrs. Anthony Musgrave and G. P. Whitley of the Australian Museum; Reports by various specialists upon them will be published in the forthcoming number of the *Australian Zoologist*, published by the Royal Zoological Society of New South Wales.

Under the direction of Surgeon-Lieutenant W. E. J. Paradise, R.A.N., a hydrographic survey of one of the best of the Museum's collecting fields, the mud-flats at Gunnamatta Bay, Port Hacking, was recently carried out.

Dr. Paradise was assisted by Messrs. T. Iredale and G. P. Whitley, who made a small collection of specimens at the same time.

Amongst noteworthy visitors to the Museum recently was Dr. Johannes Schmidt, Director of the Carlsberg Laboratory, Copenhagen, Denmark. Dr. Schmidt is engaged on a six months survey of the Indian and Pacific Oceans, to complete his investigations into the life-history of the common eel. If any of the readers would send specimens of freshwater eels to the Director of the Australian Museum, they will materially assist Dr. Schmidt in his important investigations. An article on freshwater eels appeared in the October-December issue of THE AUSTRALIAN MUSEUM MAGAZINE.

Mineral Collecting on the Northern Rivers of New South Wales.

BY T. HODGE SMITH.



Kyogle and district as seen from Fairymount. The Richmond River, a fine example of a typically mature river valley, meanders through a very rich alluvium of volcanic soil.

[Photo.—T. Hodge Smith.]

MR. ANTHONY HORDERN having very generously made available the necessary funds it was possible for the Trustees of this Museum to despatch me, accompanied by Mr. C. M. G. Friend, to inspect and collect from two interesting mineral localities on the upper reaches of the Richmond and Clarence Rivers, New South Wales.

The first objective was Kyogle on the Upper Richmond. A quarter of a century ago Kyogle was a large cattle station but, to-day, it is a thriving, prosperous town surrounded by some of the richest country in New South Wales. Why is this district so fertile? The answer must be sought in its

geological history. During what is called by geologists the Tertiary period, long before man appeared on the face of the earth, the district had a sandy soil which was not nearly as fertile as some of the soil to-day. Towards the close of this period the quiet normal times so long enjoyed by the district were suddenly changed. Great earthquakes violently shook the district, and numerous volcanoes appeared on the coastal area while fissures opened in the earth's crust through which lava welled up and poured over the surface of the earth. The record of all these happenings is kept in the hills existing to-day around Kyogle. They run in a general meridional direction and are composed of



The Kyogle Shire Quarry. The zeolites were obtained from the extreme right hand edge of the photo. The white line sloping to the top right hand corner shows the junction of two lava flows.

[Photo.—T. Hodge Smith.

basalt or, as it is more commonly known, "blue metal." The Shire Council has opened up several quarries in the hills for the supply of blue metal for road-making purposes. In the largest of these quarries, quite close to the town itself, at the foot of Fairymount, four distinct lava flows can be seen as well

over the district.

The particular point of interest of the visit was the presence of a very interesting group of minerals known as zeolites in the basalt of the shire's quarry which has just been referred to. Molten lava contains a great deal of water under pressure which on reaching the

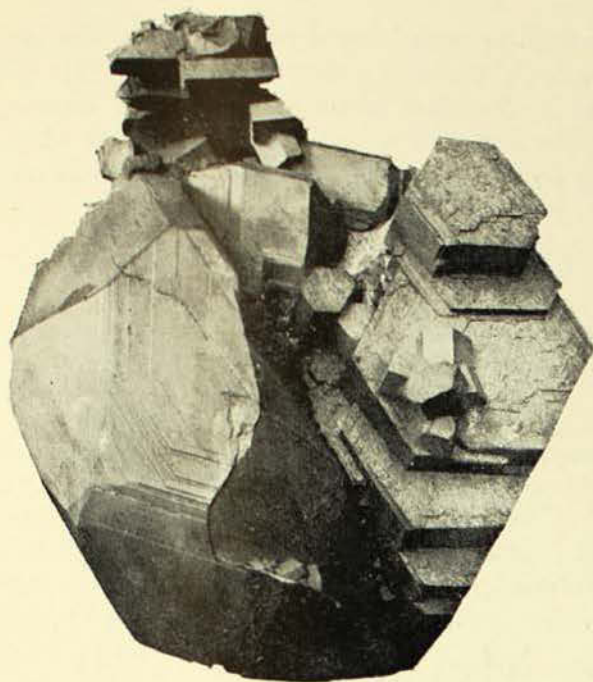
as a dyke which represents the old fissure up which welled the molten lava.

Originally the basalt hills were joined together by the lava flows, but in the time intervening since the outpouring of the lava on the old Tertiary land surface, the work of rain and rivers has been responsible for the cutting out of the valleys separating the hills. These valleys are typically mature river valleys of considerable width and upon their floors has been deposited rich soil derived from the disintegration of the basalt. Thus it will be seen that Kyogle owes much of its prosperity to the time when volcanic activity held its awful sway



Large crystals of calcite and basalt, coated with chabazite, from the Kyogle Shire Quarry.

[Photo.—T. Hodge Smith.



Group of calcite crystals from the Garibaldi Mine, Lionsville, showing two distinct types.

[Photo.—G. C. Clutton.]

surface escapes as steam. Thus it is that the freshly solidified surface of a lava flow appears like petrified froth. However the solidification of the lava is so rapid that many of the bubbles of steam are unable to reach the surface and remain imprisoned in the solid rock. Now this water contains mineral matter in solution and as it cools the minerals are deposited in the steam holes and the cracks or crevices that form during the solidification of the molten rock. Each mineral crystallises in its own particular form and so can often be readily distinguished by its external shape. In the illustration it will be seen that there are large six-sided crystals which are composed of calcite (carbonate of lime), and these crystals, as well as the rock itself, are coated with another mineral called chabazite (hydrous lime aluminium silicate). In addition to these minerals were found fine specimens of analcite and natrolite (hydrous soda aluminium silicates). We were able to collect over four hundred and sixty specimens from this one quarry.

Leaving Kyogle and the Upper Richmond River we proceeded to Lionsville, about six miles west of the Upper Clarence in the Solferino gold district. The country here was exceedingly rugged and the scrub very thick, being almost semi-tropical. Situated to the west of and about 700 feet above the

little hotel at Lionsville is the Garibaldi Gold Mine.

On driving into the hill in search of the precious metal the miners noticed that on one side of the drive a considerable amount of water was coming in and also that the wall at this place sounded somewhat hollow. It was decided to investigate and a "shot" was put in, with the result that a cave was opened up, the roof, walls, and floor of which were lined with the most beautiful crystals of calcite, large and small. The largest crystals yet found in Australia are obtained from here, many individuals weighing several hundredweight. Some of the calcite is water clear; this is known as Iceland Spar. The origin of this name is the fact that in Iceland there are large deposits of this material which is used in the manufacture of optical instruments such as polarising microscopes. A quantity of Iceland Spar from the Garibaldi Mine has been sent to Germany to be used in this way. For this reason most of the calcite crystals have been broken up and are thus forever lost.

Everyone is familiar with limestone caves with their beautiful stalactites, shawls, crystals of calcite, etc., and their origin is easily explained; but the Garibaldi Mine is primarily a gold mine and there is no lime-stone in the vicinity of the cave from which carbonate of lime could be obtained for the formation or growth of the calcite crystals. The rocks are of igneous origin and are known as porphyries. The formation of the cave itself is due primarily to faulting or differential movements of the earth's crust, and the secret of the supply of calcium carbonate is in the lode which had intruded these rocks. The lode material is composed of quartz, calcite, and, of course, some gold. Surface waters percolating along the ore channel have dissolved the calcite of the lode and carried it into the underground cave. In time the cave became filled and, of course, a constant supply of calcium carbonate would be maintained from the ore channel; in this way the calcite crystals have been deposited and have grown under ideal conditions.

The Australian Museum collection already contains a number of specimens from this cave, but the object of the visit was not so much to collect as to investigate the origin

of the calcite. Transport is a very difficult proposition in such a rugged place, which is considered by the people of the Upper Clarence to be the "the edge of beyond." However the manager, Dr. W. F. Straubel, has kindly offered to forward a fine crystal

weighing some hundredweights by the next bullock team leaving the mine. This will be a decided acquisition to the Museum collection and will dwarf those crystal which, up to the present, we have regarded as very large.

Allan Riverstone McCulloch.

The ashes of the late Allan Riverstone McCulloch, ichthyologist and senior zoologist of the Australian Museum, were brought back from Honolulu where he died at the end of August 1925, and have since been laid to rest on Lord Howe Island. He loved the little island and its people, frequently spending holidays there and doing important work upon its natural history, so that to many his agreeable personality seemed to have become part of the delightful spot. Because of this, colleagues and friends decided to erect a granite monument to perpetuate his memory and pay tribute to his splendid qualities as an eminent scientific worker and lovable friend.

With the very sympathetic co-operation of the Lord Howe Island Board of Control and the island folk, a beautiful and commanding site was chosen, the ashes reaching the island on their last journey on Christmas Day 1925. A colleague, Mr. E. Le G. Troughton, entrusted with this duty and the arrangement of the memorial, has returned to tell of the completion of the work, and of the universal regret of the island residents for the loss of a true friend, coupled with sincere pleasure that their island home had been chosen for his last resting place. Every man on the island was anxious to help with the monument and both islanders and visitors were included in the working party which erected the fine memorial standing over twelve feet high, on which this inscription is engraved.

In memory of
Allan Riverstone McCulloch.
Naturalist.
1885-1925

Erected by friends and fellow workers.
His ashes rest herein.

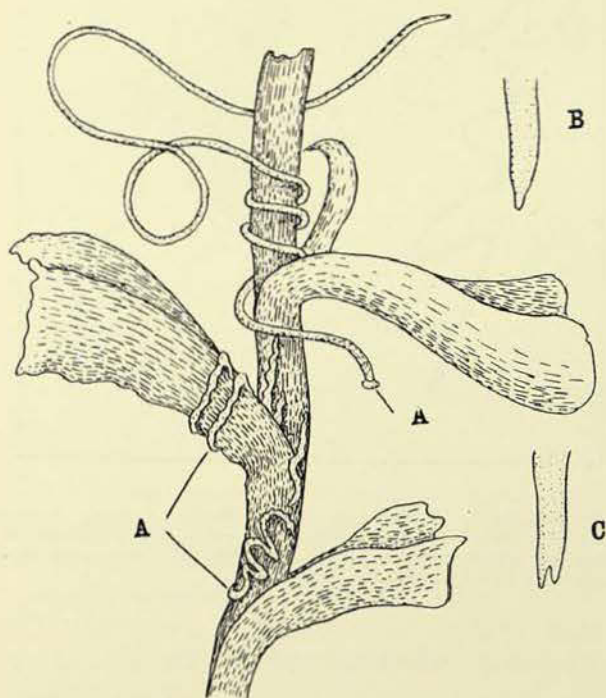
It stands on Flagstaff Hill, a small headland jutting out from the foreshores of the lagoon, facing the sheltering coral reef upon which so much of McCulloch's work was done for the Museum coral group and science generally, and it also faces the mainland where he had done so much, and hope once ran so high for greater achievements.

Here, on Friday 15th January 1926, his ashes were enclosed within the monument and a simple burial service conducted by the Rev. J. H. Clarke Kennedy in the presence of the entire population of residents and visitors. Standing facing the reef with the waves thundering on the coral barrier one realised how appropriate was this setting for the resting place of a man who was in every sense a nature lover, the restless surf seeming to typify the unceasing mental energy which ultimately consumed him. As one old resident expressed it after the service "When the signal flag goes up on the hill we'll know that old 'Mac' isn't far away from us," and so we may think of him, cheerfully as he would wish it, resting finally in surroundings of great beauty amongst a people to whom his visits brought much happiness, and his passing most intense regret.

The Gordian Worm.

BY W. BOARDMAN.

DURING the warm months of every year there is scarcely any creature received at the Museum with such regularity as the gordian or horse hair worm. A number have been received within the last month, each time with the query "What is it?" and in order to cope with this recurrent question we have found it necessary to have a leaflet printed for the information of enquirers.



A female 'gordian' writhing around the stem of a water plant upon which she is depositing strings of eggs. A. Strings and clump of eggs. B. Posterior extremity of a female gordian. C. Posterior extremity of a male gordian.

[F. A. McNeill, del.]

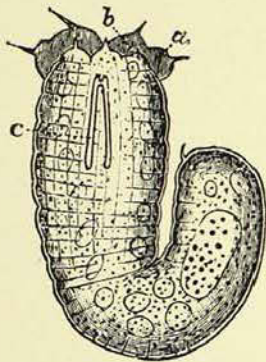
Gordian Worms are to be found all over the world and belong to the class of the Round Worms (Nematoda), most of which are parasitic and include such well known forms as the small thread worms of children and the larger wire worms occurring commonly in the intestines of pigs and other mammals. They may, however, be said to possess more highly specialised habits than their

allies, and from what we learn are certainly much more versatile. Average specimens measure about eight to sixteen inches in length and are about one sixteenth of an inch thick; the general colour is a variable brown, but some specimens are nearly white. In habit the adult gordians are exclusively aquatic, living in ponds and streams, where they are found either moving with a graceful undulating motion through the water or writhing round the stems of water plants. Sometimes numbers of them may be seen tangled together in a mass resembling a gordian knot, the scientific name *Gordius* having reference to this habit. The sexes are distinct, the male being easily distinguishable from the female by its darker colour and forked tail.

LIFE HISTORY.

The life history of the Gordian Worm is long and complex. Unfortunately, little if any work has been done towards the elucidation of the life cycles of our indigenous species, but the knowledge at our disposal indicates that these differ only in detail from those of the better known exotic forms. In the life cycle there are four distinct phases—(a) the formation of the embryo larva within the egg, (b) the first larval stage, (c) the second larval stage, (d) the mature animal. Both larval stages are parasitic and their life is spent in feeding. On the other hand, the mature animal takes no nourishment whatever, and engages solely in reproduction. After fertilisation the female worm lays many thousands of eggs in beady strings about the bases of water plants. In about a month the embryo worm within the egg is developed sufficiently to break through the eggshell and make its escape into the surrounding water as the first larval stage. At this juncture the gordian is of almost infinitesimal dimensions, measuring about one-fiftieth of an inch in length, but its head is provided

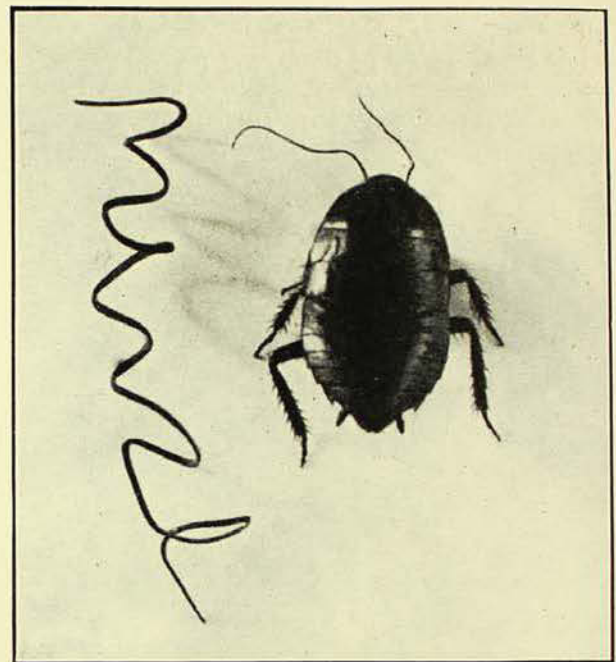
with a very effective arrangement of horny rods which enable the creature to force entry into its first host and thus embark upon the initial phase of its parasitical career. This first host is usually and preferably the larva of some insect that the gordian encounters on the bed of the pond or stream. It rapidly bores its way into the body of this unfortunate, and comes to rest in an organ known as the "fat body," which functions as the reserve food store of the insect. Here the gordian larva remains ensconced until the following spring, and during this time its larval insect host has passed through the phases of its metamorphosis and is now the imago or perfect insect.



First larval form of a gordian highly magnified (natural size one-fiftieth of an inch). *a*, and *b*. Bristle-bearing lobes on head. *c*. Protrusible boring apparatus. [After von Linstow.]

Now insects have many enemies, and a large number of gordian-infested ones fall prey to other predatory insects such as beetles and cockroaches. By this means the larval gordian becomes transferred to the intestine of a new host, from whose alimentary canal it bores its way into the body cavity. Established in this new position it rapidly assumes the second larval form, which remains in the new host's body for another period terminating with the close of the succeeding winter. Meantime the larval gordian eats so voraciously that by the advent of summer almost the whole of the abdominal contents of this second insect host have been consumed. At this stage there is little to distinguish the gordian entombed in its living insect prey from a free-living mature worm, the only difference being in the immaturity of the sexual organs. Almost immediately now the death of the second host becomes a necessity before the gordian can enter upon the final phase of its life history.

Just prior to this inevitable event the insect victim's body is little more than a shell, inside of which is tightly packed the numerous folds of the nearly adult worm. If the unlucky insect happens to perish in a dry spot its body may become a sepulchre for the parasite, which must perish in the absence of water; on the other hand, if death overtakes the second host at a spot where this medium is present, the gordian quickly discards the shelter of its victim's body, matures, and engages in reproduction.



A wingless cockroach from Banks Island, Torres Strait, which was found upon examination to contain the gordian worm photographed beside it. From the collection of the Australian Museum.

[Photo.—G. C. Clutton.]

GENERAL REMARKS.

The results of investigation point to the fact that the gordian larva is not partial to any one or more definite hosts, as are most other parasites, but associates itself with the first which comes along. As already indicated, this is normally the larva of an insect which undergoes part of its metamorphosis in water, but this first host may even be a fish, from which the gordian may pass to a warm blooded creature such as a bird, and it has even occurred in man himself.

Reflecting on this marvellous versatility as claimed for *Gordius* by several investigators, a celebrated authority points out that it is contrary to our knowledge of parasites

that the same species should develop equally well under such varied conditions. He rather favours the opinion that they belong to different species of gordians, or that they have been accidentally introduced, having passed into these strange hosts with drinking water.

Numbers of gordian worms may suddenly appear in water hitherto free from them and curious explanations of this phenomenon have been advanced. One is that the worms have descended in a shower of rain, but another view which is still current in some of the rural districts of Europe, is that they are derived from horse hairs and will later develop into eels.*

*see the AUSTRALIAN MUSEUM MAGAZINE, Vol. II, No. 8, October-December, 1925, p. 266.

Misconceptions as to the origin of gordian worms exist in this country also. Last year an excited visitor arrived at the Museum with a worm which he had discovered in his morning milk. The worm on being examined was immediately recognised as a gordian, but how it got into the milk was a mystery, until on enquiry it was found that a drowned moth had also been found in the jug. The gordian had undoubtedly escaped from the body of the moth, but naturally it had not occurred to the mind of the householder that the simultaneous presence of the two creatures was in any way connected.

Lecture Notes

The Popular Science Lectures, which were inaugurated by the Trustees of this Museum some twenty odd years ago have proved to be one of the most attractive features of the institutions work, and not infrequently they draw an audience in excess of the accommodation available.

The 1926 session of these lectures will be opened by Mr. T. Iredale on April 15th at 8 p.m., who will take as his subject "A Naturalist with Captain Cook."

No charge is made for admission to these lectures; for details of other lectures see syllabus announced elsewhere in this issue.

The following lectures have been delivered recently by the following members of the Museum staff to various bodies.

Mr. W. W. Thorpe.—The Sydney Kindergarten Training College, "Prehistoric Man," "Ancient Egypt;" "Aborigines of New South Wales." The ship's company of H.M.A.S. *Tingira*; "Ancient Egypt." The

Banksia Free Church Young Peoples' Institute; "Aboriginal Weapons and Implements."

Mr. J. R. Kinghorn:—The Central Methodist Mission; "Our Feathered Friends," To the Scouters, at the rooms of the Boy Scouts' Association, Mr. Kinghorn, delivered an informal chat upon snake-bite and its treatment, and the economic importance of our birds.

Mr. T. Hodge Smith:—The Railway Institute, Werris Creek; "The Geology of the Sydney District."

That popular scientific lectures, such as these, are appreciated is amply evidenced by the fact that at Mr. Kinghorn's lecture upon "Our Feathered Friends" there was an audience of 1100 present, whilst that of Mr. W. W. Thorpe's on board H.M.A.S. *Tingira* was attended by the entire ships company, excepting those members on watch.

Earthworms.

BY ARTHUR A. LIVINGSTONE.

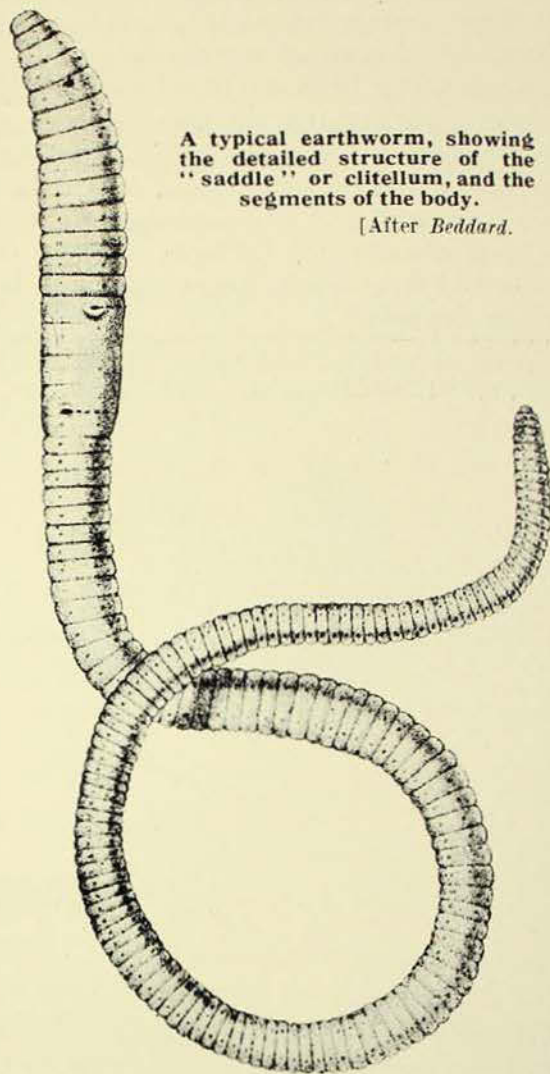
I would not enter on my list of friends
Though graced with polish'd manners
and fine sense,
Yet wanting sensibility, the man
Who needlessly sets foot upon a worm.

Cowper.

WHAT use is that despised earthworm, the creature we tread under a heel of contempt when seen slowly and laboriously making its way across a path or being swirled swiftly down a tiny rivulet during rainy weather? The good the little animal does, which is discussed hereafter, is of rather an indirect nature, generally unnoticed by many and forgotten by the few whose sole ambition it is to destroy life. Such long lank creatures do not tend to create interest in even the most curious, yet the earthworm possesses wonderful interest for those keen enough to examine it and its habits.

STRUCTURE.

The body of our common Sydney earthworm is composed of a number of ring-like segments, provided on each side with a bunch of minute, almost microscopic bristles. These bristles greatly assist the process of locomotion, the worm being capable of moving backwards as well as forwards. Because the worm lives in the dark ground eyes are useless and consequently, in accordance with the laws of Nature, are absent, yet the animal is able to distinguish between the darkness of night and the light of day. By possessing this indispensable faculty the worm is able to escape the danger of contact with diurnal animals by remaining in its burrow during the day and so depriving them of a dainty morsel. A swollen and smooth area in front of the middle region of the body is characteristic of earthworms and is known as the saddle or *clitellum*. It is this peculiar structure that is often erroneously supposed to be the place where the worm has, at one time, been cut by a gardener's spade. The mouth is situated at one end of the body and is followed by a well developed alimentary canal, which includes a pharynx, an aeso-



A typical earthworm, showing the detailed structure of the "saddle" or clitellum, and the segments of the body.

[After Beddard.]

phagus, a crop, a gizzard and a special structure called the typhlosole which can be used to increase the area of absorption. A remarkable fact about earthworms, and many other worms, is that they are hermaphrodites. This means that the sexes are united, there being no distinct males or females.

The length of ordinary earthworms varies from about one inch to three to five feet. The species of our common acquaintance, true, is only from four to six inches long, but in Gippsland, Victoria, there occurs a worm of huge dimensions. Many specimens from this locality have been found to measure as much as five feet in length and a little over an inch in thickness. Five feet of earthworm

is difficult to imagine, and the first found by early settlers were identified as snakes until they were found to be gigantic earthworms of great interest and scientific importance.

HABITS.

The habits of earthworms have been studied for many years and much can be said upon the subject. The aim here is to give some of the more interesting points associated with the creatures, and for those requiring further information reference to Darwin's great work *Earthworms and Vegetable Mould* is recommended.

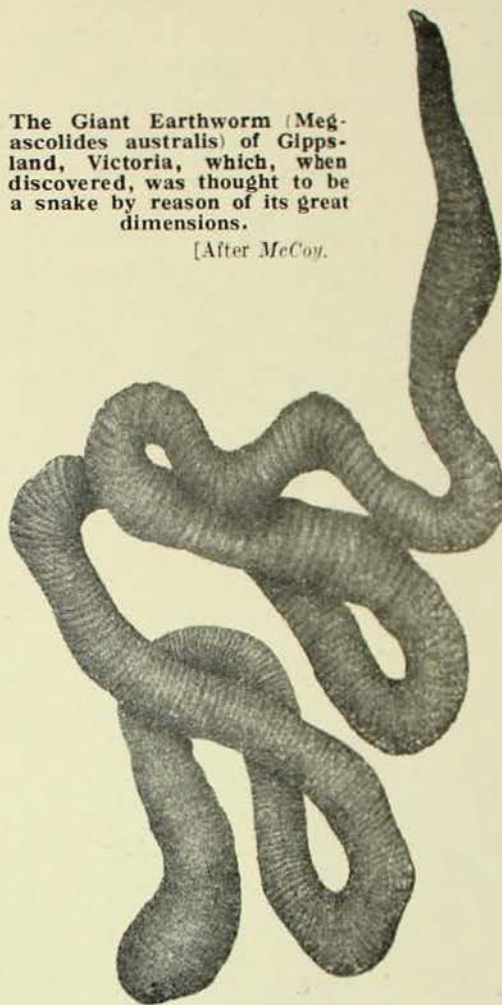
As a gardener the earthworm belongs to the industrious and diligent type which works hour after hour in your garden tilling the soil, turning it over and making it loose and friable for the roots of grass and young plants. This tiller of no mean order does not wrangle with the foreman gardener over wages, he does the gardening for nothing, and it is for our own interests that we should harbour and protect such a steady worker. The fact that the bodies of earthworms contain soil, is known to both young and old, but the reason may not be so widely known. The worm's diet consists chiefly of minute particles of nutritive material contained in the earth, and in order to secure this food the worm is obliged to swallow the soil whilst making its subterranean passages. When the nutritive particles have been absorbed the worm ejects the sieved earth on the surface of the ground in the form of sausage-like coils or globular heaps. These are commonly known as worm castings and can be often found on the lawns of parks and the turf of tennis courts.

When account is taken of the number of earthworms in a moist garden it can be readily seen that they can turn over a comparatively large amount of soil, and this acts as a stimulating medium for grasses and other herbage growing under natural conditions. The following calculations referred to by Darwin will serve to show the activities of earthworms with regard to their habit of turning over soil.

"Castings ejected near Nice within about a year, collected by Dr. King on a square foot of surface, calculated to yield per acre 14.58 tons.

The Giant Earthworm (*Megascolides australis*) of Gippsland, Victoria, which, when discovered, was thought to be a snake by reason of its great dimensions.

[After McCoy.]



"Castings ejected during about forty days on a square yard, in a field of poor pasture at the bottom of a large valley in the Chalk, calculated to yield annually per acre 18.12 tons."

The following is a summary of the thickness of the mould or earth cast up by earthworms and accumulated in the course of ten years over objects left strewn on the surface.

"The accumulation of mould during 14½ years on the surface of a dry, sandy, grass-field near Maer Hall, amounted to 2.2 inches in 10 years. . . .

"The accumulation during 29 years, on good, argillaceous pasture-land over the Chalk at Down, amounted to 2.2 inches in 10 years."

During rainy weather myriads of worms are known to come to the surface and die. The reason for such mortality seems to be at present unexplainable, though several probable hypotheses have been advanced. Some folk believe that the excess of water caused

by rain compels them to vacate their burrows and migrate to the surface to be drowned. Others maintain that death is caused by an epidemic of parasites or from the poison from asphalted surfaces. So far no conclusive evidence has been brought forward as to the reason of mortality during rainy weather, and it seems that, until we know more about earthworms and their complex anatomy, we can only conjecture upon the subject.

It is a well known fact that trap-door spiders provide covers for the entrances to their burrows, and perhaps the statement that the earthworm occasionally does the same thing would cause no little surprise. It is an established fact however, and, as Darwin states, it is "one of their strongest instincts." Their exact object, like many other peculiarities, is yet a mystery, but it is supposed that the mouths of burrows are closed to keep the air within damp, or that it is done for protection. Darwin inclines towards the view that the plugs check the free ingress of the lowest stratum of air, when chilled by radiation at night, from the surrounding ground and herbage. Whatever the motive is, the fact remains that earthworms are, whenever possible, intent on closing the mouths of their burrows with small pebbles or leaves; they may or may not replace their "door" when they come out at night. An interesting experience of Mr. D. F. Simpson which serves to illustrate the remarkable activities of earthworms in this direction, is related by Darwin. "On a calm damp evening he heard so extraordinary a rustling noise from under a tree from which the leaves had fallen, that he went out with a light and discovered that the noise was caused by many worms dragging the dry leaves and squeezing them into their burrows."

EARTHWORMS AS HEALING MEDIA.

Although to-day we find no use for the earth worm in the practice of medicine, our forefathers resolutely believed that many cures could be effected by their use. In those days the advancement of knowledge on a large scale was only beginning and little blame can therefore be attached to them for believing in such fallacies. Some of the cures and preparations of concoctions are very amusing to read of and references to some of the more striking were made by Topsell in his history

of serpents. This author writes.—"Earthworms do mollifie, conglutinate, appease pain, and by their terrestrial, and withall, waterish humidity, they do contemper any affected part, orderly and measureably moderating any excess whatsoever. The powder of worms is thus prepared: They use to take the greatest earth-worm that can be found, and to wrap them in mosse, suffering them to remain for a certain time, thereby the better to purge and cleanse them from that clammy and filthy slimyness, which outwardly cleaveth to their bodies. When all this is done, they press hard the hinder part of their bodies near to the tail, squeezing out thereby their excrements, that no impurity, so near as is possible, may be retained in them.

"Thirdly they use to put them in a pot, or some fit vessel, with some white Wine, and a little salt, and straining them gently between the fingers, they first of all cast away that Wine, and then do they pour more Wine to them, and after washing of the worms, they must also take away some of the Wine, for it must not all be poured away (as some would have it), and this must so often be done and renewed until the Wine be passing clear, without any filth or drossinesse, for by this their slimy jelly, and glutinous evil quality is clear lost and spent. Being thus prepared, they are to be dried by little and little in an Oven, so long till they may be brought to powder, which being beaten and searsed, it is to be kept in a glass vessel far from the fire, by itself. A dram of this powder being comixed with the juyce of Marigolds, cureth the Epilepsie, it openeth obstructions of the Liver, driveth away Tertian Agues, being given and taken with the decoction or distilled Water of Germander, Wormwood, Southernwood, Garlick, *Scorum*, Centory, and such like.

"Kibes in the heels, sinews that have been cut or punctured, and broken bones may all be healed by the external use of this wonderful powder. Pain is soothed, erysipelas cured, and scalds or burns are healed by a plaster made of earthworms."

From the foregoing the reader can see that the earthworm has received its fair share of attention from the hands of mediaeval apothecaries, and can hold its own as a curative medium when compared with the famed stone from the head of a toad, belief in which has long been exploded.

A Giant Fish.

BY G. P. WHITLEY.

THE Government of Fiji recently sent some fine specimens of fishes to the Australian Museum to be mounted for the New Zealand and South Seas International Exhibition at Dunedin, New Zealand.

The first to arrive was labelled with the native name "Koakoa," a fish known in Australia as the Queensland Groper (*Promicrops lanceolatus*) but not hitherto recorded from Fiji. This species, which is closely related to the Rock Cods or Hinds (*Epinephelus*), must not be confused with the Red and Blue Gropers (*Achoerodus gouldii*) and the Brown Groper (*A. badius*), which are large parrot fishes.

Queensland Gropers are noted for their large size, and the Fijian fish is no exception. It is six feet seven inches in length and weighs over 350 pounds. The Australian Museum has a similar specimen suspended from the Fish Gallery, which was caught, with others of its kind, near Wide Bay, Queensland. The species appears to be fairly common along the Queensland coast, and is sometimes caught in the estuaries of northern New South Wales.

Some fifteen years ago, there was one well known to Clarence River fishermen who named it "Nugget, the King of the Clarence." According to a newspaper report, this fish eluded the most tempting lures for five years. One day, however, "Nugget" was observed chasing a school of fish, so a cunning angler quickly baited a 40-foot shark line with a live fish. The groper took the bait and a battle royal followed. After towing the boat for about half an hour, the fish was exhausted, drowned, and hauled ashore. It is said to have weighed 413 pounds, and measured seven feet two inches in length. A larger one than this has been recorded from India, however; it was nearly seven and a half feet long and weighed 460 pounds.

The Queensland Groper is evidently an estuarine or inshore fish, probably hiding amongst rocks and feeding on any animals which come near it. The stomach of the

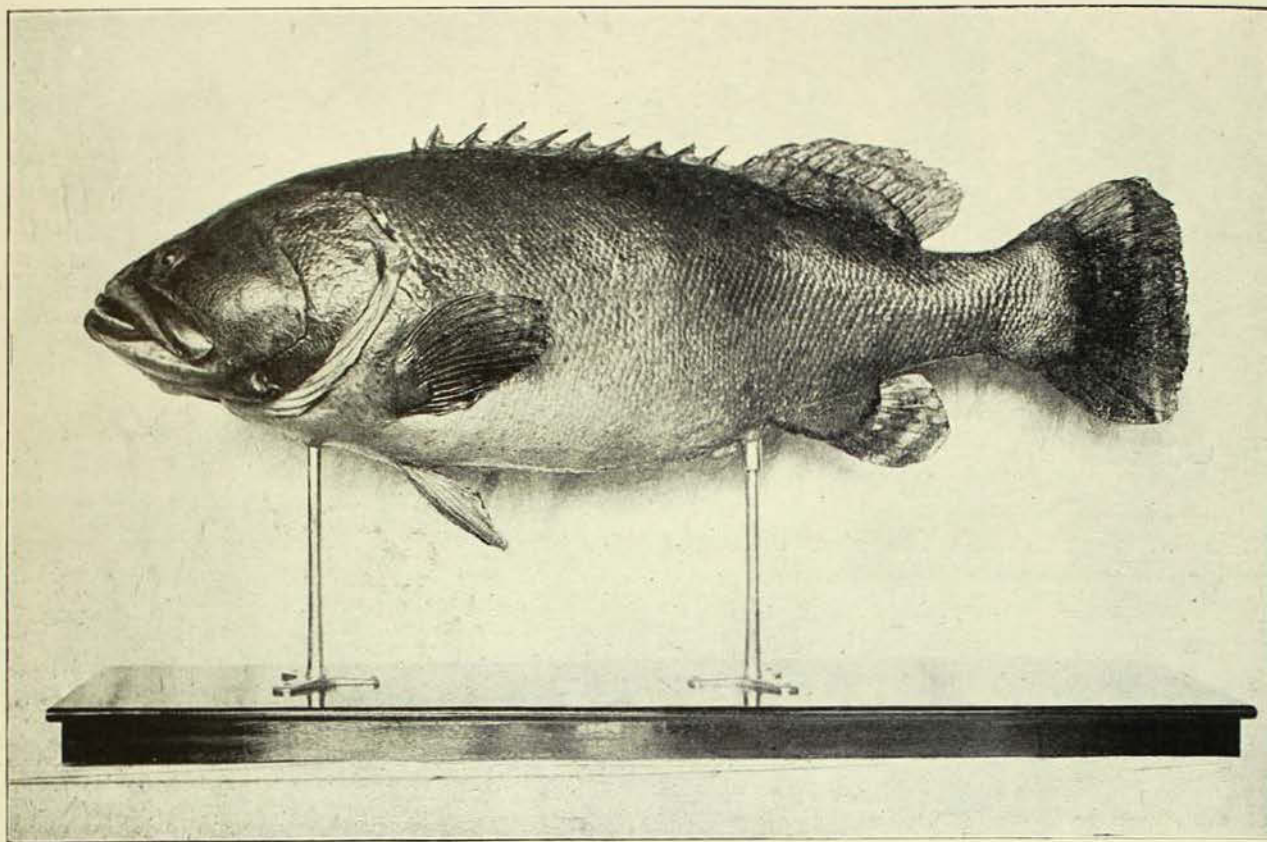


The "Koakoa," vernacularly known in Australia as the Queensland Groper (*Promicrops lanceolatus*). Some idea of its size may be gauged by the fact that Mr. H. S. Grant, standing beside the specimen and who is responsible for its mounting, is six feet in height.

[Photo.—G. C. Clutton.]

Fijian specimen was full of the remains of large and small crabs, identified by Mr. F. A. McNeill as Mangrove Crabs (*Scylla serrata*).

In his well known book *The Confessions of a Beachcomber*, the late E. J. Banfield wrote that the groper "will follow a man in the water with dogged determination foreign to the nervous suspicious shark. Recently a vigorous young black boy was attacked by a groper while diving for bêche-de-mer. The fish took the boy's head into its capacious mouth, mauling him severely about the head and shoulders, and but for his valiant and determined struggles would doubtless have succeeded in killing him." The late Allan R. McCulloch once told me that divers are afraid to descend to the trea-



The Groper as a finished museum exhibit—a striking example of modern taxidermy.

[Photo.—G. C. Clutton.]

tures of the wrecked Spanish galleons which lie around Boot Reef in the northern Coral Sea because of the large groper there. Whether they belong to the same species as the Queensland Groper or not nobody has been courageous enough to determine.

The full-grown Queensland Groper is not very handsome, being "all head and stomach"; according to Stead's *Fishes of Australia*, the head of one turned the scales at seventy-five pounds, nearly a third of the total weight of the fish. The colour of the adult is almost uniformly dark brown with a few spots on the fins. The young groper is much prettier, however, being yellow, ornamented with irregular dark blotches. As the fish grows, these markings assume roughly the shape of vertical bluish-black bands, breaking up into blotches and spots on the fins. When a length of a little over a foot has been attained, the bands resolve themselves into a network of marbling over the sides, and this gradually turns into the brownish colouring of the full-grown fish.

The flesh of this species is edible, but it is said to become tough and unpalatable with age; boiled portions of the Fijian fish were, however, relished by several who tried them.

The mounting of this huge fish constituted a task of no mean order for Mr. H. S. Grant, taxidermist, and his assistants, Messrs. J. H. Wright and W. Barnes. Fish of this size are rarely handled by taxidermists, and, as the Government of Fiji required durable as well as expert work, methods and means had to be carefully considered. After close study Mr. Grant devised a method of preparing a manikin upon which to place the skin. Such a method is a well known practice in the treatment of mammals, but not so regarding fish, and the following brief description may, therefore, prove of interest to other taxidermists and our readers.

When the fish arrived at the Museum it was frozen in a solid block of ice, from which it was thawed and a colour sketch made, and measurements and drawings carefully taken. These, of course, had to be taken with precision since they were to form the basis of the manikin. The next stage was to remove the skin, which was then placed in a specially made large tank and preserved so that it will last for all time.

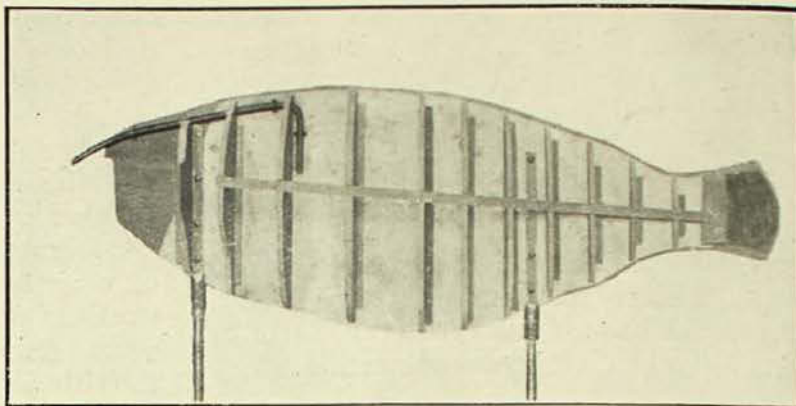
The manikin had now to be prepared, due allowance being made for any shrinkage

and working of the skin. The "keel" was fashioned out of redwood, for lightness, and side plates, conforming to measurements and drawings taken from the fish in the flesh, were attached at prescribed distances on each side. On to these two side-strips were fixed to keep the whole rigid, the head support rod, iron socket brackets and pedestals were then bolted into their prescribed positions on the keel. Over the frame wire gauze was tacked, and upon this was modelled a thin coat of papier mâché, giving the true contour of the body. When this was dry several thin coats of shellac were applied and the manikin was complete. In the meantime all superfluous tissues had been removed from the skin; this was essential not only to ensure permanency of the exhibit but also to enable the skin to fit closely and with an even surface.

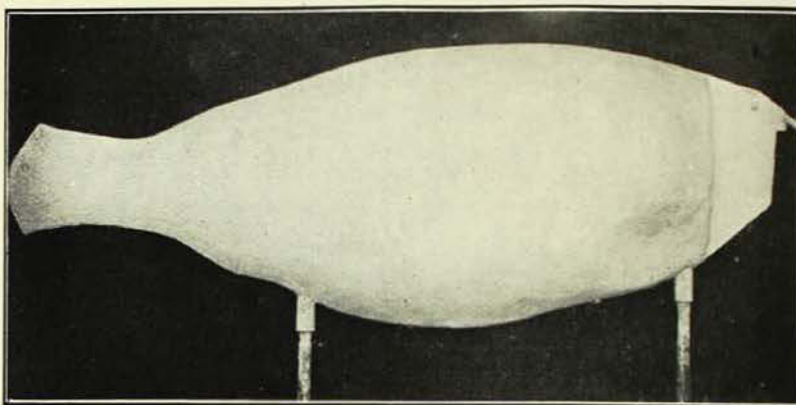
The skin was then fitted over the manikin, and so accurately had this been made that the fit was perfect. The skin was then sewn up, papier mâché worked into portions of the head and fins where required, and modelled into shape. A setting frame was then constructed, built round the fish, fins set out thereon and paper pasted over the whole to keep the scales down during the long process of drying. When dry the setting frame was removed, specially prepared artificial eyes fixed into the eye sockets, and the fish prepared for colouring.

The noted fish artist, Miss Ethel A. King, very delicately applied the colours, and when the exhibit left her skilful hands a true replica of the fish had been produced.

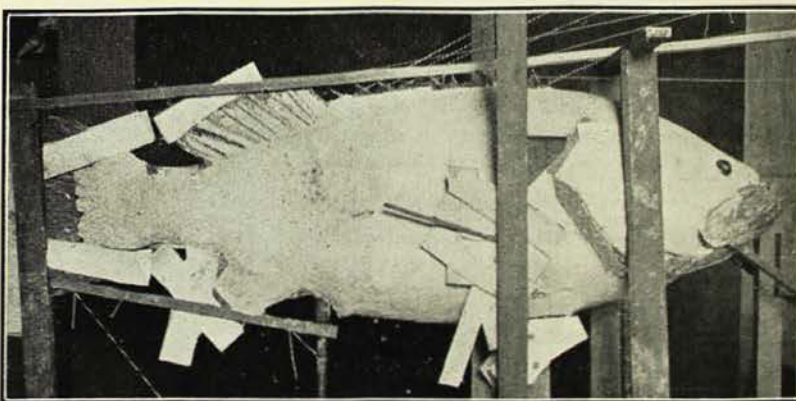
The fish was then fixed upon a polished oak stand, and gold leaf applied to the iron pedestals, the whole being an excellent example of modern taxidermy.



First stage, the manikin showing the keel, side plates, and head support rod.



Second stage, the manikin, framework as above, covered with gauze and papier-mâché.



Third stage, the manikin with the skin fitted, and in position in setting frame.

[Photos.—G. C. Clifton.]

Three other specimens were also mounted at the same time as the giant fish and, though smaller, are not devoid of interest.

One was a trevally (*Caranx sp.*), three feet eight inches long and weighing fifty-two pounds, and thus a large fish of its kind. The species has not yet been determined but it is evidently allied to the New Guinea

Caranx papuensis. The Fijian name is Varimoce or Varimosa. Miss King reproduced the fish's silvery tints, flushed with violets and pinks, with wonderful fidelity.

Another was a Giant Herring or "Ten-pounder" (*Elops hawaiiensis*), a widely distributed Pacific fish with an intensely silvery body. A little under three feet in length, this fine specimen weighed ten pounds. The species has not hitherto been recorded from Fiji, where it is known as Sila Sila.

The third specimen was the most gorgeous of all having wavy brown lines and stripes of varying thickness on a greenish ground colour, whilst the front of the head, which was adorned with a large bony knob like that

of a snapper, was bluish. Two dark stripes radiated from the eye. The fins were densely striped with brown and yellow, and the task of painting the mounted specimen from the sketches and photographs proved very trying for Miss King and those who temporarily assisted her. Nevertheless the finished exhibit looks so well that the tedious hours of work by preparators and artists were well worth while. This fish appears to have no common English name, so I propose for it the title of Wavy Tusk Fish in allusion to its colour-markings and large tusk-like canines. In Fiji it is called Yatu, whilst science has christened it *Cheilinus undulatus*. Our specimen was three feet and a half long, and weighed twenty-five pounds.

Reviews.

Animal Life in the Sea. BY R. J. DANIEL, M.Sc. University Press of Liverpool, Ltd.; Hodder and Stoughton, Ltd. London, 1925. (Our copy from G. E. Moore, Moore's Book Shop.)

This work gives in compact form a popular and readable account of the creatures that inhabit the ocean. The first chapter treats of life in the shallow seas, shellfish, crustacea, fishes, and others. These, though best known, are not so interesting as the inhabitants of the abysses which are described in the succeeding chapter. In response to the environment abyssal forms have developed special features, one of the most striking being the property of luminescence, though this is not restricted to dwellers in the depth. There is a special chapter devoted to "some large fish of the sea," such as the halibut, tunny, sunfish, manta, and shark, and another to the squids, some of which may have arms over twenty feet in length. The remaining chapters deal with whales and the whaling industry, some extinct marine monsters, and that elusive creature the sea serpent. The book concludes with a short bibliography of works dealing with life in the sea.

Last Leaves from Dunk Island. BY E. J. BANFIELD. With an introduction by A. H. Chisholm. (Angus and Robertson Ltd.), 1925. 10/6.

These, the posthumous writings of the "Beachcomber" (Edmund James Banfield), have been drawn together by Mr. A. H. Chisholm, the well-known naturalist, who had the good fortune to be an intimate of the author.

The "Beachcomber's" contributions to natural history literature have been familiar to Australians, and a host of readers elsewhere, for many years past, and this collection is in every way as excellent as the forerunners.

In an introduction written with a keen intuition, Mr. Chisholm has placed on easily accessible record many interesting details and incidents in the life of "Rob Krusoe," an earlier pen-name of the recluse of Dunk Island and has described him as a man "compact of energy." Banfield, accompanied by his wife, journeyed to Dunk Island 28 years ago in quest of health—the feverish rush of a journalistic career had sadly sapped his small lithe frame and left him but a wreck.

Here they dwelt—the words are his—in “this delicious Isle, this unkempt, unrestrained garden where the centuries gaze upon perpetual summer. It typifies all that is tranquil, quiet, easeful, dreamlike, for it is the Isle of dreams.” As his writings show, he was an ardent and accurate observer of Nature and her treasures, and he wrote with a fluent pen and rare style.

Last Leaves contents are varied; climate, aborigine and natural history are all treated and in that thorough manner so characteristic of Banfield.

Green Islands and Glittering Seas.—By MISS W. L. PUXLEY. George Allen and Unwin, London.

We have lately received from the publishers a copy of Miss W. L. Puxley's book. The authoress has been very observant during her island travels, and possesses the happy knack of setting down in an attractive form what has come under her notice. The description of the coral reefs, the tropical vegetation and the bird life, is very fascinating, while the sketches of the dusky inhabitants make very interesting reading. Although there are a few ethnological errors, the book forms a *pot pourri* of historical facts regarding the advent of white man in the Pacific, rarely found under one cover. It is well illustrated, and we can recommend its perusal to the nature student, especially to those interested in the denizens of the tropic isles.

The by-laws of the Australian Museum empower the Trustees to elect as honorary correspondents “persons who have rendered any service to the Museum or to the general cause of science.” The following benefactors, therefore, have been approved for election as Honorary Correspondents.

Messrs. R. E. Baxter, Lord Howe Island; H. Burrell, Sir Hugh Denison, Sir Hugh Dixon, Robert Dixon, William Dixon, Sydney; C. E. Hart, N. S. Hefferman, Solomon Islands; Mr. Anthony Hordern, Sir Samuel Hordern, Sydney; G. McAndrews, Shellharbour; A. E. Phillips, O. Phillips, Sydney; Dr. R. H. Puleine, Adelaide, S.A.; E. H. Rainford, Bowen, Q.; Sir Arthur Rickard, George Robertson, T. E. Rofe, G. A. Taylor, Mel-

The Mammals of South Australia. BY FREDERICK WOOD JONES, D.Sc. Part III. conclusion (British Science Guild, South Australian Branch). (Angus and Robertson, Ltd.), 1925, 5/-.

The completion of *The Mammals of South Australia* by Professor F. Wood Jones marks a distinct advance in Australian Mammalogy.

The first part, dealing with the monotremes and carnivorous marsupials, was reviewed in a previous issue of this MAGAZINE; part ii, containing an account of the bandicoots and herbivorous marsupials appeared in 1924, and the work is now rounded off in part iii, the Monodelphia (non-marsupials). It may occasion surprise to those who regard Australia as the land of marsupials when they learn that part iii is the most substantial.

The author has succeeded in producing a well-balanced account of Australian mammals and has covered a wide field. Anatomical structure is dealt with in an adequate manner, and in simple language, so that even the unlearned can appreciate the points of structure on which classification is based. The habits of the various species, their adaptations to environment, and the question of their possibilities of survival under the changed conditions which now menace their existence, are treated in a lucid and interesting manner. Unquestionably this is one of the most important contributions to the study of Australian mammals that has yet been published, and the author and the South Australian Branch of the British Science Guild are to be congratulated on the completion of the work.

bourne Ward, Dr. A. G. Waterhouse, Sydney; H. L. White, Scone, N.S.W.; W. H. Wooster, Canley Vale, N.S.W.; Alfred Wunderlich, Sydney.

Mr. Melbourne Ward upon many occasions has rendered the Trustees of this Museum valuable service. Learning recently of our need of a marine aquarium to further research work he placed one at our disposal complete with aerating apparatus. Mr. Ward's thoughtfulness will considerably facilitate researches and his kindness is much esteemed.

It is hoped at a later date to have such aquaria in the exhibition halls.

The Ravi, or Papuan Club House.

A Recent Exhibit.

BY W. W. THORPE.

The ravi exhibit, recently completed, is perhaps the most ambitious effort yet attempted in this Museum in the way of group exhibits, and brings before the citizens of this State a glimpse of stone age man and his doings.

When the late Allan R. McCulloch, to whom this institution owes a vast debt, was in the Delta region of Papua with Captain Frank Hurley he was immensely impressed with the ravi, or native club house,* and upon his return here he immediately applied himself to the task of creating an exhibit representing this native institution. From photographs, sketches, notes and measurements taken in the field, Messrs. G. C. Clutton, J. Kingsley, and W. Barnes, preparators of this Museum were enabled to construct the fine exhibit now displayed, and which we illustrate in the frontispiece of this issue of the MAGAZINE.

Palm leaves for thatching and timber for the framework were procured, and what was not obtainable was successfully imitated in plaster and fibre. Papuan trophy skulls were assembled, other appurtenances such as gopi boards, weapons, masks, and utensils completed the ensemble, four cubicles were completely furnished, and to give an illustration of distance (for these ravis range to a few hundred feet in length, though ours of necessity is reproduced from a much smaller one), a painted background was prepared. To add life to the exhibit our preparators constructed a life-size figure of a Papuan warrior, which was gaily and appropriately dressed and placed at the entrance.

To several esteemed friends of this Museum, Sir Arthur Rickard, Sir Samuel Hordern, Sir Hugh Dixon, Messrs. T. E. Rofe and Orwell Phillips, who jointly contributed £120 to cover the cost of casing, our warmest thanks are extended, without their generous help it would have been impossible for us to provide the necessary protection for this striking exhibit.

The custom of building club-houses for men has an extensive vogue in Papua. In Urama, on the Purari Delta, whence our model had

its origin, these structures are referred to as "ravi." In other parts of the territory they are known as dubu, eravo, or eramo houses. Speaking generally of these buildings Dr. W. M. Armstrong, Anthropologist to the Papuan Administration, says "These dubu houses are a species of men's club houses of great size, forbidden to women, and are associated intimately with the magico-religious ceremonies of the people, especially the initiation of boys, and a species of ancestor worship."

As the late Mr. McCulloch graphically described the ravis of Kaimari in the article referred to above there is no need to repeat what he said, but perhaps the legendary account of their origin at Maipua, also in the Papuan Gulf, may be of interest. Their beginning is said to be associated with cannibalism and the Rev. James Chalmers, an early missionary in these parts, who was himself killed in a "longhouse" and eaten by the natives, places on record that the women folk were the originators. The story goes that at the village of Maipua, some male members of the community were returning from a hunting expedition, and, as was their wont, were dancing and singing at intervals on their homeward journey. When they approached the village the women went down to the river bank to meet them. They had in their canoes wallabies, boars, and cassowaries. Asked what success they had, they invited the women folk to have a look. The women said—"That rubbish; who is going to eat that?" This puzzled the men, until one of their number, more enlightened than the rest, said "I know what they mean, it is man," and throwing the wallabies and other animals ashore, away they started to a neighbouring village and brought back ten bodies. As they neared the bank the women saw what they had, and shouted "Yes, yes, that is it. Now you can dance and sing, you have something to dance and sing about." The bodies were singed, cooked and eaten, and pronounced good.

This man-killing led to the building of club houses, in order that the men might have a

*THE AUSTRALIAN MUSEUM MAGAZINE, Vol. 1, No. 10, 1923, pp. 293-300.

place to themselves to rejoice in when returning from a successful man-hunt.

After a fight in which heads had been taken the victorious party, returning to their villages, were met by the women, who danced around them in celebration of their achievement. The men who had taken the heads at a distant village would send presents of food to their tribal neighbours to provide a feast in commemoration.

The heads were cooked in earth ovens

until the flesh came away from the bone, the skulls were then soaked in water, and when clean were placed in the ravi above the sleeping place of the slayers. While the heads are being cleaned a dance of triumph is kept up. Skulls appear to be taken merely as vouchers for the bravery and strength of those who take them. There appears to be no exchange of skulls on peace being made between the hostile tribes; when a man dies the skulls he has taken during life are buried with him.

A New Gallery Exhibit.

A Large Paper Wasp's Nest.

BY T. G. CAMPBELL.

THE gallery collection of the Department of Entomology has been recently enriched by the addition of a large paper wasp's nest. This nest is the gift of Mr. Colin Geissmann, of Mount Tambourine, Southern Queensland, an enthusiastic collector who has rendered yeoman service to members of the Museum staff who have visited the mountain.

Paper wasps belong to the family Vespidae and the large nest on view, secured in the vicinity of Mount Tambourine, is a monument to the skill of one of the smaller members of this family. This species, *Rhopalidia cabeti*, is said to occur in Australia and Tasmania, but all specimens in the Museum collection come from Queensland. The adults measure about three-eighths of an inch in length, and a colony contains very many individuals. The nest is composed of "wasp paper" the cells forming large combs somewhat like those of the hive bee, but with only a single row of cells. Each cell is of the typical hexagonal form, its opening being about one eighth of an inch in diameter.

A typical nest of a "paper-nest wasp" is that of *Polistes variabilis*, which constructs a small mushroom-shaped nest, usually attached to a tree or the eaves of a house. This may measure six inches in diameter and the cells are large, being about one third of an inch across. The wasps are much larger than the tiny *Rhopalidia cabeti*, and measure about five-eighths of an inch in length.

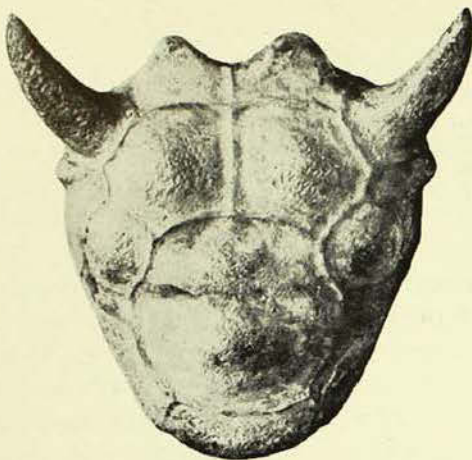
The material known as "wasp paper" is a kind of wood-pulp, small portions of dry wood being rasped off by means of the wasp's jaws and mixed with saliva. Paper wasps are social insects and in some communities there are three types of individuals, a functional female or "queen," workers, and males. Among some of the paper wasps the workers and males perish during the autumn, while the "queens" hibernate during the winter and give rise to new colonies in the following spring. Other types of paper wasps form perennial colonies which survive for some time. In the early spring the "queens" search out suitable places to build, and then gather together the necessary materials for the construction of the nest. A small number of cells are built and an egg is deposited in each. The larvae on hatching are cared for by the parent female until they pupate. On emergence these individuals, which are always workers, take over the duties of caring for the young and adding new cells to the nest, the parent female devoting her attention solely to egg-laying.

Rhopalidia cabeti and its allies form perennial colonies in which workers are either absent or numerically few. When present they are but slightly differentiated from the functional females. These nests emit swarms of females sometimes accompanied by workers. This type of colony has no true "queen" and is possibly more primitive in its organisation than those colonies of paper wasps which are presided over by a single "queen."

The Extinct Horned Turtle *Meiolania*.*

By C. ANDERSON, M.A., D. SC.

THE low-lying parts of Lord Howe Island, which is situated about 300 miles east of the New South Wales Coast, are largely covered by a consolidated coral-sand formation of no great thickness. In composition this formation resembles the recent beach deposits



Model of the skull, dorsal view, of *Meiolania platyceps*, Lord Howe Island. Prepared by J. Kingsley, Australian Museum. About one-fifth natural size.

[Photo.—G. C. Clutton.]

of the island and it is generally regarded as an accumulation of wind-borne sand. About fifty years ago, or perhaps earlier, certain bones were discovered, embedded in or washed out of this coral sand formation, and when they were submitted to Sir Richard Owen, Director of the British Museum, he named the animal to which they belonged *Meiolania platyceps*, which he regarded as a kind of lizard. The keen-eyed Huxley re-examined the bones and showed that *Meiolania* was not a lizard but belonged to the reptilian order Chelonia, comprising the turtles and tortoises.

But that is not the real beginning of the story. At a still earlier period the imperfect skull and part of the bony tail sheath of a similar animal, known now as *Meiolania oweni* had been found in the alluvial deposits of King's Creek, Darling Downs, Queensland. It may seem strange that two members of the same genus of Chelonians should be found, one in the interior of Queensland, the other

in the lonely island of Lord Howe, but, stranger still, about 1900 a third species, which is known as *Meiolania argentina*, was found in much older rocks in Patagonia. As it was thought that *Meiolania* was a land or marsh turtle and unable to cross the sea this new discovery created great interest. There are many resemblances between the animals and plants of South America and Australia, and, in order to explain this phenomenon, it had been argued that at one time there was a land connection between these two regions, probably brought about by northerly extensions of the Antarctic continent. The occurrence of *Meiolania* in these widely separated spots was thought to be an additional argument in favour of the existence of this old land bridge.

Fresh light has been thrown on this question by the discovery within the last few years of still another species of *Meiolania*. About a hundred miles south east of New Caledonia lies the small island of Walpole. It is a recently formed island, entirely composed of



Model of the skull, side view of *Meiolania platyceps*, Lord Howe Island. Prepared by J. Kingsley, Australian Museum. About one-fifth natural size.

[Photo.—G. C. Clutton.]

coral sand and rock phosphate, and in all probability it has never been connected with any large land mass. Here scattered through the phosphatic deposits, which are being exploited by the Australian Guano Company, fragmentary bones were found and brought to

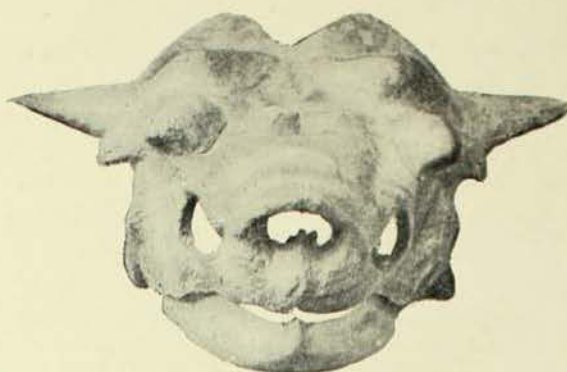
*Anderson—*Records of the Australian Museum*, xiv. 4, 1925, pp. 223-242, plates xxx-xi.

the Australian Museum by Mr. A. C. Mackay, engineer to the company. These were readily identified as meiolanian, belonging to a form very similar to *Meiolania platyceps* of Lord Howe Island but smaller and more slender in build. As it could have reached Walpole Island only by swimming it is probable that *Meiolania* was not a purely land form, but that most species at least could make short sea trips and did not require a continuous land surface for their migrations. It is also conceivable that the ancestors of *Meiolania* originated in the northern hemisphere, and that one branch of the family migrated to South America a long time ago, and another travelled southwards over the island stepping stones of the Malay Archipelago to Australia and the Pacific.

No more meiolanian remains have been discovered in Queensland or Patagonia, but parts of many individuals have since been unearthed at Lord Howe Island, and a large series of the bones of *Meiolania platyceps* is now in our collection, having been secured by residents or collected by members of the staff when on holiday trips to this charming little island. Consequently we know more about the Lord Howe Island form than any of the others, and a close study of its skeleton sheds some light on the affinities of this strange animal.

One of the most striking features of Chelonians is the strong bony box or shell in which their bodies are enclosed. In many forms the head, limbs, and tail can be withdrawn within this fortress, so that the animal secures complete protection from its enemies, and no doubt this device has enabled the order to maintain its existence through the long geological ages since it first appeared on the earth. *Meiolania*, too, had a shell, though apparently not a very thick or strong one, and in addition it had bosses and horns on its head, and its long strong tail was enclosed in a bony sheath armed with formidable spikes. On the back of its head were two large horns not unlike those of ruminants, but varying in shape and disposition in the different species. In the Queensland and Patagonian forms the large cranial horns stand out horizontally on each side as in some breeds of cattle, while in the Lord Howe and Walpole Island animals they curved boldly upwards and backwards something like those of a goat. Whether *Meiolania* used

those formidable horns to defend itself from enemies, or whether they were employed in wrestling bouts with its fellows, is a moot point. Some living tortoises fight with one



Skull of *Meiolania oweni*, from the Darling Downs, Queensland. In this form the cranial horns stood out horizontally, and from tip to tip there was a span of about two feet. This is the earliest species described.

[After Smith Woodward.]

another in a peculiar way, each striving to turn the other on its back, and we can visualize homeric battles between two enraged meiolanian rivals, each endeavouring to insert his horns underneath the shell of his opponent, and perhaps using his long tail as a fulcrum as he heaved mightily in an attempt to put the other on the mat. Or perhaps the horns and tail spikes were but useless excrescences such as seem to develop without rhyme or reason in races which are nearing extinction.

Meiolania platyceps of Lord Howe Island apparently grew to a size comparable with that of the giant tortoises of the Galapagos and Mascarene Islands, though many of the bones found belonged to much smaller individuals. Its cranial horns sometimes reached a length of four inches with a span of ten inches between their tips. Its limbs resembled those of river or marsh turtles in some respects, but in others, particularly the hoof-like terminations, they are like those of typical land tortoises. Thoroughly aquatic turtles such as the common Green Turtle and the Luth have their limbs modified into swimming paddles or flippers, but *Meiolania* shows no adaptation of this sort.

Modern Chelonians are divided into two main divisions according to the manner in which they withdraw their heads under their shells. One group called Cryptodires bend their necks in an S-shape in a vertical plane, another, the Pleurodires, to which belong



Posterior part of the skull of *Meiolania platycephala*, Lord Howe Island, showing the large cranial horn cores, which curve upwards and backwards, somewhat like those of a goat. About three-fourths natural size. Australian Museum specimen.

[Photo.—G. C. Clutton.]

all our Australian Chelonians exclusive of marine form, bend their necks sideways. The structure of the neck bones is different in the two groups, and it is a matter of importance to discover if possible what was the condition in the neck of *Meiolania*, which has generally been looked upon as a member of the pleurodire division. In our collection is a nearly complete set of the neck vertebrae of *Meiolania platycephala*, and, when this specimen was cleared of the coral matrix by treatment with dilute acetic acid (which removes the coral sand without injuring the bone), the discovery was made that its neck had not the special adaptations of either the Cryptodires or the Pleurodires. It appears that *Meiolania* could not withdraw its head under its shell by bending its neck either in a vertical or in a horizontal plane; in any case its horns would prohibit retraction.

Now an extinct suborder of Chelonia called the Amphichelydia, which died out long long ago, had a neck structure not unlike that of *Meiolania*, and it seems probable that *Meiolania*, whilst it differs in some respects from a typical amphichelydian, may be a modified descendant of that old group. If that be a true view, *Meiolania platycephala* of Lord Howe and *Meiolania mackayi* of Walpole, both of which have become extinct quite recently, afford another instance of the survival in the Australasian region, the land of living fossils, of forms which have died out long ago in other parts of the world.

Judging from the abundance of its bones in the coral-sand rock of Lord Howe Island *Meiolania platycephala* must once have frequented the beaches there in large numbers. An interesting fact is that, now and then, casts and moulds of its eggs are found, and my former colleague, the late A. R. McCulloch, who had made a close study of the mode of occurrence, was of opinion that *Meiolania platycephala* was a marine turtle, which came ashore only to deposit its eggs in the sand as the Green Turtle does to-day, and



Egg mould of *Meiolania platycephala*, Lord Howe Island. The shape of the egg has been preserved by the encrusting coral sand. About one half natural size.

[Photo.—G. C. Clutton.]

that some came to grief and left their bones ashore. Another view is that it was an estuarine or shore-living turtle which was accustomed to make short excursions to sea.