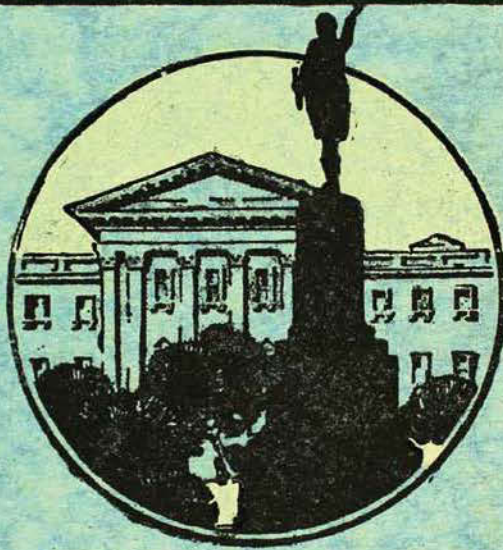


The
AUSTRALIAN
MUSEUM
MAGAZINE

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



Early Days

The Isles of Santa Cruz - - -
E. Le G. Troughton and A. A. Livingstone.

History of the Trout in New South Wales
H. K. Anderson

Water Bugs - - - - - *Thos. C. Campbell.*

Australia's Largest Fossil—The Rhoetosaurus Dinosaur
Heber A. Longman

Angler Fishes - - - - - *G. P. Whitley*

A Census of Australian Fishes - - *G. P. Whitley*

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THE AUSTRALIAN MUSEUM

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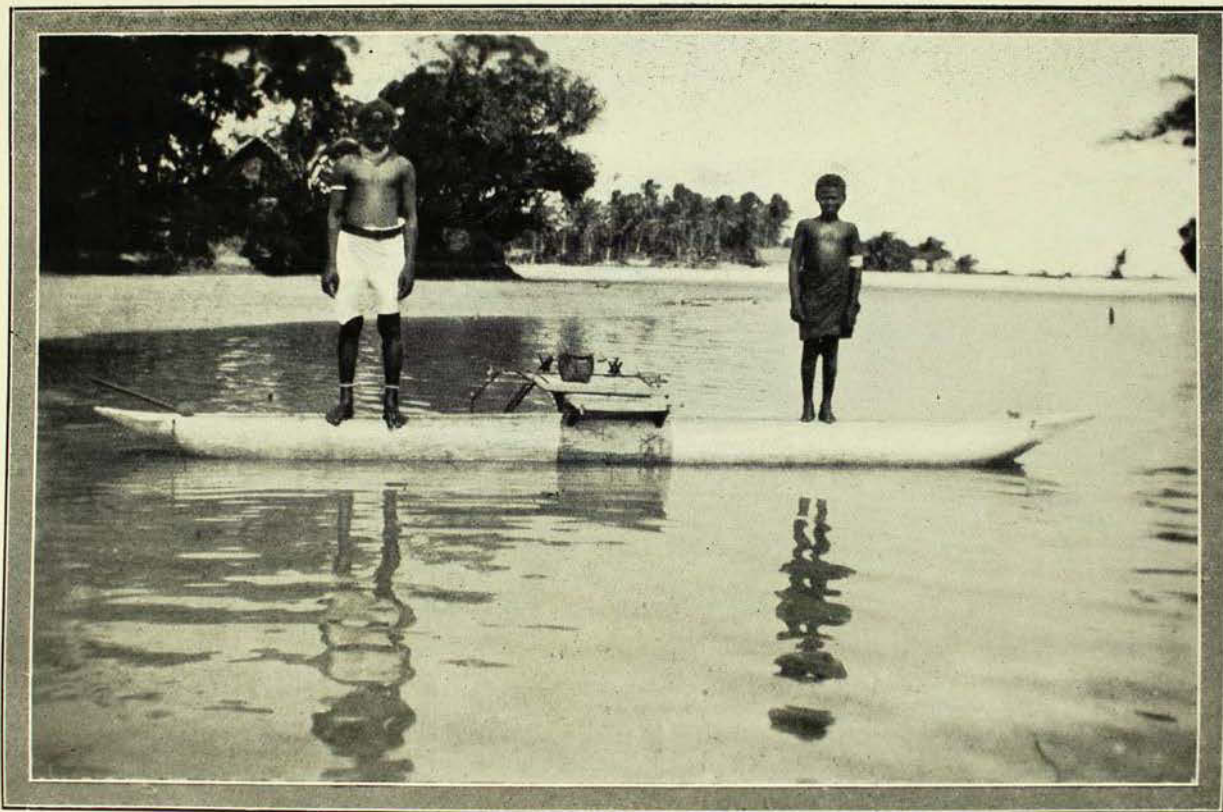
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MUSEUM MAGAZINE should be addressed to the Secretary.



Two keen volunteer collectors "dress ship" as our vessel, the A.V. "Tulagi," leaves her anchorage at Mohawk Harbour, Reef Islands, one of the loneliest spots in the Santa Cruz Group. Both boys were exceedingly helpful, the piccaniny stalking birds and butterflies for hours on end, and the older one taking Livingstone in his canoe to shoot seabirds otherwise unobtainable. On a nearby island there is a mission church, while to the left may be seen the peaked roof of the missionary's single-roomed house. Suffering the effects of malaria, and several years of solitude, the missionary was removed in a critical state of health on the previous cruise of the "Tulagi."

[Photo.—A. A. Livingstone.]



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VOL. III., No. 3.

JULY-SEPTEMBER, 1927

Early Days.

IN a recent issue under the heading "Centenary of the Australian Museum" some notes were given on the early history of the "Colonial Museum," as it was called. Until the Linnean Society of New South Wales was established in 1874 there was no scientific society in Sydney specially concerned with biology, and the Colonial Museum was the place where those interested in natural history met as members of the Committee of Management or of the staff and discussed matters of common interest. All the leading zoologists of the Colony were thus connected in some way with the Museum, which formed a kind of zoological club. It is interesting therefore to know something about these men, who in their time exerted a very important influence on the pursuit of zoological knowledge in a country where many of the animals were of a new type.

Alexander Macleay, who at the age of fifty-eight came to Sydney in 1825 to fill the position of Colonial Secretary, had long been an ardent worker in entomology, and for several years he had acted as Secretary of the Linnean Society of London. On his arrival in Australia he took a prominent part in promoting the study of the flora and fauna of his new home. He has been

called the "Father of Zoology" in Australia, and we know that, if he was not actually the founder of the Museum, he took a lively interest in its inception and progress. He was probably the first to suggest the establishment of a museum here, and he was chairman of the first committee formed in 1836 and continued to take an active part in museum affairs until his death in 1848.

Another early member of the Committee was William Sharp Macleay (1792-1865), the eldest son of Alexander. After a period of years spent mostly in the diplomatic service, he retired and thenceforth devoted himself to scientific pursuits. In 1839 he arrived in Australia, and became a member of the Committee in 1848. It was by his advice and co-operation that the act incorporating the Australian Museum was introduced and passed in 1853, and he continued to be a member of the Board till 1862. He has been described as "the life and soul of the institution." W. S. Macleay was a voluminous writer on natural history, and is perhaps best known as the author of the so called *Quinary System*, a pre-Darwinian attempt to formulate a natural system of classification, which however never obtained any considerable measure of support.

Sir George Macleay (1809-1891), second son of Alexander, was also a member of the 1836 Committee. He had followed his father to Australia in 1827, and was mostly engaged in pastoral pursuits near Camden. He accompanied Captain Sturt, also a member of the original Committee, in his expedition down the Murrumbidgee and the Murray in 1829. He was a member of the Committee or an Elective Trustee from 1836 till 1859.

Sir William Macleay (1820-1891), nephew of Alexander, came to Australia with his cousin George in 1839, and for fifteen years was engaged in sheep rearing. He was an elective Trustee during the years 1861-1877, but is best known as the liberal patron of the Linnean Society of New South Wales, and the founder (1889) of the Macleay Museum, University of Sydney, where the collections made by Alexander and William Sharp Macleay, and greatly augmented by himself, are deposited. Sir William Macleay was the Maecenas of Australian science, and his munificence has already had far-reaching effects. The researches published in the Linnean Society's Proceedings, and including those of the Macleay Bacteriologist, and a succession of distinguished Macleay Fellows, form an enduring monument to this great-hearted patron of science.

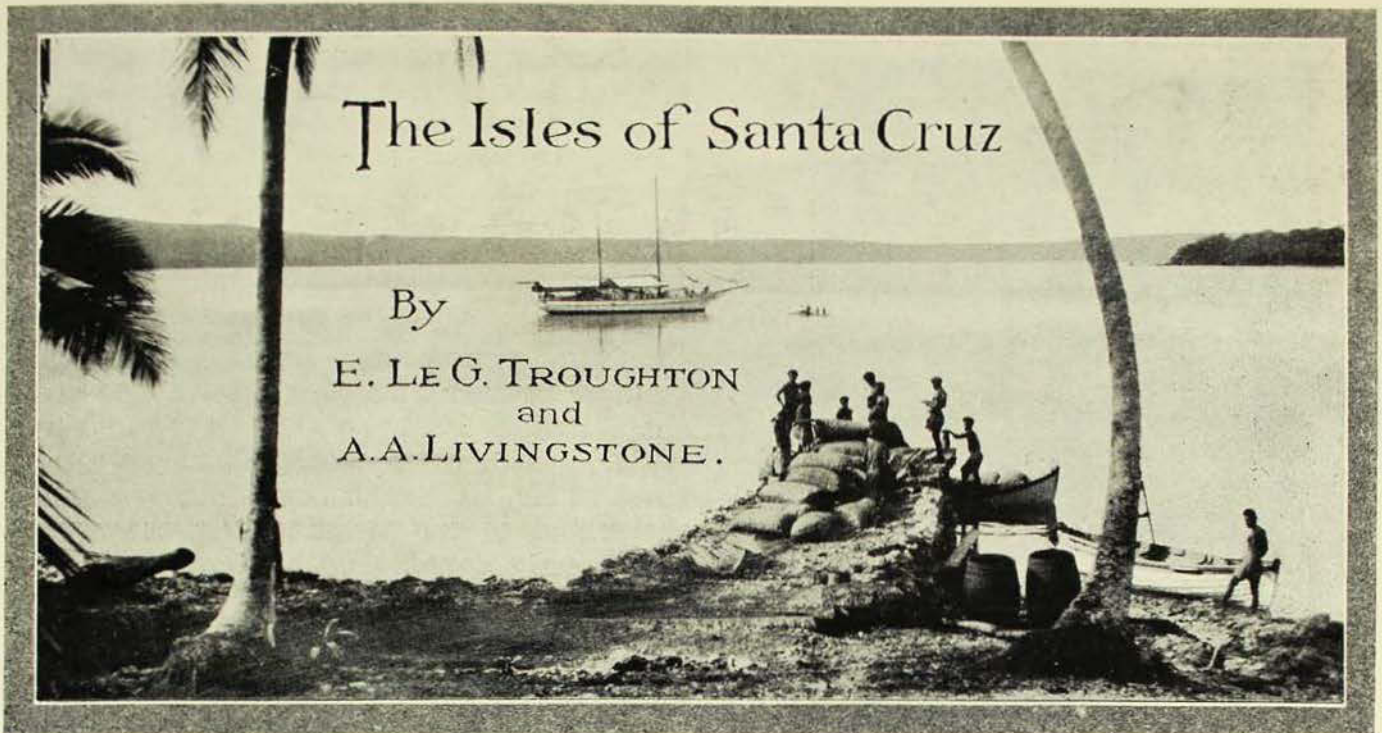
Dr. George Bennett (1804-1893) was an outstanding figure in scientific circles in the middle of last century. After two visits to Australia he finally settled in Sydney to practise his profession of medicine, but he seems to have had plenty of time to pursue the study of natural history, and he took an active interest in all scientific movements. He was the first Curator of the Colonial Museum, and in various official documents he is referred to as director, superintendent, conservator, zoologist, curator, or secretary. He was apparently an officer of the Museum from 1836 to 1838, a member of the Committee 1838-1853, Elective Trustee 1853-1874, so that he was connected with the Museum for the long period of 38 years. Dr. Bennett was an accomplished naturalist and writer, and his *Wanderings of a Naturalist* (1843) and *Gatherings of a Naturalist* (1860) are classic works. For fifty years he corresponded regularly with Richard Owen, the great comparative anatomist and palaeontologist, and procured for him many of the specimens

on which his writings on the extinct animals of Australia are based.

The second Curator was the Reverend W. B. Clarke (1798-1878), "the Father of Australian Geology," who was a member of the Committee 1838-1853, secretary 1838-1841, Secretary and Curator 1841-45. From 1853 to 1874 he was an Elective Trustee. His successor as Curator was William Sheridan Wall (1814-1876), who was born in Dublin and arrived in Sydney about 1840. He was an excellent anatomist, and his *History and Description of the Skeleton of a New Sperm Whale*, published by the Trustees in 1851, proves him to have been a skilled osteologist.

Sir Thomas Livingstone Mitchell (1792-1855) served in the Peninsular War under Wellington, and came to Australia in 1827 to act as Deputy Surveyor-General. In the following year he succeeded Oxley as Surveyor-General, and subsequently surveyed eastern Australia, laying out towns, roads, and public reserves. He had a strong scientific bent, and his *Three Expeditions into the Interior of Eastern Australia* (1838) contains much valuable information regarding the aborigines, and the plants, animals, and geology of the country traversed. He does not seem to have been closely associated with this Museum, though for a short period he was a Trustee, but his discovery of fossil marsupials at the Wellington Caves led to their systematic exploration by the Trustees, the work being supervised by Krefft, who had become curator in 1861.

Johann Ludwig Gerhard Krefft (1830-1880), generally known as Gerard Krefft, born in Brunswick, Germany, went to America in 1850, where he was employed as a clerk and draughtsman. He studied the works of Audubon in a New York library, and by copying and selling some of the illustrations he made enough money to pay his passage to Australia. He became an assistant in the Melbourne Museum, but in 1860, after a short visit to Germany, he settled in Sydney, where he was appointed Secretary and Assistant to Pittard, Curator of the Australian Museum, whom he succeeded, resigning in 1874. During his period of office he made important contributions to vertebrate zoology and palaeontology, and he was recognized as an authority on snakes.



Loading copra from Buckley's trading station at Trevanion Island, which overlooks the wide expanse of Graciosa Bay.

[Photo.—A. A. Livingstone.]

SANTA CRUZ or Ndeni Island, whither we are bound, is about sixteen miles long, densely wooded, and well watered, and is memorable as the scene of many tragedies, the natives until quite recently bearing the worst of characters. Conflict with them contributed to the failure of Mendana's attempt at settlement in 1595, the group not being visited again by Europeans until nearly 200 years later when Carteret rediscovered it in 1767, losing his pilot and boat's crew by the people's treachery, or was it age old instinct for self preservation? In 1875 Commodore Goodenough was murdered when on a visit of peace, but five years later Bishop Selwyn succeeded in winning the confidence of the east coast natives and founded a mission there. Santa Cruz has since been visited by many expeditions, that of the Australian Museum, if possibly the smallest, being certainly one of the most productive from the zoological point of view.

Other islands of the group are the Matema or Reef Islands, Utupua, and the still active Tinakula or Volcano Island, which were visited by us; outlying are the Duff Islands to the north-east, and the isolated Tucopia, Cherry, and Mitre islands. It is surprising that Great Britain's opportunities, coupled with her rediscovery of the group

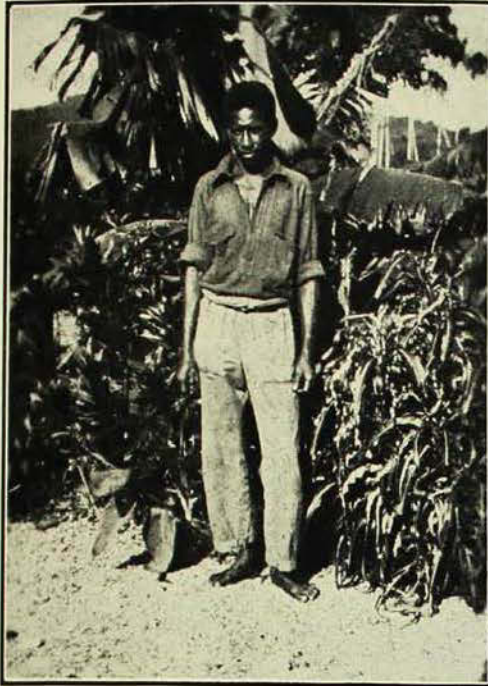
in 1767, did not lead to earlier annexation, for it was not until 1898 that H.M.S. *Mohawk's* cruise extended the British protectorate over the southern Solomons to Santa Cruz.

OUR EXPERIENCES BEGIN.

The close of the first article* left us safely established aboard the *Tulagi*, where Mr. N. S. Heffernan, District Officer of the Group, with characteristic concern for our health, insisted we should sleep when possible, and do our evening work, to escape the anopheline mosquitoes which launch massed attacks from the mangrove swamps bounding the settlement of P \acute{e} u on either side. It is doubtless to the experience and solicitude of our host that we owe our immunity from malaria and the dreaded complication of blackwater fever.

Though it was mid-July the heat and humidity made our first day ashore particularly trying. Collecting gear had to be re-arranged and transferred to the *Tulagi*, or to the District Headquarters, and the proper stowage of collecting chests, six-gallon cans of alcohol, guns, traps, and photographic apparatus, was heavy work, and moreover taxed our knowledge of

* *The Australian Museum Magazine*, vol. iii., No. 2, April-June, 1927, pp. 41-46.



The accomplished Bosun and Chief Engineer, John Asa, a Solomon Islander who is perhaps one of the "Museum Magazine's" most appreciative readers. Promised some memento of his valuable services to the authors, he chose a dictionary, and writes excellently phrased letters which invariably conclude with a simple expression of his love.

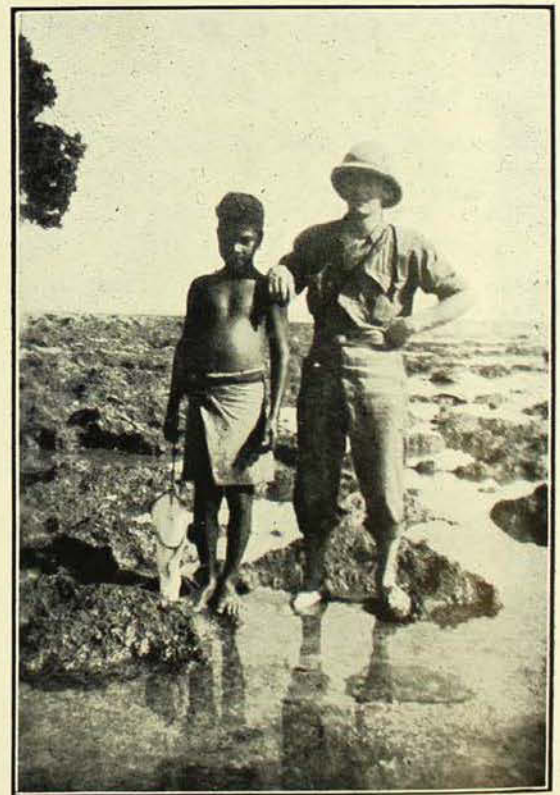
[Photo.—A. A. Livingstone.]

pidgin English severely. A Wardian chest for the housing of orchids, desired by Mr. O. C. Beale, who had helped the expedition very materially, puzzled the natives until finally realising its purpose they dubbed it "small fella house belong flower."

The capable crew, consisting of six "boys" and two piccaninnies, was in charge of Boatswain John Asa, an extremely agreeable and intelligent Solomon Islander, who not only reads THE AUSTRALIAN MUSEUM MAGAZINE but also writes his mother in the Solomons all about it. He was chief engineer as well and treasured a treatise on marine oil engines, the contents of which he must have often longed to infuse into the stolid mind of Menelua, the assistant engineer. Not the least helpful was the stupid but docile Keo, a huge native detailed as orderly to carry our haversacks, guns, butterfly nets or cameras, which he did with unlimited patience, opening and shutting bags or killing-bottles hundreds of times a day with the same indifference with which he watched us bound through prickly bushes after butterflies, or manoeuvre an indignant land crab into a tin. Pre-

siding over the domestic side of our schooner life, Kesi, a Reef islander, did remarkably tasteful things with the inevitable assortment of tinned goods ranging from brussels sprouts to boiled mutton, his only failings being a fixed idea that a tin of pork and beans was a foundation for a gallon of soup, and the regularity with which he selected quinces when ordered to bring "some fella float." Assisting him were the two youngsters, Daumago and his younger brother Piccaninny, attractive little chaps hailing from the Duff Group in Polynesia, where their mother had entrusted them to Mr. Heffernan's care. They showed the value of his training, for they were surprisingly capable cook-stewards, baking excellent bread and scones, making beds in approved steamer style, and having a remarkable capacity for finding new places for everything when tidying up.

Wearied with the long day and despite the novel surroundings we were soon dozing contentedly in our bunks, lulled by the lapping waves and the drowsy murmur of a native "sing-sing" ashore. Alas, into this Stevensonian atmosphere broke a medley



Livingstone prepares to explore coral pools on the shore reef at Carlisle Bay, aided by the agreeable Daumago, who proved an excellent if excitable collector with the hand-net, when not busy as cook or laundryman.

[Photo.—E. Le G. Troughton.]



A typical scene of life astern on the "Tulagi." To his delight, Piccaninny takes a turn at the wheel, while Kesi the cook, on the extreme right, thinks out new dishes. Aloft swings the breakfast ham, and on the left is the orchid chest and a prisoner sentenced for wife-beating.

[Photo.—E. Le G. Troughton.]

of sounds, weird and alarming until traced to their source, a spree amongst a party of Japanese trochus-shellers, singing ditties in their native tongue till even that became inarticulate, when they carried on with a gramophone and a petrol tin obligato. Next morning, however, started pleasantly with a dive overboard and a freshwater shower in the tiny bathroom, followed by bacon and eggs in the best Kesi tradition. Later there was a pleasant interlude when several ladies making the round tour on the *Makambo* came to tea on the *Tulagi*, an experience they found thoroughly interesting, while they considered our host's sponge sandwich and Piccaninny's scones beyond reproach. Being the youngest and quite the most serious of the ship's complement, Piccaninny, with his dark eyes, shining teeth, necklet of green beads, and blue lava-lava setting off his dark skin, was acclaimed a "darling," and the ladies departed regretting the law which prevented them adopting him as a solution of the servant problem.

Presently, the last kauri log loaded and Mr. Heffernan having done the honours as health officer and harbour-master, the *Makambo* threaded her way out through the treacherous coral passages, with a farewell salute from her siren. During the morning Mr. Whiteley

McCoy of Norfolk Island, who was rejoining his vessel at Santa Cruz, raised our quota of whites to four. About midday "up anchor" was ordered, and we were soon sailing up the lagoon between the coral barrier of the reef and a network of mangrove entanglements ashore. All the islands of the group are volcanic, but despite the mountainous nature of Vanikoro, whose highest peak, the extinct Mt. Kopogo, is 3,031 ft. above sea level, there is a sameness about the scenery. The scarcity of coconut palms, so characteristic of

other islands of the group, due to the limey nature of the soil, and the mesh of green vines draping even the tallest trees and giving the impression of a bubbling cauldron of green, adds to the monotony.

Several miles from P \acute{e} u occurs one of the few breaks in the verdant expanse of draped tree-tops, where there is a grassy hill of brilliant green from which streaks a lone coconut palm, like a petrified rocket against the skyline. Native legend says that a despatch box and treasures of La Perouse were buried here and as the D.O. unfolded the pidgin English version of the story we felt like embarking on a



Friend McCoy of Norfolk Island points out some interesting fish, too small for Keo's bow and arrow, while some of the crew try to capture them. Second from the right is Billy who proved a devoted assistant collector, taking great personal pride in our successful haul of shells, crabs, fishes, and other teeming marine life of the tropics.

[Photo.—A. A. Livingstone.]

treasure hunt. The story is that upon the approach of danger one of La Perouse's officers handed over a cash box, log, and records to a native woman whose affection he had won; the remaining whites being killed shortly afterwards, she took to the bush from Péu, and while passing the grassy spot saw two ships standing off to sea. Becoming frightened, she broke down a sapling, tore the rough edges off with her teeth and dug a hole, in which she buried the box, marking the spot with a coconut which she carried for food. To this day natives say that when fishing off the reef, about three miles out, they can see fire rising on the grassy spot, and vow it is the reflection of gold. Has this queer mixture of fact and fancy any real significance and does that lone palm stand sentinel over the secret of La Perouse's fate? Alas we could not spare time to track down a legend when the surroundings teemed with animal life, and chests and cans were waiting to be filled.

Our destination was the beautiful islet of Naunaha with its thick growth of breadfruit and other tropical trees. About 300 yards long with a beach of coral shingle, it is sheltered by the main reef, and being separated by a wide expanse of lagoon from the mainland of Vanikoro, is an ideal spot regarded as the local health resort. It is the haunt of many birds and a large species of fruit-bat or "flying-fox," specimens of which were taken to Paris by the French naturalists, Quoy and Gaimard, who obtained them in 1828, and we were delighted to land and begin collecting in such promising surroundings. While the D.O., Livingstone, and Billy, who was an excellent shot, started on a bat shoot, Troughton amazed some of the boat's crew by his antics in alternately grubbing in the carpet of leaf-mould for land shells and tiny but extremely active land shrimps, and pursuing butterflies with a net, consisting of yards of entangling muslin.

So interesting did our first field prove that it was not till dusk approached that the D.O. was able to drag us away, when in the half-gloom one of us tripped over some coral, mossy with age, which inspection showed to be arranged in grave like areas. About 1840, our host explained, a whaling vessel was wrecked in the vicinity and the dead were buried on Naunaha by their fellows, the survivors being later killed by the natives who handed the story on. Standing by the mute evidence of this long forgotten tragedy, we thought of these hardy souls journeying round the world to meet their deaths, and were glad



An old chief of the wild west coast of Noli, Santa Cruz Island, where the natives are still dangerous and whites seldom venture. Apparently friendly, as pawpaw and nuts were piled in his canoe, the old man sheepishly withstood all inducements to come aboard.

[Photo.—A. A. Livingstone.]

to exchange the gloomy silence punctuated by the shriek of disturbed bats, for the cheery excitement of departure. As we cleared the reef for the open sea, the fading light was used in storing the day's catch; Troughton engaging in a spirited hunt amongst the fur of his beloved bats in search of tiny spider-like parasites known as Nycteribids. Regarded with extreme disfavour by all save naturalists, these crab-like creatures are really flies whose wings have degenerated and disappeared owing to dependence upon the bats for their



A "street" scene at Santa Cruz showing the well kept paths, often edged by specially planted shrubs. The walls of dead coral and rocks were originally built as defences against attack by neighbouring islanders. The natives' hair is bleached a light yellow by lime or stained by the seeds of a plant; armbands of plaited grass and shell-beads are favoured masculine adornments.

[Photo.—A. A. Livingstone.]

food and locomotion, so that they view the world as miniature aeroplane passengers with but little fear of crashing. Their feet are specially adapted for sidling with great rapidity through fur so that catching them is a tedious business.

BOUND FOR SANTA CRUZ.

The distance to Santa Cruz is about 90 miles and we travelled all night through a heavy sea, making a detour to escape the wide flung reef fringing the island of Utupua where, it is said, the boat built by La Perouse's survivors came to grief. During the night a flying fish flung itself aboard, doubtless attracted by the lights; a pretty sight it was with wide wing-like fins and gleaming scales dripping with sea-water charged with tiny phosphorescent organisms (*Noctiluca*). It is an excellent table fish, and, warned by the anticipatory gleam in the helmsman's eye we hastily transferred the unexpected catch to spirits; it has since been identified as a rare species not hitherto represented in the Australian Museum collection. Flying fishes are trimly built creatures, of which about a dozen species are known from Australian waters.

It has not yet been proved whether the enlarged fins are used as wings or mere gliders; possibly their rapid vibration helps to sustain the flights, which are said to extend to three hundred yards and to be undertaken to avoid enemies.

Prompt preservation of edible specimens was adopted for the future, as the flying-foxes caught the evening before, and set aside for the taking of colour notes in daylight, had disappeared by morning, only a few charred claws and wing bones bearing witness to the native *penchant* for them; the crew made no secret of having made "ki-ki along some fella blying-bokus," supposing we had finished with the bats. Disappointment was soon lost in watching the approach of Santa Cruz, the D.O. explaining that Cape Mendana was just ahead, and that the coastal area known as Noli was still a dangerous part where the natives remained hostile and white men had only landed twice. There was not even smoke from a camp fire to be seen, and no villages could be discerned until flat areas marking the cleared village spaces were pointed out in the undulating greenery of hills. Some time ago a punitive expedition, having occasion to send a shell or two into or near some villages, trained their guns



Crocodiles abound in the rivers and lagoons of Santa Cruz, a thought which occasionally curtailed the early morning dip while anchored in the river at Carlisle Bay, where this 11 ft. one was shot from a canoe. A Japanese trader, Ito, is seen taking off the skin of the legs which is used to make tobacco pouches, the rest being taken for bags and shoes.

[Photo.—A. A. Livingstone.]

by these tell-tale flat areas, the ability to spot villages which they supposed entirely hidden, impressing the natives more than the shelling.

TAXATION IN THE TROPICS.

It fell to our friend, the D.O., to inaugurate the 5/- head tax which every native must pay, being allowed six months in which to amass that sum with the alternative of three months' prison. To those heavily taxed readers who may have envied the immunity of their dark brothers, it may be a shock to hear that even in distant Santa Cruz the income tax collector holds sway. The method of collection is fortunately much simpler and often provides the collector with a bonus of amusement and not a little excitement. On one occasion the taxpayers organised a little demonstration which necessitated an order being given the native soldiery to fire over their heads; noticing a poisoned

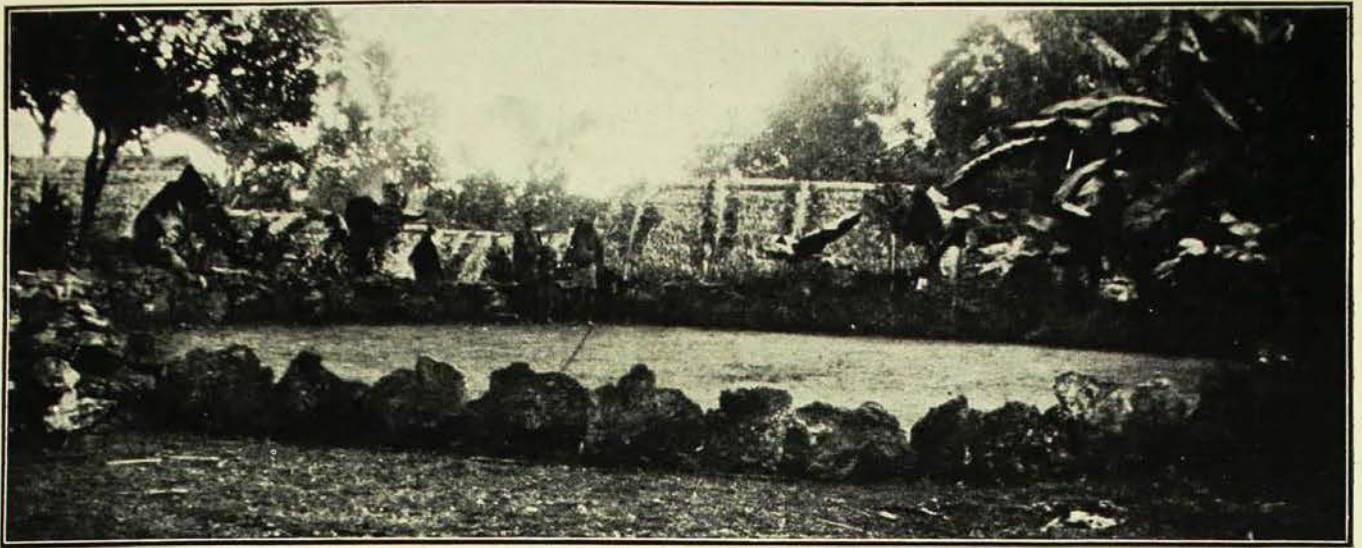
arrow trained on his chest one of the soldiers made a "slight" alteration in aim and shot the bowman in the thigh. The wound proving fatal in spite of the D.O.'s efforts in treating it, the member of his body-guard, with due consideration of the law of self preservation, was reduced to the rank of laundryman, a position which he still fills to his own and the D.O.'s satisfaction. At Graciosa Bay, where we were to spend several days, the D.O. had an amusing experience when he called in about twenty villages to request them to pay the tax. A chief who informed the District Headman that he wished to speak, was a wild-looking fellow with staring eyes. He boldly stepped forth and said that he had been speaking with a great spirit, and that the great spirit had told him he and his people were not to pay tax; hundreds of natives standing round eagerly awaited the verdict in this important test case. "Alright," said the D.O., "Your spirit may have spoken, but so has mine, and it tells me to tie you to a coconut tree and knock the hide off you with a stick." The chief did not wait for further communication with the spirits, and he and his people were the first to pay up, a tribute to the methods of peaceful persuasion.

As we hugged the coast of Noli, furtive figures were seen and the suspicious attitude of the natives was indicated when an old chief, who set out in a small canoe, re-



Only the offer of trade tobacco and pipes wooed these bashful matrons from the laborious tasks provided by their husbands, to pose for us. Enlargement of the spleen following repeated malarial infection causes marked distension of the abdomen. The huts are protected with planks hewn by native implements; these serve to ward off the flights of poisoned arrows which would be used in an attack.

[Photo.—A. A. Livingstone.]



A native dancing ground which separates Christian and heathen villages at Trevanion Island.

[Photo.—A. A. Livingstone.]

sisted all efforts to coax him aboard. After dancing a kind of nautical lancers in which he paddled forward when we went ahead and coyly retreated when our engine stopped, we retired regretfully, as the D.O. wished to interrogate him, and he was wearing a fine badge of office which we hoped to purchase for a few yards of gaudy print. The badge consisted of a large flat disc of clam shell which had been painstakingly ground down in a trough of sand and water, and ornamented by a slender design carved out of tortoise shell; these ornamented discs may be worn only by high chiefs, but anyone may don the plain ones.

A little further on we went ashore at a small island called Nia, hoping to secure a few decorated skulls from a head-house, or house of the dead, in which skulls of relatives are deposited after death. As we approached natives were seen swimming to the mainland, at the same time trying to deceive us by leaving their outrigger canoes behind. Following a native track into the otherwise impenetrable undergrowth we came upon a thatched hut with the sides reinforced by thick boards lashed together as a protection against the poisoned arrows of attackers. Crawling on our knees through the only opening we found, as half expected, that the native intelligence corps had been working and all the skulls had been removed. Food offerings to the spirits of the dead were in evidence, in the shape of coconut shells filled with meat, usually a pigeon, and wrapped up securely

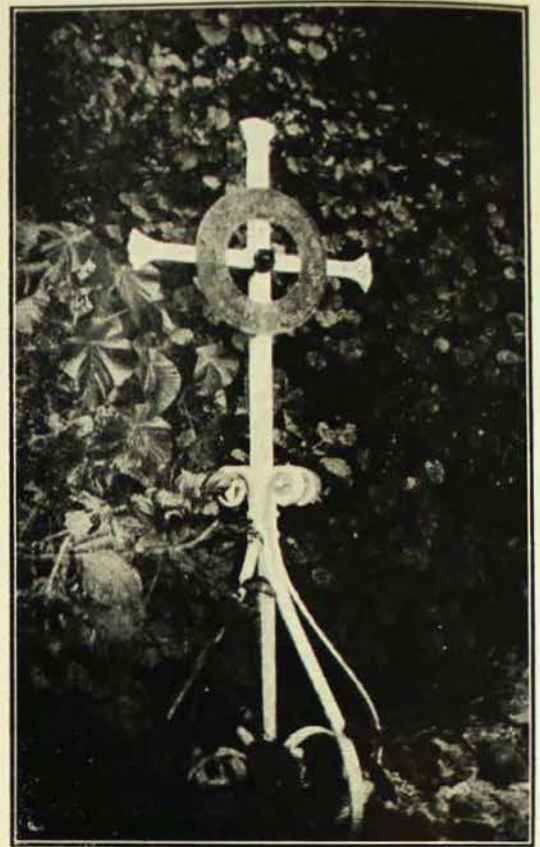
in a coconut leaf. Round the walls hung queer doll-like bundles of leaves, which must be presented whenever a native makes an offering, and scattered about the floor was a weird collection of the possessions of the departed, including teeth of crocodiles and pigs, tortoise shell and bone ornaments and armlets, lime gourds associated with the chewing of betel-nut, and a neat little bundle of poisoned arrow-tips which evoked a timely warning from the D.O. On leaving the island with our selection of ethnological treasures, we stopped to talk to a few elderly natives assembled in a hut, the D.O. explaining as well as possible in their limited language the purpose of our mission, and giving them pipes and tobacco. Evidently impressed, one old chap graciously presented us with his best fishing kite made of flattened palm leaves in the shape of a bird, from the centre of which is suspended a small length of fine string ending in a tuft of specially prepared fibre. Flown over the water, the little tuft of fibre skips along the surface and on being seized by a fish becomes entangled in its teeth, and fish is on the menu forthwith.

TREVANION ISLAND.

Departing in good order and apparently good favour too, we travelled round the coast and entered the wide expanse of Graciosa Bay, which is about three miles in extent and hemmed across by Trevanion Island, off which we anchored for several

days. On shore was a small copra station which was being organised by a Mr. James Buckley who dined with us that evening, apparently finding much pleasure in the unexpected company. He took a great interest in our work and assisted us generously with trade articles and specimens which we lacked. His home had been well built by native labour, the thatched walls and roof, and floor of split palms making it extremely cool. Not the least helpful action of Buckley's was his success in enlisting Charlie's interest in our work. An alarming figure at first sight, Charlie's bundle of charms consisted of a leg badly distorted and swollen by the activities of the parasitic *Filaria* worm, a decided tendency to "embonpoint," probably caused by enlargement of the spleen following malarial infection, holes in his ears in which match-boxes were often carried, and a devastating grin which obliterated his face, exposing an amazingly discoloured and jagged set of teeth to our startled gaze. A mop of hair bleached brilliant yellow, and blue-topped wax vestas stuck in tiny holes in each lobe of his nose helped to produce a striking effect. Under Charlie's amiable guidance, followed by a horde of curious but well meaning small boys, we climbed for over a mile up a steep but well made path till we arrived at the native villages, sweating and weary from chasing butterflies, and making excursions into the tropical jungle after an occasional bird or bat.

On the road a little party of women stepped shyly aside into the shadows of the bush, apparently much too nervous to undergo the ordeal of being photographed. True to native tradition, they had been out working while their menfolk indulged in the favoured occupations of talking, smoking, and chewing betel, or making themselves ornaments and weapons. The women were loaded with bundles of firewood and green leaves and shoots of plants; some of the eatables were neatly parcelled up, large green leaves of the banana, or a giant lily, taking the place of the brown paper bag of civilisation. The women are always less in evidence and appear to lack the individuality of the men, but what could you expect when the unfortunate women's personalities are suppressed by the possession of one name common to



The simple memorial to Commodore Goodenough who died from tetanus after being pierced by a poisoned arrow as he landed at Carlisle Bay in August, 1875.

[Photo.—E. Le G. Troughton.]

them all, a woman being known as "Mary" throughout the Pacific Isles.

As we passed down the road between orderly rows of thatched huts, evidences of missionary work were seen in the crosses suspended round many necks, and the neat well-washed lava-lavas. This village evidently sheltered converts from the adjacent heathen settlement, from which it is separated by a badge of heathen frailty, a large circular dancing ground about thirty feet in diameter, edged round with a low wall of jagged coral, and looking like a stone-age circus ring; the earthen floor is flattened to rock-like hardness by generations of feet stamping out the measures of native dances, which are tabooed by the missionaries. The heathen dwellers, however, proved most interesting hosts, a very aged chief doing the honours with a bag of Pandanus nuts, while the young men cheerfully posed for the camera after adding a few more flowers to their hair, a favourite adornment.

Our next anchorage was a very beautiful one in the river mouth at Carlisle Bay, which is approached through a narrow

reef passage with waves thundering on each side; on the left is seen the rough pier and neat huts which are the headquarters of the trusted and efficient Willie, Headman of the island, and on the right are the crumbling overgrown walls of the village, long forsaken, whose people killed Commodore Goodenough in 1875. Embowered in brilliant creepers is a simple cross of ironwork with a circle bearing this inspiring inscription "John James Goodenough, Commodore R.N., August 12, 1875. Ad. Sanguinem. If I be lifted up from the earth I will draw all men unto me." After a distinguished naval career Goodenough was in 1873 placed in command of the Australian station with rank of Commodore. Island affairs immediately claimed attention, for he had to report on the necessity of annexing the Fiji group. Visiting the New Hebrides in 1875, where he successfully promoted friendly relations, he proceeded to the Santa Cruz group with the same object. The ship being hove to off the bay for fresh-water supplies, the Commodore was rowed ashore with a view to friendly advances. As the boat grounded he stepped across the thwart and placing his hand on a sailor's shoulder jumped ashore,

when his chest was pierced by a poisoned arrow which subsequently caused tetanus and his death at sea. Survivors managed to back the boat away and reach the ship, and the Commodore and two sailors wounded at the same time were subsequently buried in the cemetery of St. Thomas's, North Sydney. It was hard to visualise the tragedy in that peaceful spot, with friendly natives nearby.

Exploring the jungle paths and villages, and collecting on a shore reef which teemed with marine life, proved a fascinating experience which sped the days too quickly, while the drowsy nights were all too short for the tedious aftermath of labelling and safely storing the varied catch. Yarning over coffee and a last cigarette, the natives making a soft "sing-sing" round the galley fire while the breadfruit baked, the world seemed a very remote place indeed, with which our only tangible link was the battered gramophone with its clamorous fox-trots; at regular intervals the shuddering cough of the active volcano of Tinakula is heard and a glow lights the sky with promise of new wonders and novel experiences awaiting the last phase of the cruise.

The usual series of lectures is now in full swing. Five evening lectures have already been delivered and attracted large audiences. The lecture on Java delivered by Mr. R. H. Cambage, O.B.E., trustee, was so well attended that it was necessary to repeat it, and again the Lecture Hall was filled.

Two addresses have been given to the boys of Sydney High School; the lectures to public school scholars and talks to pupils of the Institute for the Deaf Dumb and Blind are being continued as in previous years.

We have to thank the Australian Board of Control for International Cricket for the gift of a magnificent bison head. This fine specimen was presented by the Calgary Canadian Cricket Association to the manager of the 1926 Australian Eleven, who received it for and on behalf of the Australian Board

of Control. The Board, realising the value of the head and having no facilities for displaying it effectively, were good enough to transfer it to the Museum, where it is now on view in the mammal gallery.

A fine series of plaster casts of the stone age implements of Finland has been obtained by exchange with the National Museum, Helsingfors; the exchange was arranged by Mr. Harald Tanner, Consul for Finland in Sydney, to whom we are indebted for this service.

On 10th June a party of third year students from the Geography Department, the University of Sydney, accompanied by Miss Dorothy Taylor and Mr. G. A. V. Stanley, B.Sc., visited the Museum and were conducted round the ethnological collections by Mr. W. W. Thorpe, who explained the exhibits to the visitors.

History of the Trout in New South Wales.

By H. K. ANDERSON.

Inland Fisheries Officer.

[Compilation authorised by the Under Secretary, State Fisheries, Sydney.]

WITHIN the State of New South Wales there are many hundreds of miles of rivers with tributaries which, in the scheme of nature, were either left unstocked with fish of economic value, or, having been so stocked, the fish were destroyed by poisonous elements, such as alkaline ashes, the result of bush fires, being washed into

few feet in height. As most of the streams drop down very suddenly from the tablelands, these conditions applied to practically all the rivers, creeks, and water courses on the great southern, western, and northern uplands.

It was not until the year 1888 that any official move was initiated for stocking



Transporting trout fry through the snow in Charlotte Pass.

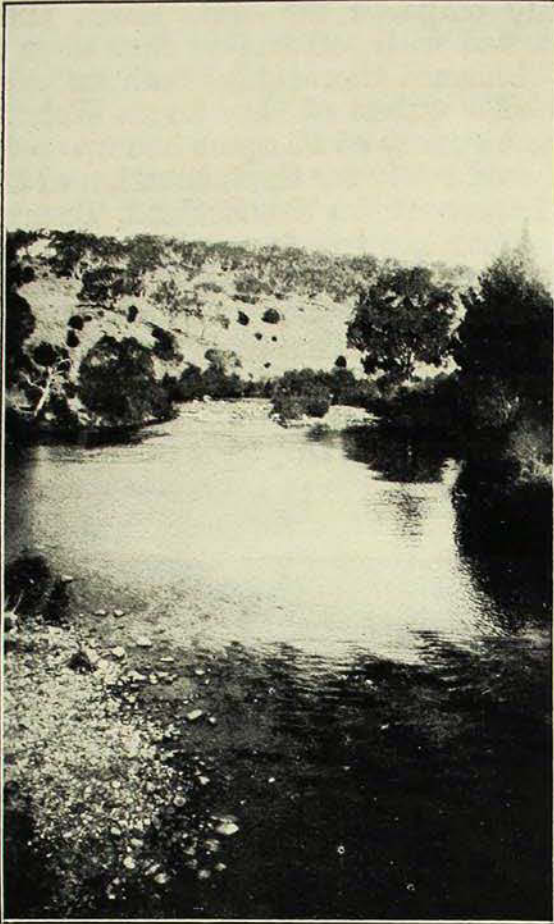
[Photo.—H. K. Anderson.]

the water by heavy rain. This, particularly, applies to the headwaters of the streams on the western side of the Great Dividing Range.

On the eastern slope, eels had penetrated right to the source of many of the rivers, but the waters were inaccessible to all other migratory fish, and for that reason none of economic value, other than eels, were found above the first waterfall of more than a

these isolated mountain streams with fish, and it devolved upon Dr. J. C. Cox, then President of the Commission of Fisheries of the Colony to undertake it.

The annual report on the fisheries of New South Wales for the year 1905 refers to a claim made by Mr. R. T. Keys, Muswellbrook, that in 1870 Mr. John H. Keys imported trout eggs from Ireland and placed them in the Hunter River. His



Thredbo River at The Creel. This is one of the best trout streams in New South Wales.

[Photo.—K. H. Anderson.]

experiments were repeated in the three years following, with eggs obtained from New Zealand and Tasmania, and it is stated that several lots of trout were hatched out and liberated in the Hunter River. Their species is not recorded.

In the year 1888, coincident with the Commissioners' activities, Messrs. John Gale and F. Campbell, of Queanbeyan, liberated 300 yearling trout (also 40 Crucian Carp) in the waters of this State; Crucian Carp may now be found all over N.S.W.

Reference to the "Report of the Commissioners of Fisheries for New South Wales . . . for the year ending 31st December, 1888" discloses the following:—"The introduction of trout fry into several inland streams has, it is hoped, been successfully accomplished during the year. Through the courtesy of the Victorian Government, aided by the Committee of the Geelong Acclimatisation Society, we were enabled to obtain, free of cost, some thousand or more of trout-fry, and these

have been distributed in the Upper Shoalhaven, the Wollondilly, the Upper Nepean, and Nattai Rivers, the Picton Lakes, in several streams in the western range of mountains, and at Mudgee. A supply was also liberated in a stream in the Armidale district, and in the Brogo River in the Eden district . . . We do not regard our efforts in this direction as completed, but intend, as early as possible in the season of 1889 to repeat the experiment . . ."

The first trout eggs were hatched by the Commission in 1889 when "some five or six thousand" Brown Trout ova were presented by the Geelong Acclimatisation Society (Victoria), and a large percentage of fry hatched out. The fish were distributed in "suitable streams" in the northern, southern, and western divisions of the colony, and in Prospect Reservoir.

During this year investigations were made with a view to establishment of a permanent trout hatchery, the eggs previously received having been incubated in the kitchen at the Fisheries Commissioners' office in Phillip Street, Sydney.

From 1889 to 1892 hatching operations were conducted each season in the Phillip Street premises under most unfavourable conditions; 66,000 trout eggs of *Salmo fario*, *ferox*, *levenensis*, and *irideus* were however treated with satisfactory results. From that time onward trout culture was carried on at Prospect Reservoir, where, by the courtesy of the Water and Sewerage Board, the necessary land and water were made available.

The earliest record of the capture of a large trout in the colony may be found in the Annual Report on the Fisheries of New South Wales for the year 1894, when a Mr. Rose forwarded to the Commissioners a large brown trout weighing seven pounds, measuring 25 inches in length and 15½ inches girth. I have ascertained from Mr. A. F. W. Rose, a well known Cooma sportsman, that it is to his father, Mr. R. U. B. Rose, of Boloco, Dalgety, that the State is indebted for this specimen. This was followed a few weeks later by a five pound trout from Bibbenluke.

During this (1894) season, failing other accommodation, a consignment of trout eggs received from New Zealand was incubated in an abandoned blacksmith's

shop at the back of the Prospect Reservoir ; further, the first experiment was made in the incubation of Rainbow Trout eggs, and three small rearing ponds were constructed at Prospect Reservoir.

Following up the work of the Commission it is found that a very decided advance was made in trout cultural operations in 1896 ; fry were distributed in no less than eighty-six different streams, in the north, north coast, south, central, and western divisions of the Colony, while a number was retained at the rearing ponds at Prospect where they developed beyond expect-

quickly outpaced the other kinds, and it was noted with satisfaction that these fish had become thoroughly acclimatised to the cooler waters of New South Wales.

The hatchery at Prospect had up to 1901 been used solely for the incubation of trout eggs imported from New Zealand, Tasmania, and Victoria. In August of that year the first attempt at stripping the ova and milt from trout was made at Prospect, when eggs were taken from four of the fish in the hatchery ponds and fertilised ; no record is available as to the result. In the following year Inspector George Glading



The Head Waters of the Snowy River, altitude over 6,500 feet.

[Photo.—H. K. Anderson.]

tations. During this season at the request of the Queensland Government some 20,000 trout eggs were hatched at Prospect ; the fry were duly forwarded to Warwick (Q.) in safety.

It was in the year 1899, after repeatedly restocking the rivers with *Salmo fario*, *S. ferox*, *S. levenensis*, *S. salvelinus fontinalis*, and a small proportion of *S. irideus*, that the remarkable adaptability of the Rainbow Trout (*S. irideus*) to waters in the colony was demonstrated ; such rapid progress was made by the few fry released that they

of the Fisheries Administration, to whom must be given full credit, on 21st July, successfully stripped and fertilised the eggs of thirty-nine two-year old trout, from which he raised 2000 fry.

In this initial operation incubation occupied thirty-one days, the eye spot appeared on the twelfth day and the fry commenced feeding on the fiftieth day after stripping. Water temperature during incubation varied from 58° to 70° F. The eggs were developed and the fry raised in

wooden hatching boxes 12 ft. long, 20 inches wide, and 18 ins. deep.

The first protection afforded the trout was in 1903, when a close season from 7th April to 31st August was proclaimed, and ten inches was declared the lawful length. No acclimatisation work was done in this year, no funds being available for the purpose. In 1906 the period of the close season was altered to embrace the months May to October inclusive, as it was found that the fish in many streams had not commenced to spawn by August 31st.

An endeavour was made in 1908 and subsequent years, to collect the eggs from wild trout in Jenolan River, and in 1910 two men were employed trapping trout in Duckmaloi River, whence a very considerable number of ova was obtained.

Experience, however, showed that with the make-shift appliances available a regular supply of eggs every season could not be depended upon, as the traps were often submerged or washed away by floods, allowing many trout to pass on up stream, and these fish were of course missed by the trappers; the importation of eggs from New Zealand was therefore continued.

From the year 1914 onwards the acclimatisation of trout has progressed by leaps and bounds; prior to that year the greatest liberation of trout in any one season was 66,250 fry in 1908. In 1914 the total number distributed was 92,100 and only once has the annual distribution failed to reach that figure, namely, in 1917 when the railway strike prevented despatch and a great many little trout died. That season's distribution was nevertheless 86,700 fish.

At the present time there are upwards of 2000 river miles of trout-stocked streams within the State of New South Wales, where good trout fishing is available and is free to all. The open season is from 1st November to 13th April following (or if Easter falls late, to the Tuesday following Easter Monday).

Some idea of the increasing magnitude of the operations conducted by State Fisheries in the acclimatisation of trout may be gauged by the following figures relating to the distribution of trout fry:—

1914—	92,100 fry	1920—	182,600 fry
1915—	95,800 „	1921—	266,590 „
1916—	95,400 „	1922—	317,700 „
*1917—	86,700 „	1923—	254,275 „
1918—	137,500 „	1924—	370,256 „
1919—	136,200 „	1925—	392,844 „
		1926—	525,109 fry.

As a result of co-operation between the Chief Secretary's Department, Tourist Bureau, Railway Department and New South Wales Rod Fishers' Society in 1924, a small supplementary hatchery was constructed at The Creel, Thredbo River on a site donated to the Department by Mr. F. Wallace of Hiawatha, Jindabyne. In that season 55,000 trout eggs were laid down and 50,098 fry were released in local waters. The following year 163,000 eggs were laid down and as a result 149,044 fry were liberated within a ten mile radius. Last year the liberations from this hatchery totalled 156,651 fry.

In 1926 another supplementary hatchery was installed near Guyra on a site presented to the Department by Mr. L. P. Dutton of Urandangie, Guyra. From this hatchery 204,693 trout fry were distributed in local waters. These figures are included in the above totals.

Still another country hatchery, to serve Glen Innes district waters, is now under construction and should be ready for piscicultural operations in the 1927 season. The site for this installation was also donated to the Department by Mr. L. P. Dutton.

Were the obstacles and disappointments which beset the pioneers of trout acclimatisation in New South Wales fully understood, the result of this great work would be better appreciated. Few persons realize the difficulties experienced—due to bush fires, as I have previously mentioned and floods which destroy the tiny fry, sometimes within a few hours of their liberation, and numerous other natural factors. Trout acclimatisation in New South Wales is now an accomplished fact and we can boast of as fine trout-fishing as is to be had in any part of the world.

*Railway strike disorganised distribution.

Water Bugs.

BY THOMAS G. CAMPBELL.

The Australian Museum

THOUGH approximately two thousand species of bugs are known from Australia, only a small proportion, about three per cent., lead an aquatic or semi-aquatic existence. Many of the larger forms of water bugs are quite common in the ponds and creeks near Sydney, so that from time to time specimens are secured and submitted to the Museum for determination. Certain of the forms occurring around Sydney are also widely distributed throughout a large part of Australia and some occur in other countries as well.

Perhaps before proceeding further it would be advisable to define exactly the term "bug." Of late years (particularly in America) it has become a common practice to refer to any insect as a "bug," while in the same phraseology entomologists and others interested in the study and collection of insects have been dubbed "bug-hunters." In the restricted meaning of the word a bug is classified along with the cicadas, leaf-hoppers and scale insects in the one great order Hemiptera, the members of which have a sucking beak or rostrum attached to the underside of the head and projecting backwards in the position of rest. In addition the Hemiptera have an incomplete metamorphosis, there being no quiescent pupal stage in their life history such as occurs in the butterflies and moths. The true bugs are further separated from their allies, and grouped together in the sub-order Heteroptera. They have the rostrum attached to the front of the head, and it consists of a tubular structure containing a number of needle-like styles, which are capable of movement inside the tube. The formation of the fore-wings further serves to distinguish the Heteroptera from the remainder of the Hemiptera, the proximal portions being usually thick and opaque, while the distal portion is membranous, a fact which is denoted by the name of the sub-order, Heteroptera meaning "different-winged."

Those bugs which are adapted to an aquatic mode of life, though agreeing with the terrestrial forms in all fundamental characters, have the body and limbs considerably modified to assist their movement either through or over the water. Comparatively few in number, the individuals comprising the better known families of water bugs, may be readily recognised after a little observation, when each family will be seen to have its ways of living. Though representatives of several families may live in the one pond or creek, they re-act to their environment in a variety of ways, while the form of their bodies is modified in accordance with each particular mode of existence and method of progression.

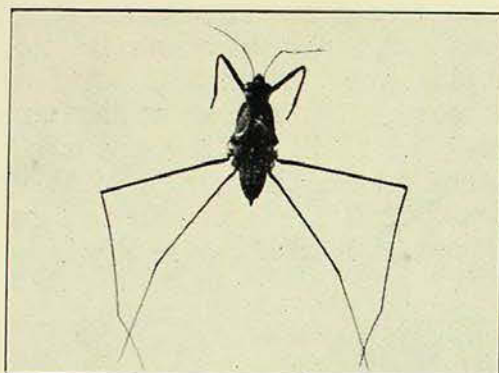
Water bugs differ chiefly from their terrestrial allies in the external shape of their bodies, which have smooth lines offering the minimum of resistance to the water, while the legs are often flattened towards their extremities or clothed with hairs which act as paddle blades. Certain water bugs, for example, the Back-Swimmers and Water-Boatmen, have the external surface of their bodies densely clothed with fine hairs. In those forms which glide over the surface of the water these fine hairs prevent the body of the insect from becoming wet and thus liable to sink through the surface film. Those bugs which spend a considerable time below the surface are able to breathe imprisoned air which they take below with them, the air being contained between the external surface of the insect's body, and the covering of hairs, so that an air film almost completely surrounds the insect while submerged. This contained air is gradually exhausted in the process of under-water respiration, after which the insect must rise to the surface for a fresh supply.

Having thus briefly considered some of the chief characters of water bugs, one may now pass on to a consideration of

some of the better known forms of Australian aquatic Hemiptera.

WATER-STRIDERS OR POND-SKATERS.

Under the above names are included a number of water bugs, members of the family Gerridae, which are frequently met with skimming over the surface of both fresh and salt water.



A Water-strider, *Gerris australis*, which glides over the surfaces of ponds and streams. Some of its relatives occur in the open ocean, hundreds of miles from land. (Enlarged.)

[Photo.—G. C. Clutton.]

Certain of these water-skating bugs, relatives of those forms which glide over the surface of fresh-water ponds and streams, are to be found in great numbers in the calm seas of the tropics. Here, often hundreds of miles from land, they skate over the surface of the ocean, resting and depositing their eggs upon weeds or other debris. They are the only insects which have taken to a sea-faring existence, and even they do not live continually in salt water. Though these bugs differ somewhat from the true aquatic hemiptera, they spend so much of their lives on the water that perhaps a few remarks concerning them will not be altogether out of place. Their long legs are densely clothed with fine hairs, which also cover the body. The "water-striders" are more nearly allied to the land bugs, and are provided with long and well developed antennae. They really walk upon the elastic surface of the water, and it is said that if their feet become wet they sink through the surface film. It is apparently for this reason that these bugs have been observed carefully cleaning and drying their legs and the attached

hairs, by raising them from the surface one at a time until the operation is complete.

Water-striders often occur in large numbers on fresh water and on the estuaries around Sydney, the writer having secured large numbers from the Port Hacking River, National Park, New South Wales. An accumulation of fine scum which was apparent in places on the surface of the water was found to have large numbers of "Water-striders" entangled in it, and, these being unable to move freely like their more fortunate brethren on the adjacent clean water, were easily captured. The second and third pairs of legs in the pond-skaters are of considerable length and move backwards and forwards so that the insects might almost be said to row themselves over the water, except for the fact that they do not break the surface. The abdomen is usually very small, the eyes are large and prominent, while the antennae are long and conspicuous, a character which separates the pond-skaters from the true water bugs, in which the antennae are small and inconspicuous, being almost concealed in cavities on the underside of the head.

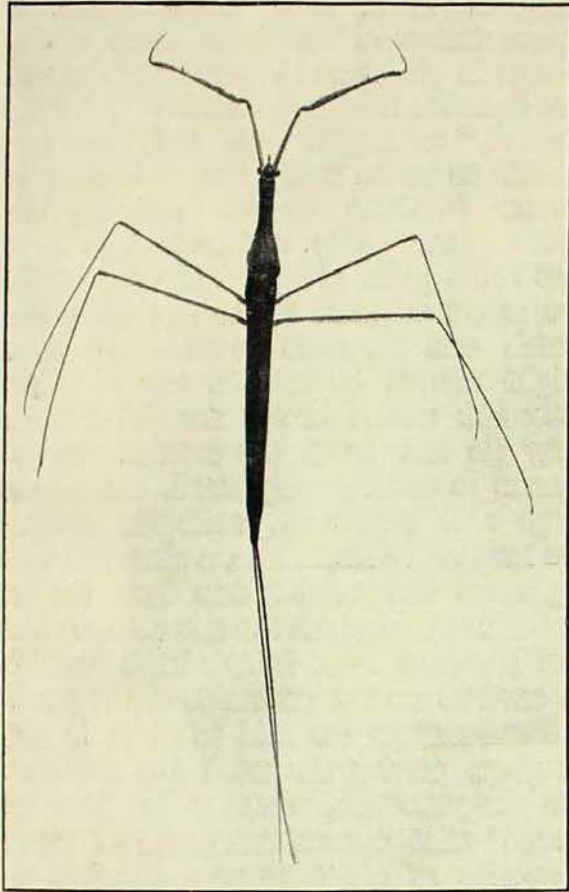
Pond-skaters are said to breed in great numbers among the weed and flotsam of the Sargasso Sea, where it has been estimated¹ that approximately 20,000 eggs of a species of *Halobates* were attached to a single floating feather from the wing of a sea bird.

WATER-SCORPIONS AND TOE-BITERS.

Under the above vernacular names are included a number of bugs which have been placed in the family Nepidae, characterised by the possession of two caudal appendages, which are grooved on their inner sides. When these two appendages are closely applied to one another the two grooves are united to form a tube through which the insect is able to breathe. When the remainder of the insect's body is submerged the tip of this tube remains above the surface film of the water, and thus the insect's respiratory system is in direct communication with an inexhaustible supply of free air. The front pair of legs are more powerfully formed than the second and third pairs and are adapted for seizing. The second and

¹Beebe, "The *Arcturus* Adventure," p. 61.

third pairs of legs are but poorly adapted for swimming, with the result that these insects are somewhat sluggish in their movements. Their drab colour and resemblance to their surroundings renders



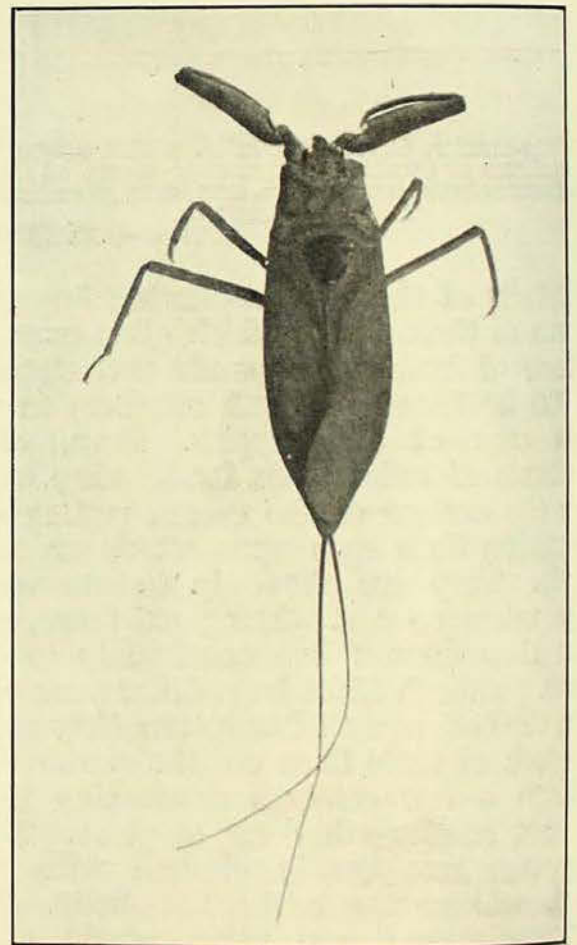
Ranatra australiensis, a typical "toe-biter" with a wide distribution in Eastern Australia, frequents ponds and old brick pits in the neighbourhood of Sydney. It seizes its prey by the raptorial fore-legs and afterwards kills it by means of the sharp proboscis. The two halves of the breathing apparatus can be seen at the posterior end of the body. (Slightly reduced.)

[Photo.—G. C. Clutton.]

the water scorpions to a large degree inconspicuous, so that much of their prey comes within easy reach, and they obtain a plentiful food supply with comparatively little exertion.

The familiar name of "water-scorpions" doubtless originated from the somewhat superficial resemblance of some of these insects to scorpions, the large fore-limbs rather distantly resembling the cheliceres of a scorpion, while the elliptical body and long abdominal appendages would further heighten this illusion. Apparently the name "toe-biters" has been applied to these bugs by persons who have thought that they were bitten while bathing in freshwater pools and streams.

One Australian species, *Ranatra australiensis*, is stated by Mr. H. M. Hale of the South Australian Museum, to lay eggs about three and a half millimetres in length, five nymphal stages being passed through by the young bugs before the adult condition is reached. Certain American and Indian species are said to deposit their eggs in the tissues of plants. The food of "water-scorpions" consists of almost any small aquatic animals or unfortunate insects which happen to fall into water tenanted by these voracious creatures. Mr. Hale² who kept numbers of these insects, says "examples were maintained in aquaria for some months, during which time the satisfying of their gastronomic needs was a matter of some moment." The eggs of fresh-water fish are also said to form part of the food of Nepid bugs. Five species of



A "water-scorpion," *Laccotrephes tristis*, which occurs throughout Australia, its vernacular name suggesting a resemblance to the true scorpion. It is included in the same family as the "toe-biters" and has similar habits and breathing organs. (Enlarged)

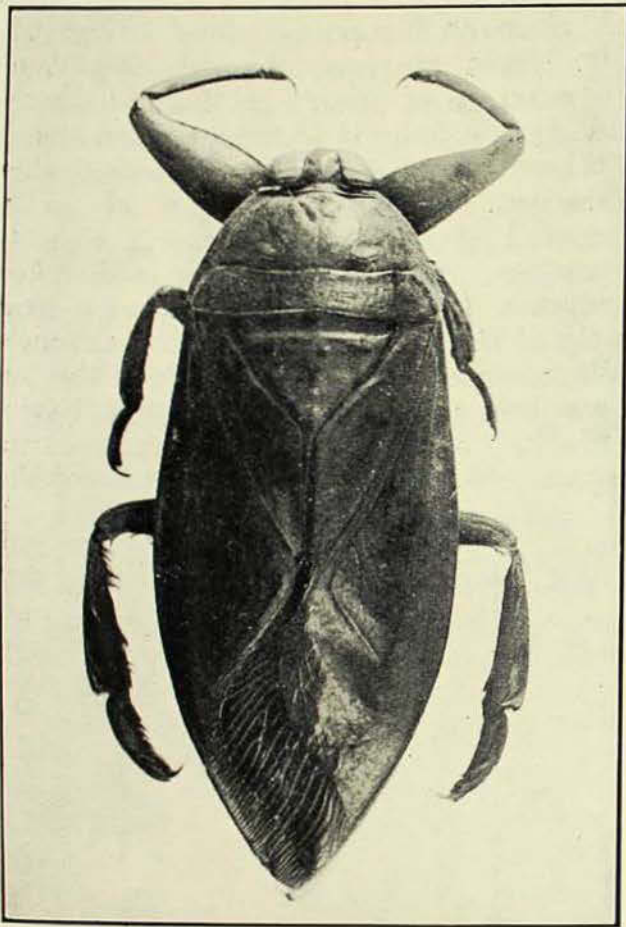
[Photo.—G. C. Clutton.]

²Hale, Records South Australian Museum, Vol. II., No. 4, 1924, p. 512.

Nepidae occur in Australia, most of which are fairly widely distributed, the commonest forms occurring around Sydney being *Laccotrephes tristis*, which is a flattened, oval-bodied insect and *Ranatra australiensis*, an elongate cylindrical species, whose body is about the diameter of an ordinary wheat straw.

FISH-KILLERS.

Perhaps some of the most remarkable of all water-bugs are included in the family



The Giant Fish Killer, *Lethocerus indicum*, which ranges from India to Australia. In India this species has been observed to capture and feed upon young fish and toads. Recently many specimens of this bug have been collected in and around Sydney and sent to the Museum. It is usually taken around electric lights. (Enlarged.)

[Photo.—G. C. Clutton.]

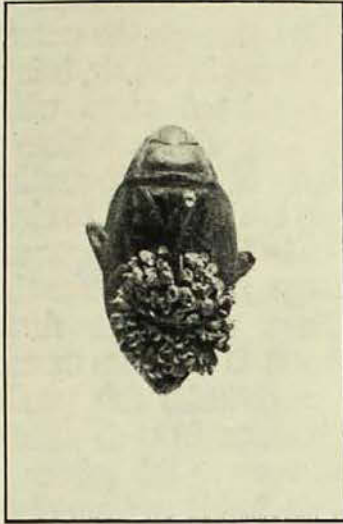
Belostomatidae and are popularly known as "fish-killers." One of these, *Lethocerus indicum*, is one of the largest bugs known, and has a range extending from India, through the neighbouring islands to Australia, where it is by no means uncommon, and in the past few weeks examples of this bug have been forwarded to the Museum

from Sydney and the suburbs. The body of *Lethocerus indicum* is flattened and fitted for swimming, the forelegs are admirably fitted for grasping the insect's prey, while the hind legs are adapted for swimming. On the undersurface of the head is situated the short beak, with which the victims are despatched and their body juices removed. Apart from the ease with which the Belostomatids move through the water, they are also quite at home in the air, being provided with well developed wings which enable them to fly long distances when migrating from one body of water to another. Many of these bugs are attracted to electric lights and are often to be found congregating about them in large numbers, sometimes great distances from water. In America this migratory habit is a serious menace to fish-hatcheries or artificial fish ponds for the bugs soon increase in such numbers as to become a menace to fish raising. For this reason it is advisable to keep electric lights some distance away from fish ponds.

Observations from India have shown that *Lethocerus indicum* feeds upon the young of a common toad. Grasping the young toads which are on the surface of the water, the bug inserts its beak near the hind legs of the victim, which appears to be unable to struggle and soon becomes limp. In addition to toads, frogs and small fish are preyed upon by these bugs, which secrete themselves among rubbish on the bottoms of pools, grasping any luckless victims in their strong raptorial fore-legs. The eggs of *Lethocerus indicum* are pear-shaped objects, about one eighth of an inch in length, and are laid in clusters on the stems of water-plants growing on the edge of pools, the young on emerging making their way to the bottom.

Another bug which is included in the family Belostomatidae, is a much smaller and broadly oval species, *Sphaerodema rusticum*, which measures approximately three quarters of an inch in length. This species, which occurs commonly in Australia, lives among water-weeds, and the eggs are carried about in a mass attached to the back of the male until they hatch. This species is not only common throughout Australia, but its range extends to India and the Philippine Islands. A number of allied species throughout the world have

been observed carrying the eggs about attached to the back of the adult insect. For a long time it was thought that the females attached the eggs to their own backs as they laid them, but it remained for a German observer named Schmidt to discover that many males carried eggs.



Sphaerodema rusticum, a widely distributed species in Eastern Australia. The female lays her eggs in a mass on the back of the male, who attends to their care and transportation. The illustration shows a male upon whose back are deposited a number of eggs. (Enlarged.)

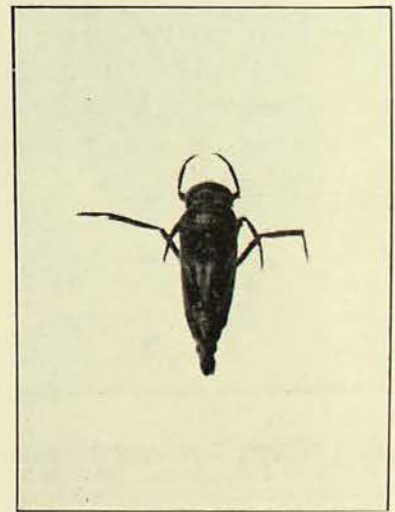
[Photo.—G. C. Clutton.]

The method of attachment of these eggs remained a mystery however, until cleared up by aquarium observations made by an American, Miss Slater, on bugs belonging to the genus *Zaitha*. She observed that the female laid them on the back of the unwilling male, though often having to struggle for hours to accomplish the task, but not giving up until she had succeeded. Speaking of her observations Miss Slater says:—"That the male chafes under the burden is unmistakable; in fact my suspicions as to the sex of the egg-carrier were first aroused by watching one in an aquarium which was trying to free itself from its load of eggs, an exhibition of a lack of maternal instinct not to be expected in a female carrying her own eggs. Generally the *Zaithas* are very active, darting about with great rapidity, but an egg-bearer remains quietly clinging to a leaf with the end of the abdomen just out of the water. If attacked he meekly received the blows, seemingly preferring death, which in several cases was the result, to the indignity of carrying and caring for the eggs."

BACK-SWIMMERS.

The most characteristic feature about this group of water-bugs is their curious habit of swimming with the ventral or undersurface of the body uppermost. They form the family Notonectidae, and occur in similar situations to most of the other water-bugs, being found in both muddy and clear water, which may be either running or stagnant. On the underside of the abdomen, that is, the portion which is uppermost in their normal habit of back-swimming, is a longitudinal keel or carina with a channel running along either side of it. Each of these channels is covered with numbers of closely set hairs, with the result that a tube is formed, and in this is contained the air used by the insect when submerged. When the supply of air is exhausted the "back-swimmer" rises to the surface, where the tip of the median keel is exposed for a few seconds, and a fresh supply of air is drawn into the two channels.

When a fresh supply is obtained the bug swims below the surface, at first having to use its swimming legs to counteract the buoyancy of its body and prevent it popping



Enithares bergrothi, a member of the Family Notonectidae. Its peculiar method of swimming with the body "upside down" has earned for it the name of "back-swimmer." (Enlarged.)

[Photo.—G. C. Clutton.]

up to the surface. As the imprisoned air becomes used up the bug shows a tendency to sink, but a few strokes of the swimming legs enables it to maintain its position. In the Notonectidae the tarsi or feet all terminate in two claws, while the last three

joints of the hind legs are fringed with hairs to act as paddles.

About eleven species of "back-swimmers" are recorded from Australia, the two dominant genera being *Anisops* and *Enithares*. Two species belonging to the former genus, *Anisops hyperion* and *Anisops doris*, occur commonly in suitable haunts around Sydney, and are found distributed throughout a very large part of Australia. Among the largest species of Australian "back-swimmers" is *Enithares bergrothi*, which occurs throughout the whole of Australia, and is also found in New Caledonia, from which it was first described. Its colour varies considerably, ranging from almost white to black. This species does not occur in such large numbers as do certain species of *Anisops*, upon the younger forms of which it has been observed feeding. A sting from *Enithares bergrothi* is said to be somewhat similar in its effect to that of a bee, the wound being accompanied by swelling.

The food of "back-swimmers" consists of almost any small aquatic animals which they are able to attack and overpower, mosquito and other dipterous larvae being caught with apparent ease. Stridulating or sound-producing apparatus consists of two horny prongs, one on either side of the beak and these are rubbed across a spined area on the tibiae of the front pair of legs. This stridulating serves to attract the attention of the females during the mating season, and similar sound-producing apparatus is present in the "water-boatmen" which will be dealt with in the following section. Mr. H. M. Hale³ who made aquarium observations on *Anisops hyperion* considers that there are at least two generations of this "back-swimmer" every year. Most of the Australian species of "back-swimmers" are thought to deposit their eggs in the tissues of water plants, the abdominal terminations in the female of a number of species being eminently adapted for boring into plant tissues. *Anisops hyperion* inserts the eggs into cavities bored in the stems of water plants, the deposition of each egg occupying little more than a minute, while portion of the egg is left protruding from the cavity in which it was laid. The life cycle of this species occupies about two

months from the deposition of the egg to the adult stage, and from the time of hatching until the adult condition is reached, the young "back-swimmers" pass through five stages or instars.

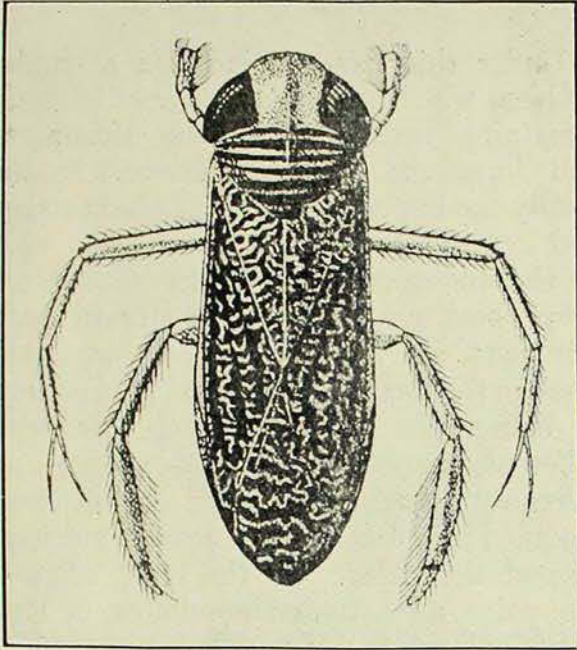
WATER-BOATMEN.

Under this name is included a number of bugs which differ considerably from the remaining families of aquatic Hemiptera, and form the family Corixidae. In this family the upper surface of the head overlaps and completely hides the prothorax, while on the underside of the head is situated the very short and somewhat flattened beak. The eyes are large and widely separated. Each of the three pairs of legs in the Corixidae is different in shape, and each pair serves different purposes. The fore-legs are considerably modified, the tarsi or feet being modified into scoop-like structures which are termed the palae. On the inner edges of the palae are situated a number of long, stout spines, and these are supposed to produce the stridulations beneath the water by rubbing against a number of much shorter bristles situated on the thighs. The middle pair of legs are long and slender, each bearing at its extremities two claws, by means of which the insect is able to retain a hold on waterweeds when wishing to remain stationary or during the process of egg-laying. On the hind legs the tarsi are considerably flattened and fringed with a number of long hairs, the entire structure functioning in much the same manner as the blade of an oar, and propelling the insect through the water.

Water-boatmen are world-wide in their distribution, and to date about fourteen species are known from Australia. These occur chiefly in slowly running or still water, and by the aid of their posterior legs are able to move rapidly and with great ease. When at rest the middle pair of legs serve to anchor them to water-plants and other submerged objects, and as the bugs take a considerable supply of air with them contained beneath the covering of fine hairs on their bodies, they are able to remain under water for a considerable time. Of the fourteen species recorded from Australia, quite a number have a considerable range throughout the continent, while a number of species

³Hale, Records South Australian Museum, Vol. II., No. 3, 1923, p. 406.

may occur in close association with one another. Mr. H. M. Hale⁴ records having collected eight distinct species from a single pool in the vicinity of Adelaide. One species of "water-boatman" which occurs around Sydney, is *Arctocorisa truncatipala*,



A typical "water-boatman," *Arctocorisa truncatipala*; the insect propels itself through the water by means of the paddle-like hind legs. (Greatly enlarged.)
[After H. M. Hale.]

which is also common in South Australia, Victoria, and Tasmania. The eggs of one species have been observed by Mr. Hale⁵ attached in large numbers to the stems of water-weeds and other vegetation overhanging the banks and entering the water,

⁴Hale, Records S. Australian Museum, Vol. II., No. 2, 1922, p. 312.

⁵Hale, loc. cit., p. 312.

and were seen to be situated in slowly-running, shallow portions of the stream. Each egg measured one millimetre in length, and was attached to some water-plant or other object by means of a flexible thread-like stalk, the end of which was flattened into a small disc so as to provide a firm anchorage.

In certain of the lakes adjacent to Mexico City two species of water-boatmen are said to occur so plentifully that their eggs are collected in vast numbers and used as food. Reeds are placed in the shallow waters of the lakes, and after the eggs have been deposited the reeds are removed and the eggs detached from them by beating. The eggs are made into cakes by mixing them with meal, and form a very important article of diet among the Indians and half-breeds.

Water-boatmen capture their prey with the anterior pair of legs, with which the victims are held until the nutriment can be extracted from their bodies. Various observations throughout the world have shown that water-boatmen can subsist on a number of different foods, such as algae, rotifers, eggs of fish and mosquito larvae. From this it may be assumed that they are practically omnivorous in their diet, while their partiality for the larvae of disease carrying mosquitoes may in some degree lessen the numbers of these pests.

Certain of the bugs dealt with in this article make suitable material for aquaria, and if a supply of small aquatic animals is available, such as mosquito larvae, water "fleas," and similar minute soft-bodied animals, little difficulty should be experienced in acquiring and keeping a number of these highly-fascinating insects.

The Trustees have been fortunate enough to acquire from Captain Frank Hurley the negatives taken by him on his two expeditions to Papua in 1920-21 and 1922-23. This splendid collection numbers about 1100 and contains a large number of native studies, views of ceremonial gatherings, pictures of native industries and architecture, landscape views, and an interesting

series illustrating the pearling industry, coral reefs and marine life. Captain Hurley is acclaimed one of the most skilful and successful of photographers and it goes without saying that every negative in this collection is a gem. We are extremely grateful to Captain Hurley for his generosity, which has enabled the Trustees to acquire these unique negatives at much below their market value.

Australia's Largest Fossil.

The Rhoetosaurus Dinosaur.

BY HEBER A. LONGMAN, F.L.S.

Director of the Queensland Museum.

IN answer to the question by Lepidus: "What manner o' thing is your crocodile?" Shakespeare puts into the mouth of Mark Antony the following facetious description:—

"It is shaped, sir, like itself, and it is as broad as it hath breadth; it is just so high as it is, and moves with its own organs; it lives by that which nourishes it; and the elements once out of it, it transmigrates."

"What colour is it of?"

"Of its own colour too."

From these witty evasions the questioner learnt nothing, but if Mark Antony had described the crocodile of old Nilus as "a Eusuchian reptile with anisodont dentition, quadrato-jugals with sharp anterior processes, small infratemporal fenestrae and procoelous vertebrae," it is doubtful whether Lepidus would have been much wiser.

Highly technical descriptions of vertebrate animals are necessarily written in the specialised terminology of comparative anatomy, and this conveys but little to many readers. In this article an account will be given in popular language of the remains of the huge dinosaur found at Durham Downs, near Roma, in south-west Queensland, which represent the largest fossil animal yet described from Australia.¹

The reptiles of to-day are relatively insignificant compared with the giants of the past. The estuarine crocodile, which is the largest living reptile, rarely exceeds twenty feet in length, but in the great Mesozoic period, which is sometimes called the Age of Reptiles, there were many gigantic forms, some of which exceeded one hundred feet in length.

When Richard Owen reported on the remains of huge fossil reptiles in England in 1841 he invented the word *dinosaur*, meaning "terrible lizard," for these remarkable animals. Numerous remains of dinosaurs have been found in Europe, Asia, Africa, and America, and it is now evident that a prodigious variety of these reptiles existed. Some authorities have divided the group into Saurischia, or lizard-like forms, and Ornithischia or bird-like forms, the distinctions being based mainly on the structure of the pelvic girdle. Although undoubtedly reptilian, they were quite distinct from modern species such as crocodiles and lizards, and the whole group has become extinct. There were pygmies as well as giants and many carnivorous as well as herbivorous dinosaurs. All were equipped with four limbs, but whilst most were quadrupedal in gait, some evidently walked almost entirely on the very elongated hind legs. Some of these reptiles were armed with grotesque series of huge plates and spines on the body. The characteristic dinosaurs possessed a great bulk of bones, but were very deficient in brains, these being far smaller relatively than those in modern reptiles. In the posterior region of the backbone the diameter of the neural canal, or tunnel in the vertebrae for the spinal cord, was considerably larger than the real brain cavity. This has sometimes been called "the tail brain." Fossil eggs of dinosaurs, some of which contain remains of actual embryos, have been found associated with their bones in the Gobi Desert and some other places. In the Australian Museum there is exhibited a replica of these eggs.²

In February, 1924, Mr. A. J. Browne, manager of Durham Downs station, dis-

¹The original detailed descriptions have been published in *The Memoirs of the Queensland Museum*, Vol. viii., pt. 3, 1926, pp. 183-193, pls. xxix.-xxxiii.; *ibid.*, Vol. ix., pt. 1, 1927, pp. 1-18, pls. i-v.

²See Anderson, "Dinosaur Eggs," *THE AUSTRALIAN MUSEUM MAGAZINE*, Vol. ii., No. 4, October-December, 1924, pp. 133-134.



Site of Dinosaur Fossils at Durham Downs Station,
south-west Queensland.

[Photo.—L. C. Ball.]

covered a number of fossil bones partly exposed in soil near the bank of a small gully which runs into Eurombah Creek. A small fragment was sent to the writer, who recognised it as a new type of fossil in Australia, and, as the result of correspondence, Mr. Browne kindly collected about four hundred-weight of material and sent it to the Queensland Museum. These remains consisted chiefly of twenty-two bulky vertebrae, all of which were from the tail region of a gigantic dinosaur. The anterior ones were about eighteen inches in height, but the series, when put together, showed rapid tapering, and towards the end of the tail the diameter was only four inches. When a detailed comparison was made with the remains of other dinosaurs, it was found that this Australian fossil had special features, and that the vertebrae were yoked or articulated together by projecting wedges and processes which were unlike those previously recorded. A small section from the shaft of a femur and other fragments were also present. The writer considered that these fossils represented "a bulky herbivorous quadruped with dominant hind limbs, and a somewhat rigid tail, which probably attained over 40 feet in length." It was named *Rhoetosaurus brownei*, the first or generic name being based on *Rhoetos*, one of the giants of mythology.

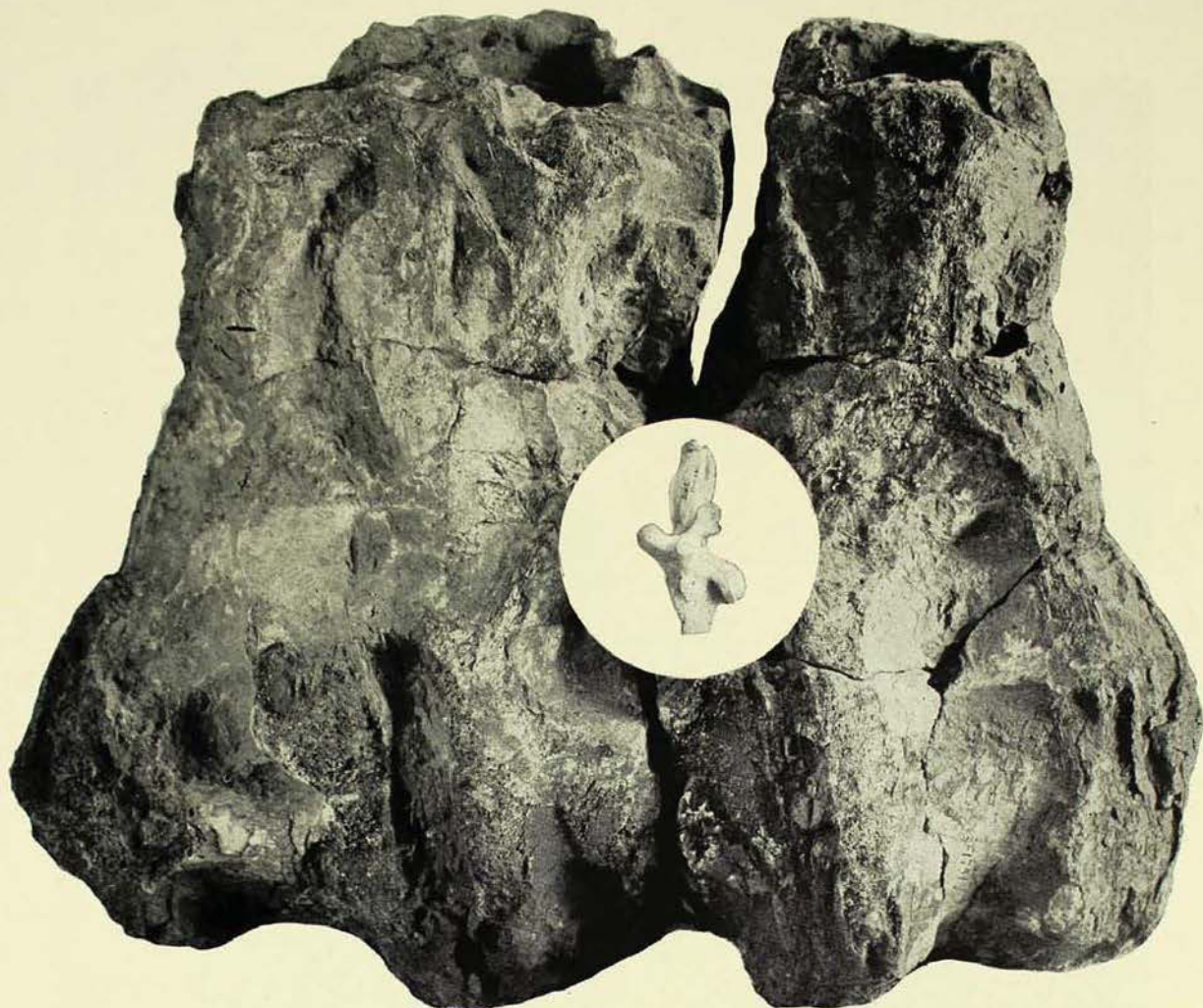
It may here be mentioned that there are many dinosaurs which were undoubtedly

carnivorous. These are chiefly distinguished by their sharp teeth and hollow limb bones and they were evidently specialised for speed and power. It was obvious that the Durham Downs fossil did not belong to this section. Among the several families of herbivorous dinosaurs the Iguanodon is well known, and because of its relatively small fore-limbs it is considered to have walked mainly on its immense hind limbs. One or two characters suggested that *Rhoetosaurus* did not belong to the Iguanodon family, but to the big group of quadrupeds known as the Sauropoda, or lizard-footed dinosaurs. It was tentatively placed in the Camarasauridae, a family which contains several gigantic forms and which was so named by

Cope because the dorsal vertebrae were curiously hollowed out or chambered (*camera*, a chamber). The Brontosaurus, on which one of the monsters so vividly portrayed in "The Lost World" film is based, belongs to this family, and the well-known Diplodocus, of which a complete skeleton has been reconstructed, is in an allied group.

Hearing from Mr. L. C. Ball, Government Geologist of Queensland, that other fossils had been exposed on the same spot, the writer subsequently visited Durham Downs, and, with Mr. Arthur Browne's valuable assistance, about a ton of new material, evidently from the same skeleton, was found in May, 1926. These specimens had to be conveyed over very rough country and across several gullies to the homestead. They were then sent by motor truck some forty miles to Roma and subsequently railed to Brisbane.

Unfortunately these fossils were much fractured and abraded and many of the fragments were invested in matrix which proved most difficult to remove. Months of careful manipulation were necessary before some of the specimens were outlined, and small chisels, drills and even discarded razor-blades were used in the preparation. The matrix consisted mainly of clay-ironstone, but there was also a closely-investing, fine-grained, calcareous sandstone which acted as a natural cement.



Conjoined Dorsal Vertebrae of *Rhoetosaurus brownei* with vertebra of a modern crocodile shown as inset.

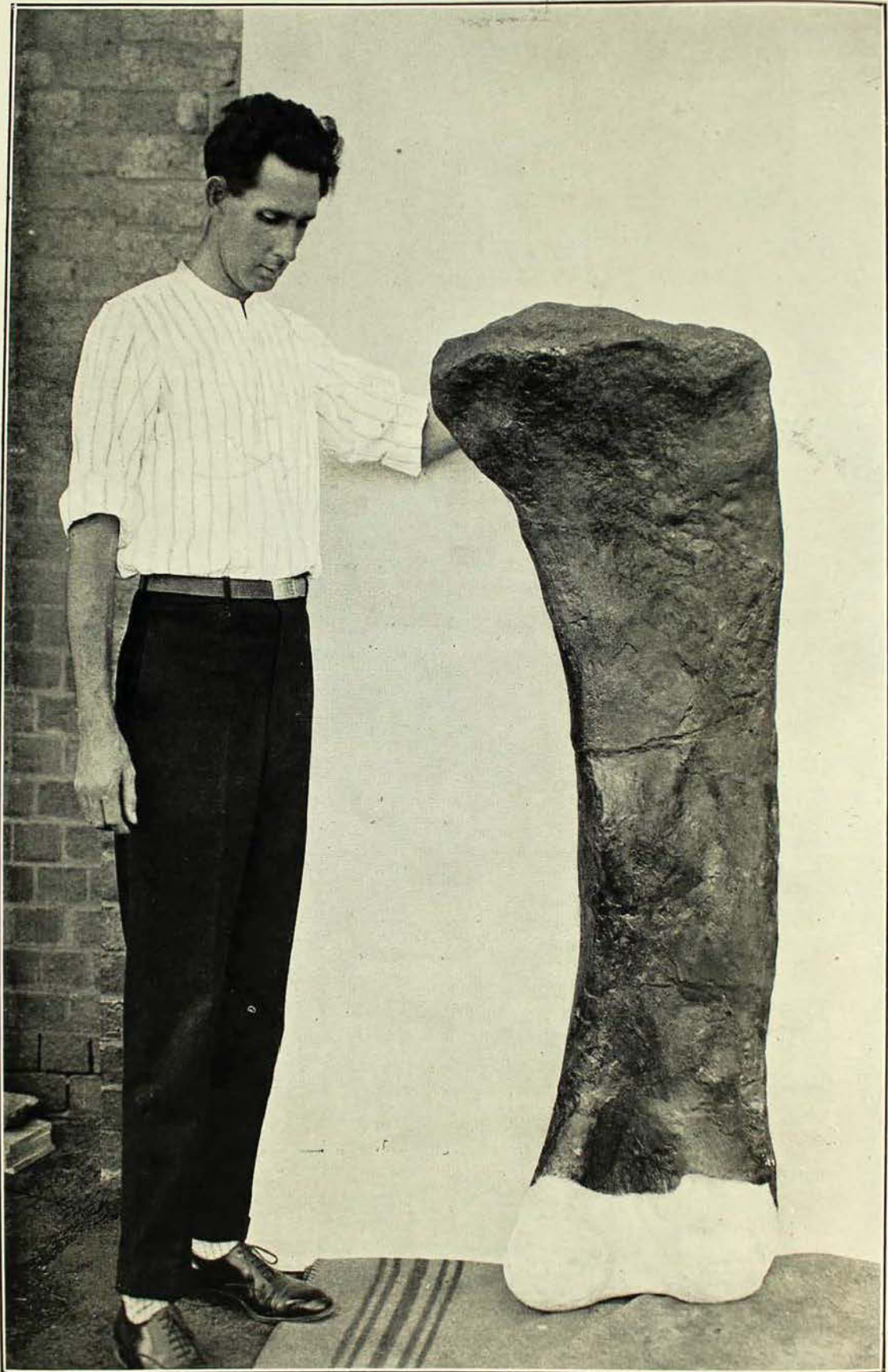
The additional material contained remains of about twenty vertebrae, including seven dorsal or rib-bearing units, and it was most interesting to find that these were of the characteristic "chambered" type of the Camarasauridae. Although incomplete, the vertebrae were about twenty-six inches in vertical height, the average length of each being over seven inches. The very complex yoking or articulating wedges and associated processes proved to be of special interest. A single vertebra from the cervical or neck region was also found.

The centrum or body of each dorsal vertebra in *Rhoetosaurus* is jointed to the adjoining vertebra by means of a ball-and-socket arrangement: a convex portion on the front of one vertebra fits into a concavity on the hinder surface of the anterior one. The vertebrae of modern reptiles are also jointed together by various forms of a ball-and-socket articulation.

It may be mentioned that the vertebrae of the tail are readily distinguished by the presence of what are called chevron bones. These are more or less V-shaped bones which are found between the units on the under side of the tail.

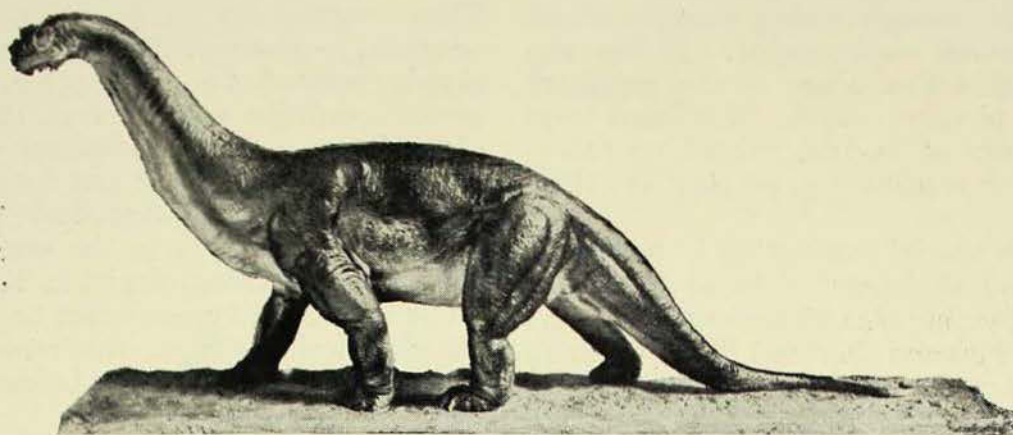
The vertebrae with hollowed-out centra are found in the neck and back region, those of the tail being solid. In some dinosaurs the vertebrae are so extensively chambered that the centra are mere shells, supported by buttresses and plates. There is evidence that the anterior part of the body of these dinosaurs was relatively flexible compared with the tail. In life these hollow vertebrae combined strength with lightness. As Cope put it, they acted as "floats" and the solid limb bones and tail as "anchors" as these huge dinosaurs walked in the water.

The most spectacular portion of the Australian dinosaur yet found is the right femur, or thigh-bone, an illustration of which is



Cast of Femur of *Rhoetosaurus brownei*, with reconstruction of distal, or lower end.
Mr. Marshall, standing by the cast which he made, is 5 feet 11 inches in height.

[Courtesy of the Queensland Museum.]



Model of the Amphibious Camarasaurus, an American dinosaur of the group to which Rhoetosaurus belongs. It was fifty-two feet long and about twenty feet in height. Prepared by the late Erwin S. Christman, American Museum of Natural History.

[Photo.—G. C. Clutton.

given. The distal or lower end is missing and the preserved portion has been put together from seven fragments. Some idea of the size and the strength of our dinosaur may be gauged from this bone, which is just over five feet in length. In comparison, the femur of a Diprotodon, our largest fossil marsupial, is dwarfed.

In life the femur was jointed to the pelvic girdle, consisting of three elements which unite to form a big hollow cavity for its head. The whole architecture of this region, including the processes uniting the pelvic girdle to the backbone, is very bulky, providing suitable attachments for the immense muscles necessary to move the hind legs. Unfortunately these bones are fractured into scores of pieces and only a partial reconstruction is possible.

The material at present available represents less than one half of a complete skeleton, and our knowledge of this Australian dinosaur is necessarily incomplete. Probably far better specimens will be available in years to come. The length of the neck, which is a variable feature in this group of dinosaurs, is conjectural, but the single vertebra found from this region is of the elongated type. It is now considered that the original estimate of a dinosaur over forty feet in total length, which was gauged from the tail, is conservative.

These fossil remains were found in freshwater deposits known as Walloon, which belong to the Jurassic age of the Mesozoic. Many fossil plants have been described from

these deposits. In this period there were vast swamps which were favourable to the development of these huge reptiles. Professor Sir Edgeworth David, when writing of Triassic and Jurassic times, stated that "a vast lake stretched from at least as far east as Brisbane more or less continuously to Lake Eyre, a distance of nearly 1000 miles." There is evidence that there were extensive areas covered with luxuriant vegetation in these ancient times. The gigantic herbivorous dinosaurs were amphibious, and one imagines them roaming slowly with unwieldy gait through the shallow waters of that weird world of the far-off past. It is most improbable that they were expert swimmers or that their habitat was in deep water. The carnivorous dinosaurs, their natural enemies, were more terrestrial in habit, and it is certain that mighty conflicts took place on the margins of the swamps. With the exception of a single claw found at Cape Patterson, Victoria, and a small tooth and a caudal vertebra from Lightning Ridge, near Walgett, New South Wales, no remains of carnivorous dinosaurs have yet been found in Australia, but it seems probable that discoveries will be made. The cast of the skull of *Tyrannosaurus*, the largest and best known of the carnivores, is on view in the Australian Museum.³

³See Anderson, "A Dinosaur Exhibit," THE AUSTRALIAN MUSEUM MAGAZINE, Vol. i., No. 10, October, 1923, pp. 314-319.

Possibly the dinosaurs died out because of geological changes which brought about an unfavourable environment. It has also been suggested that some of the primitive mammals, pioneers of the dominant vertebrate group of to-day, helped to exterminate these reptiles by preying on their eggs.

There is a special fascination in searching for the fossil skeletons of these enormous animals. The big American museums and the British Museum (Natural History) have organized special expeditions to recover from ancient strata the remains of giant

dinosaurs which lived millions of years ago. These reptiles are of great interest to the scientist, as many of the forms are obviously closely related to each other, and they present definite evidences of the processes of evolution. As the telescope enables the astronomer to look far out into space and to thrill us with the magnitude of suns that were once unknown, so the study of fossils enables the palaeontologist to look far back into time, and to reconstruct to some degree the wonderful life of the remote part of our earth, millions of years before the coming of man.

Obituary.

H. L. WHITE.

THE death of H. L. White, which occurred at his home Belltrees, near Scone, New South Wales, on Monday, May 30th, has removed an outstanding figure to whom Australian science, and ornithology in particular, owe much.

Henry Luke White, born at Anambah, West Maitland, on May 9th, 1860, was a son of the late Francis White of Edinglassie Estate, Muswellbrook, and a grandson of James White, who came to Australia in 1825 as sheep manager for the Australian Agricultural Company of Port Stephens. H. L. White belonged to a family already widely known in the pastoral and public life of the community, and his own fine personal qualities had won him the esteem of all who had the privilege of coming into contact with him.

In his youth he studied surveying, but soon turned to pastoral pursuits, and in 1885 he took over the management of Belltrees, subsequently in 1889, in partnership with his three brothers, acquiring it. Under capable management it has become one of the largest and most successful pastoral properties in Australia.

Mr. White was well known as an ornithologist and philatelist, and the splendid work he did in these two subjects forms an enduring monument to his zeal and public spirit. For many years he had sent skilled

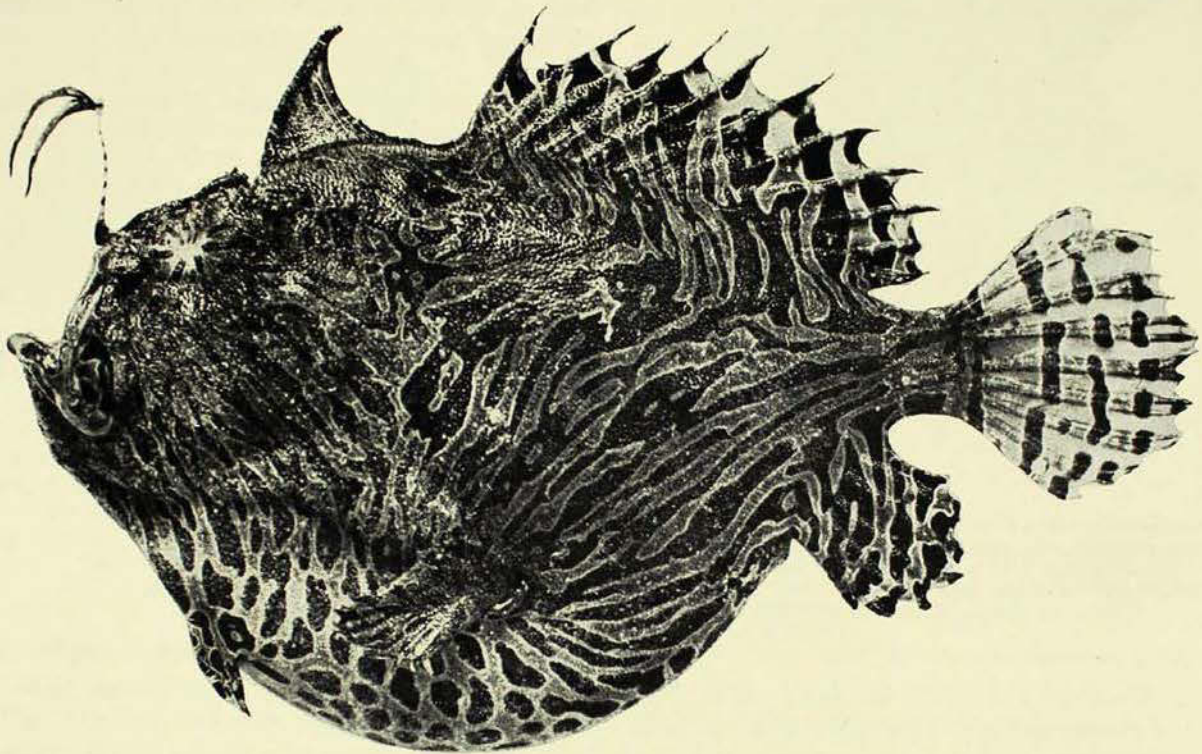
collectors and observers to the little known parts of the continent wherever rare or valuable specimens might be procured, and had formed very large collections of bird skins and eggs, not to hoard and gloat over but to be used for the advancement of knowledge. His magnificent collection of bird skins he presented some years ago to the National Museum, Melbourne, where it forms an unrivalled reference series. His collection of stamps was presented to the Mitchell Library, Sydney, and at that time was valued at £15,000 a figure which is now much enhanced.

Mr. White was a member of the British Ornithologists' Union, a Corresponding Fellow of the American Ornithologists' Union, and a member of the Royal Australasian Ornithologists' Union, as well as a Fellow of the Royal Philatelic Society of London. He was a benefactor to many public institutions and movements, and had taken a leading part as president or member of several public bodies throughout the Upper Hunter District.

To the collections and finances of the Australian Museum Mr. White was a generous donor, and in recognition of his services the Trustees elected him an Honorary Correspondent. His loss will be keenly felt by the Board of Trustees and by members of the staff, who all held him in high esteem.

Angler Fishes.

BY G. P. WHITLEY.



The Striped Angler Fish (*Antennarius striatus*) from Middle Harbour, Sydney. This fish hides amongst sea-weeds and lures other fishes towards its capacious mouth by moving the curious "fishing rod" which adorns its snout.

[Photo.—T. C. Roughley.]

THE unexpected incidents which sometimes happen are not the least of the charms of fishing. The baited hook may be taken by some everyday food-fish or it may serve to catch some queer creature of the deep which, handled gingerly, is usually either returned to its native element or used as bait. Of these, perhaps the Angler Fishes are the most interesting.

THE STRIPED ANGLER.

There are many species of Angler Fishes in Australia, of which the Striped Angler (*Antennarius striatus*) is best known. Although plentiful, this fish is rarely seen because its colours match the weeds against which it crouches at the bottom of shallow water. The ground colour of the Striped

Angler is light brown with irregular blackish stripes or blotches running over it in various directions. Several stripes radiate from its small eye, making it look somewhat like a limpet. Even the inside of its mouth is striped, so that the Angler can keep still, with its mouth open, and yet be practically invisible in its weedy environment.

Though the Striped Angler leads a sluggish existence, it manages to catch such active and elusive creatures as prawns, squid, and fishes almost as big as itself. An examination of the Angler's structure gives us a clue to the manner in which it accomplishes this. It is a plump little fish, up to seven inches long, with a rough skin which can be made to stretch considerably. This is a useful feature in a fish which eats prodigiously whenever it can, and which swells itself



A recently discovered nightmare Angler Fish (*Diabolidium arcturi*). It has long teeth, an extraordinary "fishing-rod" with a luminous "bait," and a trailing barbel beneath its chin, and lives in very deep water where no sunlight can penetrate.

[After W. Beebe.

like a Toado when it is annoyed. The fins are remarkable; the pectoral or side fins are elbowed and situated in front of the gills, not behind them as in other fishes, and the ventral or breast fins are mere stumpy quills. These fins are used rather like arms and legs, for the Angler Fish is a weak swimmer, preferring to crawl slowly along the bottom. But the most interesting features are shown by the dorsal or back fin. The first three spines of the dorsal are situated over the head and nape (in the illustration the second spine is lying flat); the foremost spine is rod-like with a curious ornament or "bait" at its tip.

The Angler, almost invisible owing to its colour and immobility, waves the first spine of the dorsal fin to and fro in the water and the bait at its tip attracts the attention of passing prawns and other marine creatures. As soon as they approach, and before they can nibble the lure and thus damage it, the Angler snaps them up in its capacious jaws. The voracity of these fishes is astonishing; their appetites seem insatiable, the mouths and stomachs of some being full of food when they are caught.

THE ANGLER AND THE ANCIENTS.

The naturalists of old regarded the Mediterranean Angler Fish (*Lophius piscatorius*) as a kind of frog or toad, and classed it with the "swimming amphibia." The Greek poet Oppian tells in verse the habits of this species, which is called "toad" or "*Rana piscatrix*." In the 1722 translation of his work in the Mitchell Library, Sydney, we read as follows:—

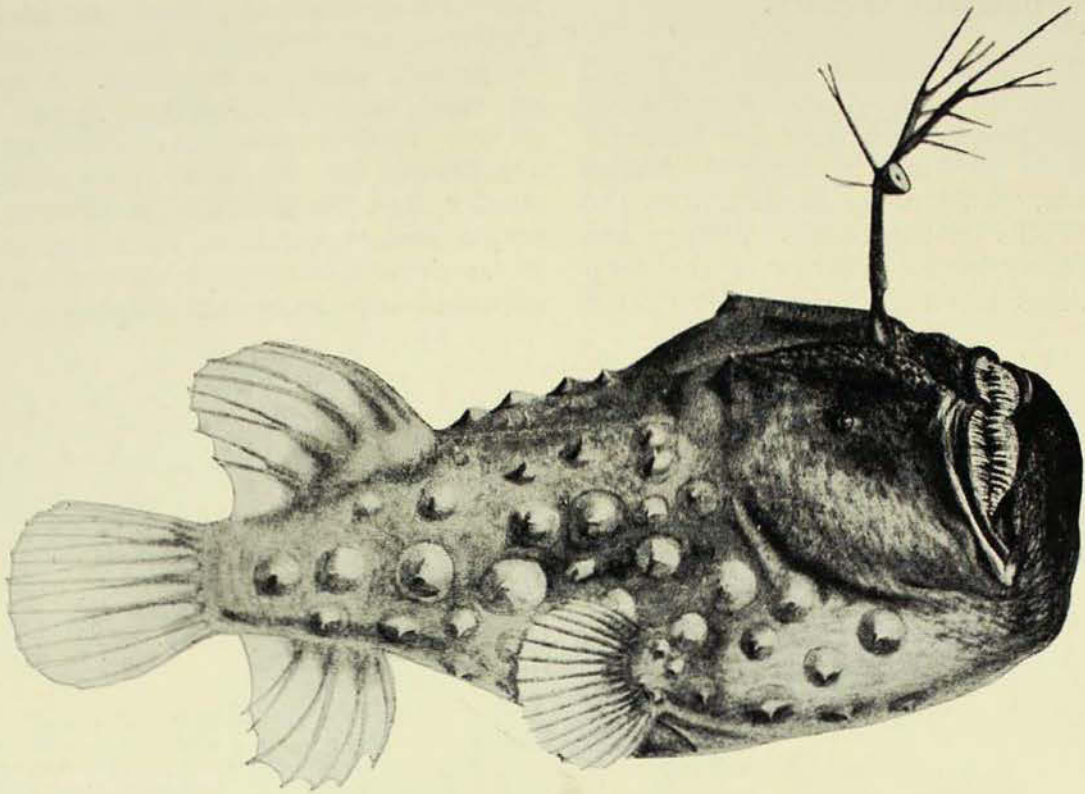
Hid in the Slime the *Toad* of form uncouth
(That fish is all one vast extended Mouth)
Her tender Body wraps, on Prey intent,
And silent there concert the great Event.
What softer Skin, and slower Pace deny,
Wise Foresight and successful Frauds supply.
Within her Jaws a fleshy Fibre lies,
Whose Whiteness, grateful Scent, and Worm-like
Size

Attract the Shoals, and charm their longing Eyes.
She to allure oft shakes the tempting Bait;
They eager press, and hurry on their Fate.
But as they near approach, with subtle Art
The wily *Toad* contracts th' inviting Part;
Till giddy Numbers thus decoy'd she draws
Within the Circle of her widen'd Jaws.

LIFE HISTORIES.

The life histories of many angler fishes are unknown, but such species as have been studied show that their growth is very interesting. In the Goose Fish (*Lophius piscatorius*), an Angler which is common in Europe and North America, many remarkable changes of form take place during the metamorphosis from egg to adult. The eggs of the Goose Fish are laid in a jelly-like substance which swells in the water and forms a "raft" which floats upon the waves. The completed egg-mass may be about thirty feet long. The jelly is transparent, but the eggs, containing developing fishes, give the "raft" a purple-grey tinge, from which it receives the name "Purple Veil." The number of eggs in the purple veil of a Goose Fish is estimated at well over a million, and the entire work is the product of one female.

The newly-hatched young are as unlike full-grown Angler Fishes as one could imagine. They look like minute, delicate, mouthless tadpoles, with broad finfolds along the upper and lower surfaces of the body. These larvae float at the mercy of the waves and many are eaten by jelly-fishes and other enemies. About a fort-



A rare Angler Fish (*Aegoeonichthys appeli*) from Hokitika, New Zealand. Only two specimens of this species are known. The illustration represents the type. Note the curious spines arising from the soft skin of the body. [F. E. Clarke, del.]

night after hatching, those which survive are greatly changed; each has grown a mouth, the dorsal fin has two separate spines in front of the main fin, whilst the ventral fins have long trailing rays. The side fins are short and broad and not at all leg-like. As development proceeds, the head becomes more pronounced and the jaws are more definitely moulded; the ventral rays grow so long that they trail behind the fish as it swims about near the surface of the sea. The end of the Angler's backbone tilts up so as to form a tail which very much resembles that of a shark. Later, the long trailers shorten, the tail becomes more symmetrical, the foremost spines of the dorsal fin advance to their positions over the head, and curious weed-like growths appear on the body and fins. The Angler Fish is now adolescent; it goes to the bottom of the sea where there are rocks and sea-weeds, and attains full size.

Another Angler, the Mouse Fish (*Pterophrynoides histrio*) lives in floating Sargasso weed. Its colours harmonise with its surroundings but it does not seem to obtain its food by piscatorial ruses, specimens in captivity having been observed to pursue

their prey and even to bite or eat one another. A Mouse Fish a little over three inches long deposited a raft of eggs which measured three or four feet in length. One female lays more than one raft at different times, though a case of two having been produced at one time is also on record. The development of the Mouse Fish has not yet been fully investigated. The Mouse Fish is very widely distributed, and has even been caught at Circular Quay, Sydney; it has been graphically described by William Beebe in his book, *The Arcturus Adventure*, as follows:—

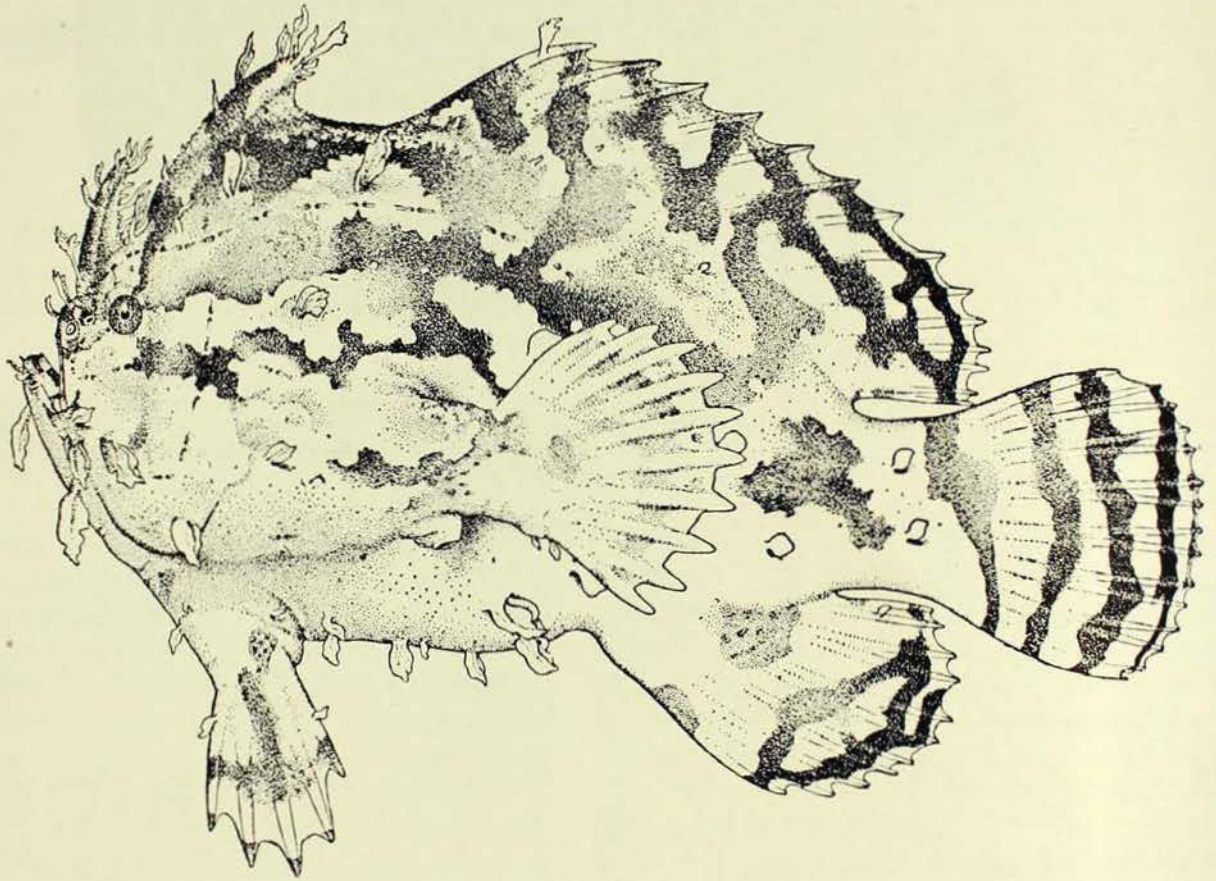
From snout to tail-fin it was the piscine essence of the fronds [of the Sargasso Weed], its fin-rays produced into finger-like appendages, with which it crept about in the weed, swinging from frond to frond, dangling upside-down, and assuming postures that were irresistibly comic. Its foolish face was fixed in an expression of intense earnestness, and the stout little body performed amazing antics with the agility of a monkey . . . Everyone who could draw clamoured to paint this specimen, others inspected it with a view to determining the species, and some of us wished merely to watch it and chuckle.

The poor fish eventually "died of publicity."

DEEP-SEA ANGLERS.

Angler Fishes of various kinds are found in almost all the seas of the world, some wedging themselves with their fins amongst corals, others drifting in tangled masses of sea-weeds, whilst many kinds live in the abysmal depths of the ocean. Nature has provided many of the Anglers of the deep with luminous torch-like baits, surrounded

Like Fabre's mantis, they can reverse in their favour the axiom that the cask must be greater than its contents. A specimen of one very little-known Angler (*Linophryne lucifer*) was once seriously inconvenienced by its own greediness. This Angler had caught and swallowed a fish which was bigger than itself, but the gases of its decomposing prey carried captor and captured up from the depths, until the



The Mouse Fish (*Pterophrynoides histrio*), an Angler which has taken to living amongst floating sea-weeds, which it resembles somewhat in form and colouration.

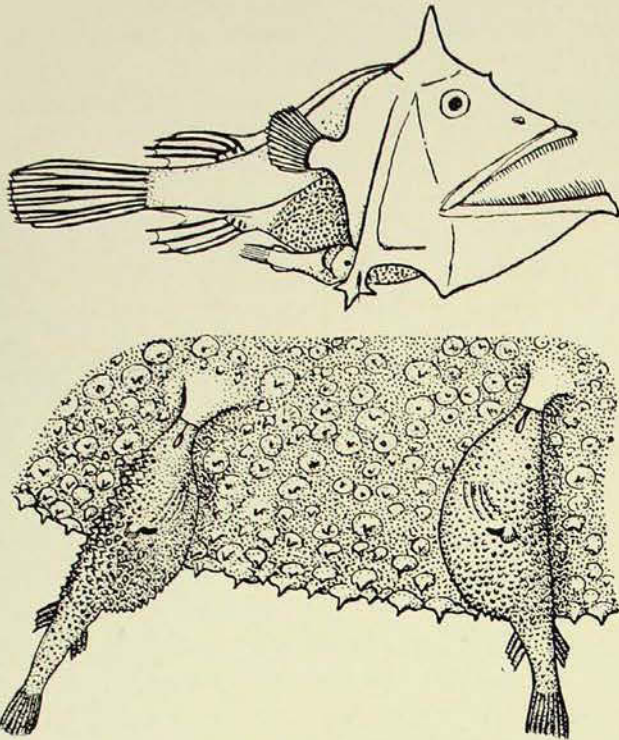
[After Jordan and Sindo.]

in some cases by worm-like appendages which must appeal to the appetite as well as to the curiosity of the fishes and cuttles which live in those dark regions. Most of the abysmal Anglers are nightmare objects, having large mouths armed with needle-like teeth, grossly robust bodies, no ventral fins, and very small eyes. Some of them have been obtained which have actually swallowed fishes longer than themselves, the elastic nature of the stomach and skin enabling them to accomplish this feat.

gourmand was found by some turtle-fishers, floating on the surface of the sea in a helpless condition, having met its death in a paradoxical process of falling upwards. Unlike most of the known Anglers, *Linophryne* has a long tentacle, tipped with tongue-like lobes, trailing from its throat.

PORTABLE BRIDEGROOMS.

The most remarkable thing about the deep-sea Angler Fishes has only recently



Diminutive male Angler Fishes attached to the bodies of females. The upper figure shows the female of a deep-sea species (*Edriolychnus schmidti*) carrying the male, upside down, attached to the lower part of her gill-cover. The lower figure shows two parasitic males of another kind (*Ceratias holbolli*) showing the mode of attachment.

[After C. Tate Regan.]

been discovered by Mr. C. Tate Regan of the British Museum,¹ who found that the males of many of these fishes are dwarfs which are fixed by their lips to the head or body of the females. The union is so intimate that it is not possible to say where husband ends and wife begins. In one weird fish, the male was attached upside-down to the female, whilst in another case he was carried on her forehead like an eccentric ornament. The females are fairly normal in structure, but their degenerate spouses have no alluring bait, no teeth, and hardly any stomach. Beyond ensuring the continuance of their miserable race, the males, depending solely on the females for their nutriment, can do little but breathe through the slits which in them take the place of a mouth.

No deep-sea Angler Fishes with parasitic males have so far been caught in Australian waters, but it is probable that they will be found when our deepest waters have been better explored.

¹Regan, *Proc. Roy. Soc. London (B.)*, xcvi., 1925

The Australian Museum has recently received generous support from public minded citizens, as a result of which its collections have been enriched and their value to science, and the State, considerably enhanced.

To individuals who so further work of the institution the Trustees are empowered to confer Honorary Correspondentship as some slight token of appreciation. At the June meeting of the Board of Trustees Miss Eadith Walker, C.B.E., the Hon. Sir Alfred Meeks, K.B.E., M.L.C., Messrs. Jas. Burns, R. H., and R. R. Dangar were elected.

The Hon. Sir Alfred Meeks, it will be recollected, enabled the Trustees to purchase the Robins collection of Ethnology which contains many fine Polynesian pieces now so scarce and difficult to procure. The other Honorary Correspondents

in assisting to acquire the Grant collection of ornithology enabled the citizens of New South Wales to possess what is undoubtedly one of the finest collections made. Had it not been for their action this collection would have been lost to Australia, for negotiations for its purchase by an outside institution had been started.

The State owes much to these people.

When the large Grant collection of birds was presented to the Museum by a number of generous donors some difficulty was found in housing the specimens in a fitting manner. Mr. O. C. Beale, Trustee, with characteristic generosity took steps to have two excellent cabinets constructed to contain the skins. These have now been received, and our difficulty has been overcome.

A Census of Australian Fishes.

BY G. P. WHITLEY.

PROFESSOR Henry Fairfield Osborn, the eminent American evolutionist, has just published the fifth of a series of papers on the origin of species¹ in which he notes the number of known species of fishes in the world as approximately 20,000, and compares it with the 3,500 known in Darwin's time, and approximately 11,000 known in 1886, his figures having been taken from the computations of Günther (1896). Henshaw, it may be noted, estimated 12,000 in 1912.

It is interesting to consider the numbers of nominal species of Australian fishes. At the end of 1883, Sir William Macleay² noted the total number of Australian fishes as amounting to 1,291 species. In 1914, the late A. R. McCulloch, who is referred to by Osborn as one of the world's outstanding ichthyologists, wrote,³ "Inclusive of both the marine and fresh-water forms, there are about one thousand eight hundred and forty species of fishes at present known from Australia. Though this number in-

cludes many which will ultimately prove to be mere synonyms of the others, yet it is almost certain that a complete list of the fishes occurring in our waters will exceed two thousand."

Mr. McCulloch compiled, in manuscript, a list of all the fishes recorded from Australia, adding to it each new record published, until, at the end of 1920, he had 1,905 species. At the time of his death, in 1925, the list included 2,140 species, an increase of three hundred in eleven years. Even when purged of synonymy, it is probable that this number will be substantially increased in future. More than one-half of the Australian species are inhabitants of Queensland, where the warm Barrier Reef waters of the north are specially favourable to marine life, and the more tepid waters of the Moreton Bay districts support many southern forms.

Australia's present census of fish species, which number about 2,150, may be compared with the approximate numbers of fishes recorded from other places: North and middle America, 3,200; Japan 1,450; India, 1,420; Philippine Islands, 830; Hawaii, 660; Samoa, 500; Fiji, 440; Natal (marine only), 400; New Zealand, 350; Lord Howe Island, 200; and Santa Cruz Group, Melanesia, 124.

¹Osborn, *The American Naturalist*, lxi., No. 672, p. 5, 1927.

²Macleay, *Abstr. Proc. Linnean Soc. N.S. Wales*, 20 Jan., 1884, p. iv.

³McCulloch, *Biol. Res. "Endeavour,"* ii., 3, 1914, p. 77.

Before his death the late Thomas Steel transferred most of his zoological collections and books and papers on natural history to the Museum. His widow has since made a further presentation including a fine series of Australian, Polynesian and other stone implements which materially supplement our collections.

Mr. Arthur Combe, of the Uganda Geological Survey, who was lately on furlough in Sydney and who has few equals as a collector of minerals, presented to the Museum some very beautiful specimens of barite, calcite, and dolomite from West Cumberland, fluorite from Durham, and augite from south west Uganda.