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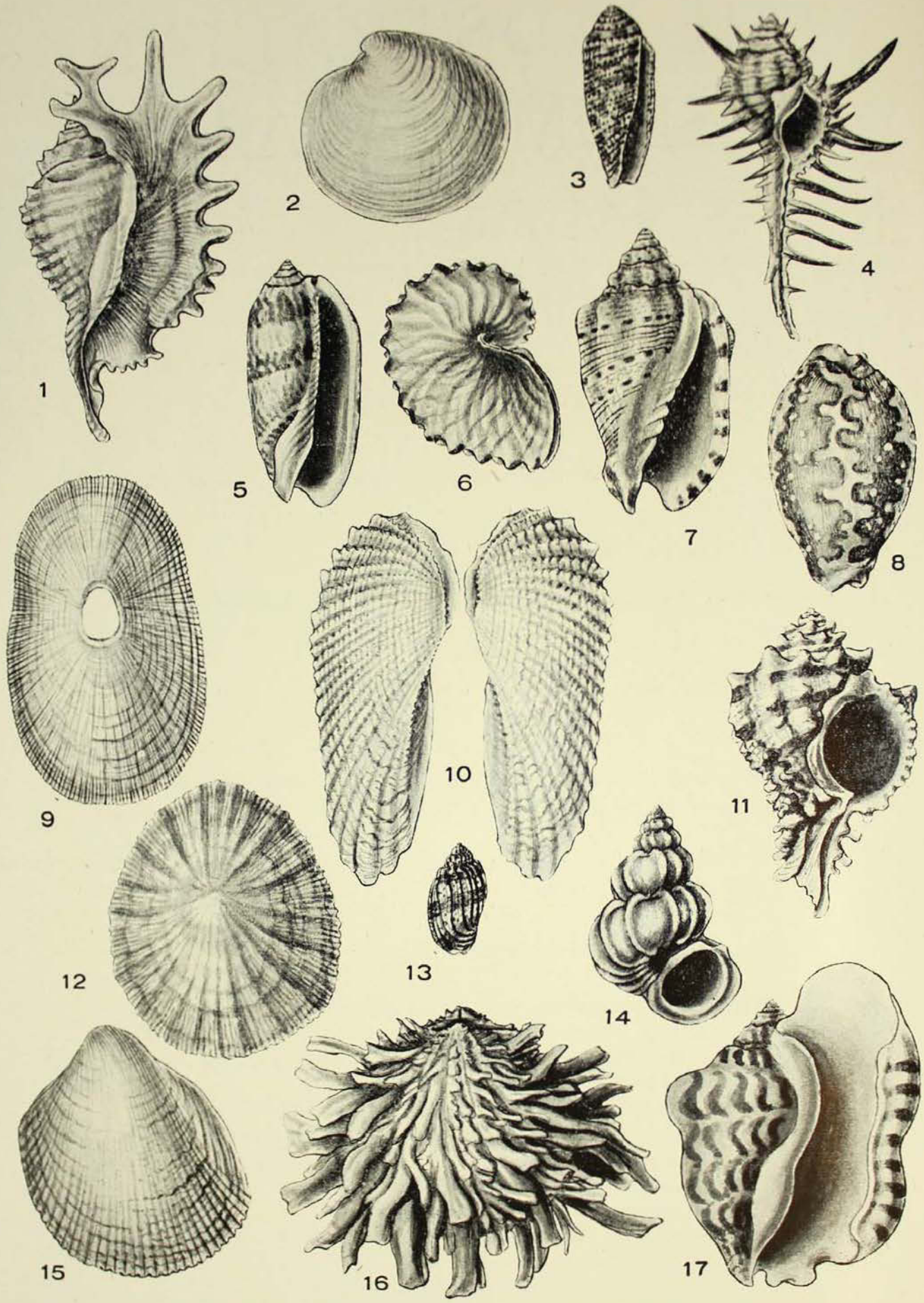

SHELLS FROM THE WATERHOUSE COLLECTION.

1, Violet Mouthed Scorpion Shell (Pterocera violacea); 2, Heavy Dosinia (Dosinia ponderosa); 3, Cone shell (Conus nussatella); 4, Black-spined Murex (Murex nigrospinosus); 5, Red-mouthed Olive Shell (Oliva erythrostoma); 6, Paper Nautilus shell (Argonauta boettgeri); 7, Music Volute (Voluta musica); 8, Map Cowry (Cypræa mappa); 9, Great Keyhole Limpet (Lucapinella crenulata); 10, Angel's Wings Boring Shell (Pholas costata); 11, Cabbage Rock Shell (Murex brassica); 12, Giant Limpet (Scutellastra kermadecensis); 13, Slender Harp (Harpa gracilis); 14, Precious Wentletrap (Scala pretiosa); 15, Great Cockle (Cardium elatum); 16, American Thorny Oyster (Spondylus americanus); 17, Very Broad Stromb (Strombus latissimus).

[Joyce K. Allan, *del.*

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VOL. V, No. 2. APRIL-JUNE, 1933.

Shells in the Waterhouse Collection

BY JOYCE K. ALLAN.

THE Waterhouse collection of shells, of which a preliminary account by Mr. T. Iredale appeared in an earlier part of this MAGAZINE,[1] contains many interesting shells, and duplicates of a great number of these would not easily be obtained today.

In this magnificent donation several families are outstanding for their completeness as well as for the perfection of the species, for example, the Cowries, Paper Nautili, Harp shells, Rock shells and Thorny Oysters. Many species are noteworthy either for their rarity, locality, or appearance, and a short account of these is here given.

COWRIES.

As a whole family, the cowries are the prize of the Waterhouse collection, and, though these shells are always noted for their rich colouring and fine polish, I doubt whether in any collection in the world more perfect or larger specimens would be found. As the cowries were dealt with in a previous article[2] the reader is referred to this for further information about these beautiful inhabitants of tropical seas.

ROCK SHELLS.

Not only are there series of different species of rock shells exhibiting variation in colours and size, but the specimens are remarkably well preserved, many of them still retaining their opercula, and the spiny ones their spines unbroken. One of the most distinctive shells in this family is the large Cabbage Rock shell (*Murex brassica*), one of the largest of the rock shells. The Cabbage Rock shell, which is found principally in the Gulf of California, grows to over six inches long, and is easily recognized by two conspicuous brown bands encircling the main part of the light coloured surface of the shell. The wide pink-lipped mouth opening is orange-coloured within.

[1] Iredale: AUSTRALIAN MUSEUM MAGAZINE, iv, 4, October–December, 1930, p. 113.

[2] Allan: *Loc. cit.*, iv, 9, January–March, 1932, p. 291.

Another, the Black Spined Murex (*Murex nigrospinosus*) from Polynesia, differing from its nearest allies by having very dark-coloured spines, is the first specimen of this species to come to the Museum collection.

Rock shells are solid univalves differing from most others by the addition of spiny processes, leaf-like expansions, or knobs, on their whorls. These striking ornamentations are arranged longitudinally, forming varices, and mark different stages of growth. The colouring of these shells, whose interiors are pink, is usually distinctive, and their animals are even more brilliantly coloured.

They form a large family of carnivorous animals living in warm seas, and some grow to a large size. The shells of the larger and stronger species are used for cameo-cutting and other shell decorations. Some of the animals are eaten by the poorer people living round the Adriatic coast. Tyrian purple, the famous dye much in demand by the ancients, was obtained from rock shells, the fluid being secreted in special glands and extracted from the animals by a pounding method.

HARP SHELLS.

Harp shells are favourites with collectors on account of their attractive shape and distinctive markings. The strong longitudinal ribs in the larger species, which suggested *Harpa* for their generic name, resemble varices, which mark periods of resting during the growth of some other shells. They live in all tropical seas except the Atlantic Ocean, and some species may be as large as five inches.

Most univalve shells are not only large enough to hold their animals when they retire, but are able to completely hide them. In the Harp shell, however, the animal is too big for its home, so that a head with tentacles and a large foot always protrude beyond it. The foot can be discarded when the animal is hurrying to safety, a fact which has been noticed in certain species in Mauritius, where the natives rake the sands for harps. The cut-off portion, however, is replaced later with a new growth.

The Harp shells were a particularly welcome donation, consisting of all the known species, two of which this Museum did not possess. The rare Slender Harp shell (*Harpa gracilis*), which inhabits Polynesian Seas, is a graceful semi-transparent shell about one and a half inches long, with rather flat, far apart ribs, and its colour is a mixture of rose pink and grey, crossed with fine red lines.

VOLUTE SHELLS.

Amongst a beautiful collection of Volute shells the most outstanding was a very attractive range of the Music Volute (*Voluta musica*), showing the variation of its colour and elongation of its spire.

The Music Volute is the most conspicuous of all the smaller species of this group, and is well described by the name given to it, as the general colour is creamy-yellow with sets of chestnut concentric lines arranged round the whorls like bars of music. Further increasing this similarity are dark brown dots like notes directly above and between the lines, with finer and fainter ones between them. Though the colouring of this species varies, as those in the Waterhouse collection show, the pattern remains fairly constant. Music Volutes are found in the West Indies and are the only species of Volute shells to possess opercula.

Volute shells inhabit tropical and sub-tropical seas, with their distribution centre in Australia. Their appearance makes them particularly suitable for cabinet specimens, many of them being rare and beautiful species, in fact, some of the most handsome shells in the molluscan group belong to the Volutes. They are rarely found with the animals inside them, as they mostly live in deep water, burying themselves in the sand should the receding tide expose them. Empty shells are occasionally thrown up on beaches, and many large ones are brought up in trawl-nets off the coast of New South Wales. One large species is used by South Sea islanders as a baler, and is commonly known as the Baler shell.

OLIVE SHELLS.

Olive shells are an exclusively tropical family of active brilliantly-coloured molluscs with a polish resembling that of the Cowries. The shells are oblong, with

small spires and long narrow mouth openings or apertures. The mantle of the animal reflects over the shell, partly concealing it. Olives live on sandy places, burrowing, if the sand is exposed, by means of a large foot. In Mauritius they are fished for with lines baited with fish. In Central America small species are strung together and sold to tourists to hang in doorways or windows. Natives of the South Pacific islands use the smaller varieties for many ornamental purposes by piercing them at their spire and stringing them.

The colouring on the surface of the Olives, either as bands, spots, mottlings or reticulations, varies through many bright shades, and often contrasts with a deep orange interior.

In the Waterhouse collection are many fine specimens from different localities, including a big range of the Red-mouthed Olive (*Oliva erythrostoma*), showing variation of colouring.

CONE SHELLS.

The Cones are a large family of beautifully marked, well-known shells living in holes and narrow crevices of rocks and coral reefs in tropical and sub-tropical seas. Their life is that of pillagers, which bore into shells of other molluscs and suck their body juices.

Though their slow crawling movements might give the impression of timidity, yet when handled the animals of some species are able to inflict a poisonous wound accompanied by sharp pain, and natives are very averse to handling live specimens for this reason.

The vivid and varied colouring of the shells, which becomes more pronounced as the tropic seas are approached, and which makes them so popular with collectors, is often hidden from view in the live specimens by a dull protective epidermis.

SCORPION OR SPIDER SHELLS.

Amongst these shells are two species of outstanding interest to the Museum ; one, the Very Broad Stromb shell (*Strombus latissimus*), from the Philippine Islands, is the only specimen of this species in the Museum collection, and the other species, the Many-footed Scorpion Shell (*Pterocera violacea*) is represented only by two smaller specimens.

The Very Broad Stromb shell is large and solid, characterized by an exceedingly wide expansion of the upper part of the outer edge of the mouth opening, which becomes reflected inwards at the side and is narrower at the base. The shell is orange-brown with white blotches, brown lines are on the reflected part of the aperture and the inside is white and polished, with a pinkish tinge underlying parts of it.

The Many-footed Scorpion shell, which comes from the Indian Ocean, is smaller and more delicate than the former, and has the outer edge of the mouth opening expanded into about ten rather flattened claws, the posterior one bifid, or even trifid. The interior of the mouth is very strongly grooved, except on the extreme edge. Concentric nodulose ridges are on the body of the shell. Its colour is whitish, marked with light orange brown, the aperture white, the innermost part stained with deep reddish-violet and the columella and outer lip orange tinged.

These two species belong to a family of very handsome active animals living in the tropical seas, chiefly of the Eastern Hemisphere. The long, curved, hollow canals or the wide wings on different species of these shells grow only after the animals reach maturity ; until then their shells are quite plain. The shells are used in the manufacture of porcelain or lime, and the larger stronger ones for cameo-cutting. Natives use them for ornamental or other purposes.

PAPER NAUTILI OR ARGONAUTS.

A complete set of known species of Paper Nautili, from small ones a little over an inch in size to the largest species, greatly enriched the shell collection, and some were quite new to it. The specimens were nearly all in perfect condition, and those who know these frail shells will realize how difficult it is to keep the thin edges from breaking or cracking.

The inhabitant of the Paper Nautilus shell is a female octopus-like animal, which uses the shell merely as a cradle for holding her grape-like bunch of eggs

in the breeding season. These are kept in the main body of the shell, which is not attached to the animal by muscles as in true shells, but is held in place only by its two dorsal arms, expanded into webs at the end for this purpose. The web-like arms secrete the substance of which the shell is made, and are capable of repairing any damage to it. The male animal is very much smaller than the female, is rarely seen, and has no shell at all. Paper Nautili inhabit the warm and tropical seas, spending the greater part of the year in the depths, but are occasionally seen in fleets on the surface of the oceans. Shells with the animals and eggs are sometimes washed up on beaches after gales, but gulls soon dispose of them and the shells are carried away by the tide. Empty shells are found at intervals round the Southern Australian coast, especially in Victoria.

THORNY OYSTERS.

These strikingly handsome bivalves easily rank next to the cowries as an attractive and colourful exhibit, and are the largest and finest series of the family to be presented at one time to this Museum. A large set of the American Thorny Oyster, showing its varied range of colouring and a perfect specimen of a smaller species from Sydney Harbour, where they are rarely found, adds to the value of this portion of the donation.

Thorny Oysters are found in warm seas, growing firmly attached to rocky surfaces or other shells, which somewhat causes distortion of form and variation, especially in the lower valves. Like the scallops they make good eating, and in some countries are considered delicacies, but difficulty is experienced in collecting them.

GIANT LIMPET.

This limpet, of which a very good specimen was presented by Mrs. Waterhouse, is the second largest species in the world, and is found in the Kermadec Islands, to the north of New Zealand. Mr. T. Iredale, who lived there for some time, says they live on the rocks in such numbers that they touch each other, and are so strong that a spade had to be used to remove them.

Six inches is about the usual size of an adult shell, which is dirty white on top, with a creamy interior, the outer edge of which is outlined with a narrow bright orange border. The animal is edible.

GREAT KEYHOLE LIMPET.

Amongst the False Limpets, to which the Keyhole Limpets belong, this giant form stands out, being sometimes over four inches long compared to about two inches in the other species. The Great Keyhole Limpet, of which there is fortunately a perfect specimen in this collection, is found below tides in California. It is fulvous-pink in colour, with a smooth white inside, and has a large black animal, the mantle of which engulfs and almost completely hides the shell. The animal's foot is yellow. In the adult shell the keyhole slit is in the apex, slightly in front of the middle of the shell, differing from its position in young specimens where it is on the margin of the shell. As the animal grows, however, this marginal slit becomes filled with shelly matter and gradually the slit journeys upwards till in the mature stage it reaches the apex. Radiating ridges and concentric lines, giving a crenulated margin to the shell, make it a very handsome species.

PRECIOUS WENTLETRAP SHELL.

Most prized of all early shells and still rather rare and in great demand by collectors, this fine species is found chiefly in the China Sea, though smaller specimens occur off the Queensland coast. It is one of the largest species in a big family of creeping carnivorous animals found all over the world and known as the Staircase and Ladder shells.

A fictitious value was placed on the Precious Wentletrap when it was first discovered, and large sums of money were paid for a single specimen; this has gradually dwindled until now a good specimen may be sold abroad for a few shillings.

Several perfect specimens are in the Waterhouse collection, and as these are localized, they have added to the range of those already in the collection.

The Precious Wentletrap is easily distinguished from the rest of the species

in the family by its broad base. It is a very polished creamy white shell, with dead white longitudinal ribs set rather far apart on the whorls, and is the most handsome member of the family.

ANGEL'S WING BORING SHELL OR RIBBED PHOLAS.

Until this donation came to the Museum, the Angel's Wing boring shell was represented by only two small specimens, so the collection benefited by the addition of two very large perfect pairs of valves.

The Angel's Wing boring shell is the largest shell in a family of boring bivalves and is usually found clustered with others deep in sandy mud in Florida and Mexico, or may bore in rock or wood. Like other boring molluscs it settles early in life in a hole dug by itself, and from this place is able by means of long siphons to obtain enough food and oxygen for its existence.

The two white brittle valves, which are always gaping except at the tip, resemble in colour and shape the general idea of angels' wings, thus giving rise to the vernacular name. The valves may grow as large as eight inches, and the animals are sold as food in some markets in West Indian towns.

THE HEAVY DOSINIA.

Most of the large foreign bivalves in the Waterhouse collection are finer specimens than those already in the Museum, and the specimen of Heavy Dosinia presented was no exception to this.

This is the largest species in a genus of Venus Clams and is found in sandy mud in California. The almost round, smooth, polished shell has a diameter of four inches, and is sometimes covered with a thin pale yellowish-brown epidermis. Thin knife-like marginal edges of the valves contrast strongly with the solid body of the shell, the inside of which is white.

GREAT COCKLE.

The collection benefited by a very large specimen of the Great Cockle, which is the largest true cockle in the world, and is found in California on mud banks at low tide. The shell, which in fully-grown specimens is six inches long, is very strong, with a shiny yellow surface covered with deep longitudinal grooves. The animal is edible.

Cockles are heart-shaped bivalves with radiating ribs. One small species is collected extensively in the British Isles and the Continent for food and bait, and various ornaments are made from the shells.

SHELL OPERCULA.

As a very representative series of shell opercula were in the donation and make an interesting exhibit they are mentioned here.

Most spiral shells have a lid or operculum which closes the mouth of the shell when the animal retires within it, and consists of horny layers sometimes hardened with shelly matter. Though discarded by some shells when young, the opercula are retained by others throughout life. Many fit the mouth of the shell tightly, others partly, some are rudimentary and some form a claw. The well-known "Cats-eye," so popular for ornamental purposes, is an example of a solid shelly operculum which tightly fits the mouth of the shell, a characteristic of many species in the family of Turban shells. The Top shells have thin spiral, almost circular opercula, in the Nerites they are shelly and hooked and do not fit tightly, and in the Spindle shells and Periwinkles they are thin and horny.

In connection with the Museums' Association Survey of Empire Museums, financed by the Carnegie Corporation of New York, Mr. S. F. Markham, M.A., B.Litt., and Professor H. C. Richards, University of Queensland, are now visiting and reporting upon the museums and art galleries of Australia and New Zealand. In February they examined this Museum, met various members of the staff, and enquired into the working of the institution.

George Tobin, A Neglected Naturalist

By Gilbert P. Whitley.

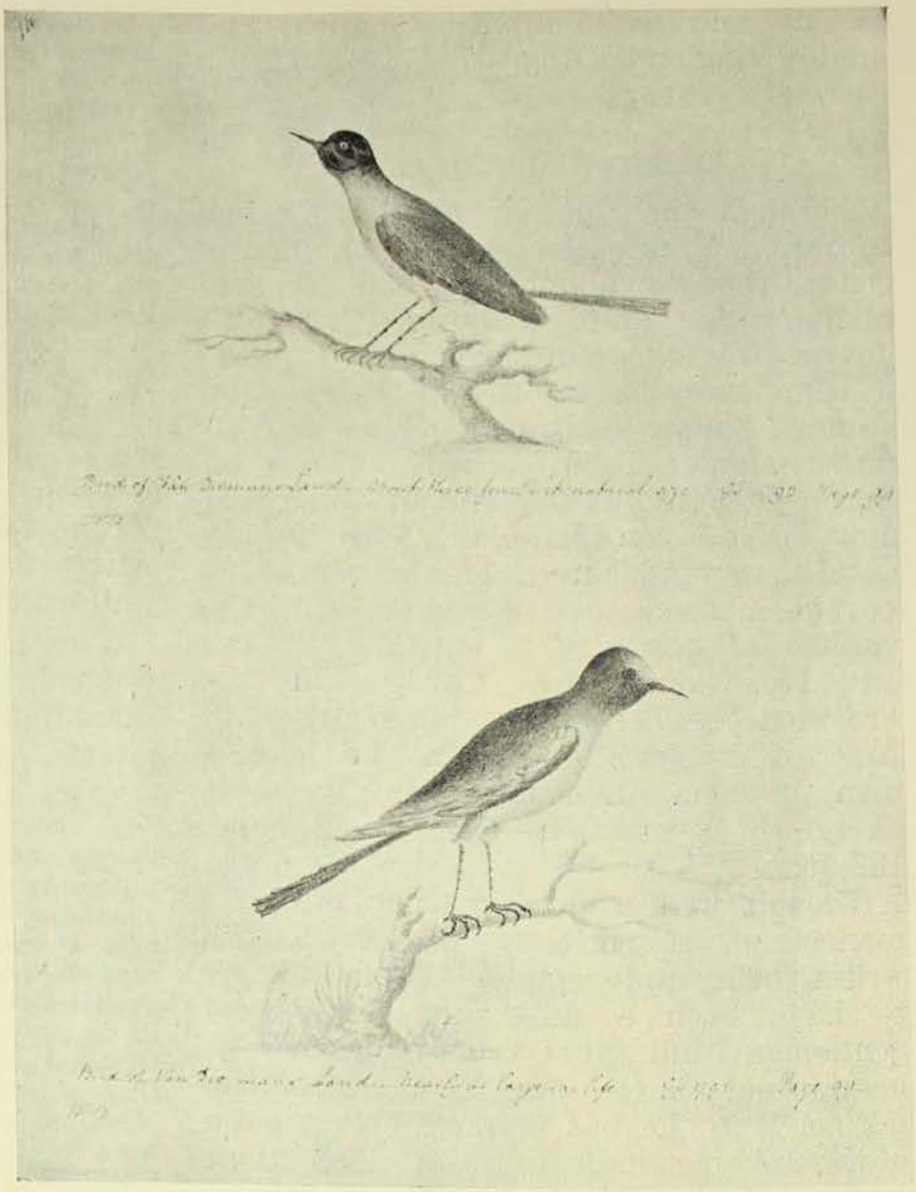
PRIOR to the year 1790, few white persons had visited Tasmania, which was still regarded as the southernmost limit of New South Wales.

Abel Janszoon Tasman discovered the land which now bears his name in 1642 and his pilot-major, on landing, noted the plants, huge trees, birds' nests, and traces of quadrupeds, making the first natural history observations in that remote part of the world. One hundred and thirty years elapsed before the natural history of Tasmania was again noticed, this time by a Frenchman, Marion du Fresne, whose expedition, in March, 1772, gathered all sorts of birds, fishes, and shellfish for food. Next year, Furneaux, in the *Adventure*, separated from Captain Cook's *Resolution*, came to Van Diemen's Land, and in 1777 Cook himself visited Adventure Bay, natural history specimens being taken to England as a result. Bligh, in the

A splendid painting, No. 16 in the Mitchell Library Collection, shows a scene in Adventure Bay, Tasmania, in 1792. Tobin and a friend are lunching in a native hut, or wigwam, outside which are the bones of some mysterious animal. The wooding and watering party is busy in the distance, where a boatload of bluejackets comes ashore from Bligh's ships. On the right is one of the hollow tree trunks which Tobin thought might have been used as a dwelling by the natives.

[George Tobin, *del.*

Bounty, visited Van Diemen's Land in August-September, 1788, but the mutiny which followed overshadowed any natural history work he may have performed at this time. Bligh used to gather shells for his wife. His collection, containing Australian shells, was auctioned at Covent Garden in 1822, and a copy of the rare sale catalogue, marked with the prices obtained, is in the Australian Museum. A further visitor to Tasmania was Captain J. H. Cox, in the brig *Mercury*, July, 1789, when Oyster Bay was named.



Two Birds of Van Diemen's Land selected by Bligh to illustrate the proposed account of his voyage, but not hitherto published. Above is a Blue Wren, and below, the earliest known painting of the Robin with red forehead and breast from Tasmania. Drawings No. 14.
[George Tobin, *del.*

TOBIN'S BOXFISH.

Amongst the curios collected by the naturalists on these voyages were gaily-striped boxfishes, "a new species of *Ostracion*," as they were called in 1782. In Dr. G. Shaw's *General Zoology*, 1804, this boxfish is "Described from a drawing by Captain G. Tobin by whom it was observed about the coasts of Adventure Bay in Van Dieman's Land," and, in Donovan's *Naturalist's Repository*, 1824, this boxfish is named *Ostracion tobinii*, the only species, so far as I have traced, which was named in Tobin's honour.

I had often wondered who Captain Tobin could have been but it was not till quite recently that I found any details concerning him, and then was surprised to discover that Tobin visited Australia in 1792 with Bligh, and made excellent drawings of the scenery and animals of the many places he visited. It is remarkable that this man should have been so generally overlooked by naturalists, as his observations and paintings are of considerable zoological and historical importance.

After the disastrous *Bounty* voyage, Bligh was chosen to lead another expedition to obtain bread-fruit in the South Seas from 1791 to 1793. This time he commanded the *Providence*, escorted by her tender the *Assistant*, under Lieutenant Nathaniel Portlock. Accompanying Bligh on the *Providence* were Messrs. Wiles and Smith, botanists; Matthew Flinders, a midshipman (later to become famous as an explorer), and the subject of this article, George Tobin, Third Lieutenant. The expedition sailed from England in 1791 and proceeded *viâ* the Cape to Tasmania (February, 1792), southward of New Zealand, and up to Tahiti, where bread-fruit and other plants were collected for transportation to the West Indies. It returned through Fiji to Torres Strait (August–September, 1792), Timor, St.

Helena and St. Vincent, Jamaica, and finally England (August, 1793) after a successful voyage.

TOBIN'S JOURNAL.

Through the courtesy of the Mitchell Librarian, Sydney, I have been enabled to consult the two volumes of Tobin's original manuscripts and drawings. Tobin's Journal is a folio manuscript of 300 pages ; it commences as a letter to " My Dear James " (more likely a brother than his father, James Tobin) dated " Thetis off Bermuda, Jany. 1797 " and explains that now he has considerable leisure he has decided to put his notes on the 1791–1793 voyage in some sort of connexion. The volume of drawings is entitled " Views etc. etc. South Sea Voyage—In the Providence—1791, 2, 3. Some Birds of America etc. etc. pasted in the book—many of them, unfinished—And, so (most likely) will they remain—G.T. Teignmouth 182 [torn]."

Though well over a century old, the manuscript is perfectly preserved, the writing being quite legible. Tobin appears to have been a neat and methodical gentleman, and gives cross-references in his journal to the drawings, whilst the initials W.B. he has marked below some of the drawings indicate those which Bligh had selected to illustrate the account of his voyage, which was, however, unfortunately never published. Tobin's Journal is crammed with natural history notes ; he says " I can tell you the colour of a bird, a fish, or an animal as well as their shape and size ; but exactly of what *species*, or to what *genus* they belong, I am in the dark."

On February 8, 1792, the coast of Van Diemen's Land was seen at daylight, and next day both the *Providence* and the *Assistant* were safely anchored in Adventure Bay, where Tobin had charge of the wooding party.

Most of his resumé of the Tasmanian fauna (Journal, pages 99–103) is worthy of publication here.

The only animals seen, were the Kangoroo, and a kind of sloth ([Drawing No.] 15) about the size of a roasting pig, with a proboscis two or three inches in length—On the back were short quills like those of the Porcupine—This animal was roasted and found of a delicate flavour—The Kangoroos were so rapid in their motions they escaped all our guns.

Of Birds, there are a great variety, both land ([Drawings No.] 14) and aquatic. Among the former several kind of parrots and hawks, some of the first, full as large as the Mackaw—A parrot in a wild state was quite a novelty, nor until there was " ocular demonstration of it " could I suppose their flight was so rapid. I speak particularly of a small kind, of which there are abundance in these woods—When *convocated* on a high tree, a " *confusion of tongues* " frequently attracted our attention—A few of the smaller birds are singularly beautiful in their plumage and not without a pleasing note. They are particularly shy of the approach of man . . .

The " kind of sloth " was the Porcupine Ant-eater (*Tachyglossus setosus*),* then quite a novelty.

Tobin did not personally observe partridges or black swans, though he introduced some of the latter into his scenery, also gannets diving for fish.

The *Seine* was frequently hauled, and at times with considerable success. The fish taken were chiefly Spanish Mackerel, besides many others unknown to us—One kind the seamen called Elephant fish from their having a long snout like that animal—With hook and line a very delicate sort of Rock Cod were caught in the bay, and it is probable that the large kind of Cod would be found in deeper water as the Latitude (except being in the Southern Hemisphere) does not vary much from that of some of the fishing banks on the coast of Newfoundland and Nova Scotia . . . The Dog fish were so numerous as to be very troublesome to the lines—Several Seals were seen.

The wooding party killed snakes of different kinds, but without ascertaining whether their bite was poisonous or not, nor was it judged prudent to make any personal experiments on such a question—A large kind of Lizard seeming to partake somewhat of the West India (Guana) was killed ; its length about a foot, but very thick in proportion and bearing a disgusting appearance.

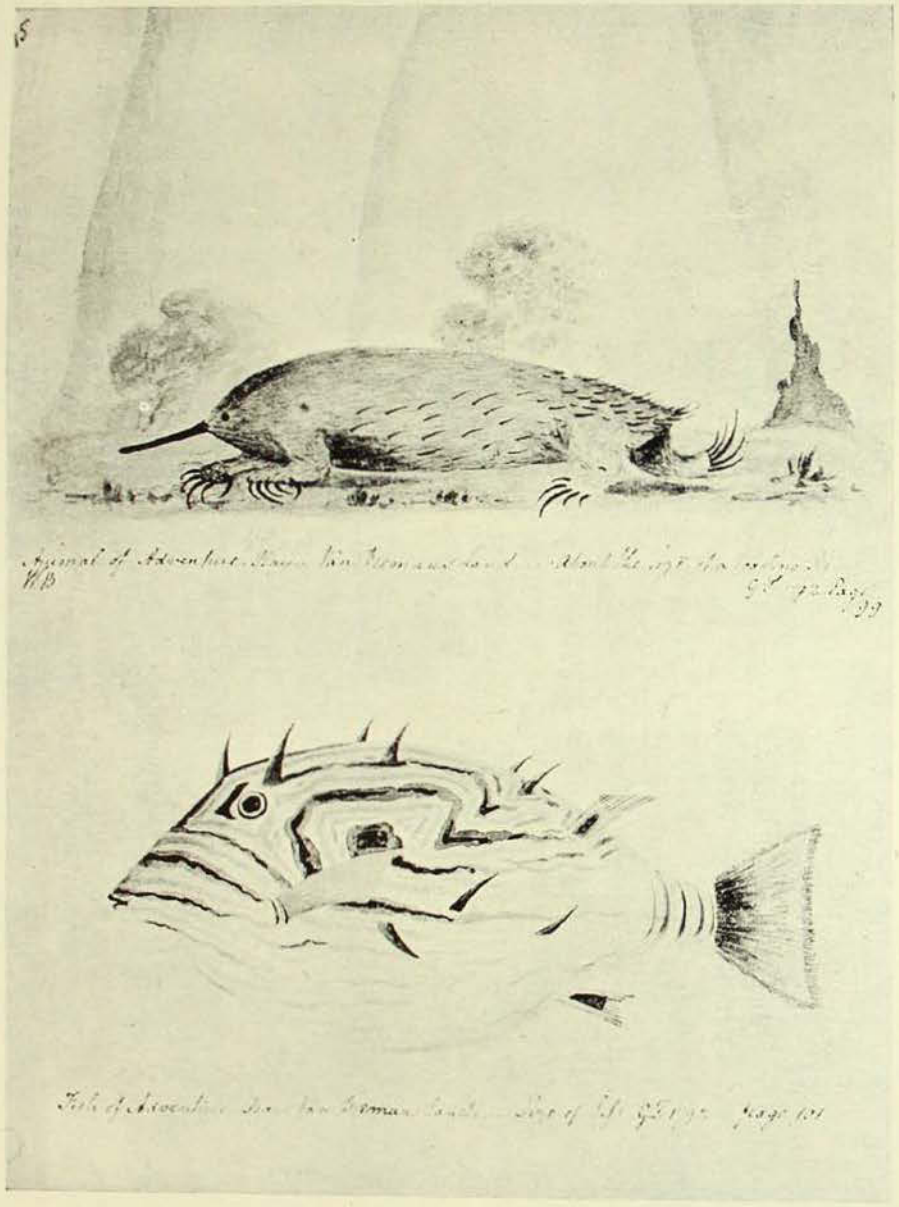
The Sea coast abounded with a variety of shell-fish, most of which are eaten by the natives . . .

Tobin mentions oyster banks, " a very beautiful large kind of limpet, to Seamen

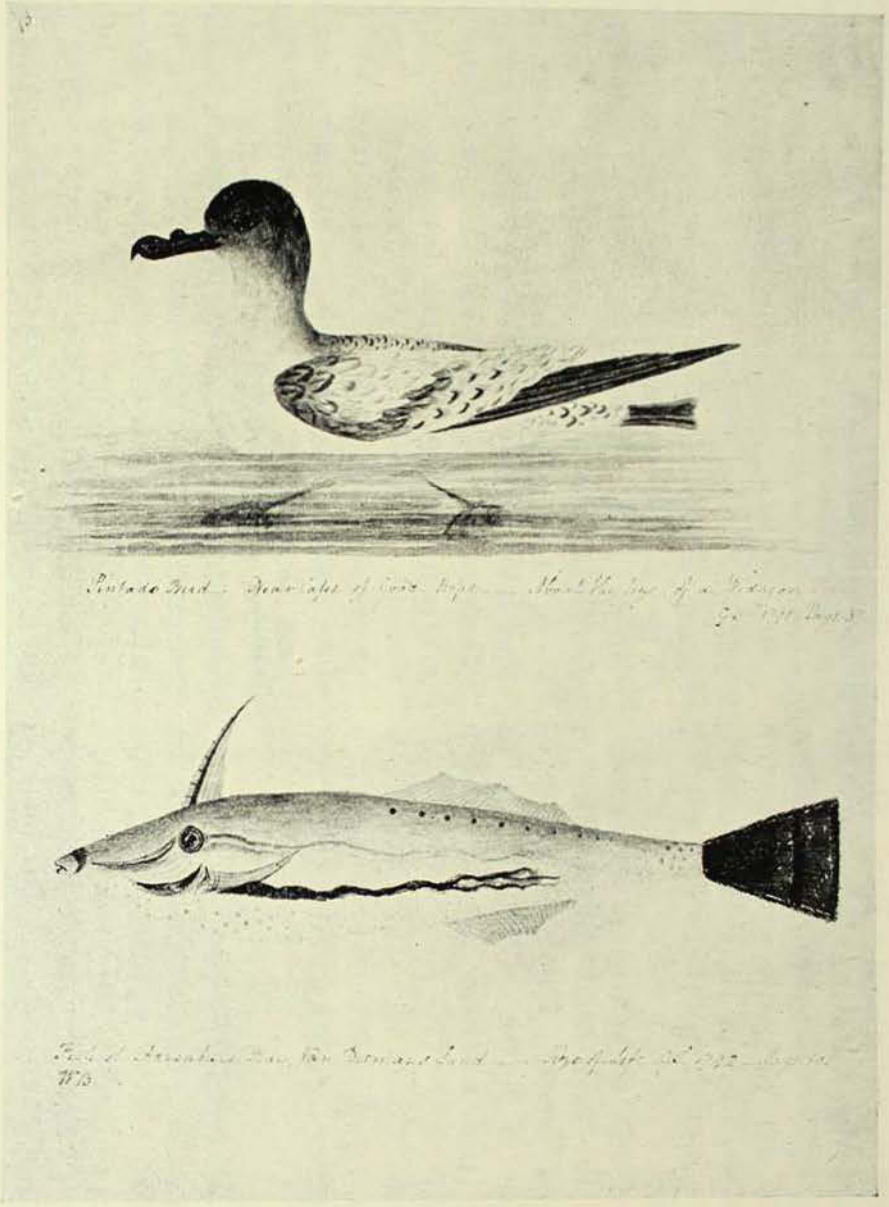
*Bligh described the ant-eater thus :

It was seventeen inches long, and has a small flat head connected so close to the shoulders that it can scarce be said to have a neck. It has no mouth like any other animal, but a kind of duck-bill, two inches long, which opens at the extremity and will not admit anything above the size of a pistol ball. It has four legs, and on each foot are very sharp claws ; it has no tail but a rump not unlike a penguin's, on which are quills of rusty brown.

Miss Ida Lee (*Captain Bligh's Second Voyage to the South Sea*, 1920, p. 20), who quotes this passage from Bligh's MSS., identified this animal as a platypus, but Mr. Clive Lord showed that it was an Ant-eater, an opinion confirmed by Tobin's drawing. Bligh also made a drawing of this animal which was reproduced in the *Philosophical Transactions*, 1802. The species still lives in the Adventure Bay district the present writer caught one there in 1928.



The "Animal of Adventure Bay, Van Dieman's Land, About the size of a roasting Pig," drawn in 1792, is the Tasmanian Porcupine Ant-eater. Tobin's painting is pale greyish brown or dark grey, with the spines and claws black. The Boxfish below is banded blue and yellow; tail orange, spines blue; eye yellow and black; pectoral fin puce. This is the type of Ostracion striatus Shaw, 1804 = Platycanthus auritus, and was also named in Tobin's honour by Donovan in 1824. These historic paintings are numbered 15.



A Pintado Bird or Cape Pigeon from near the Cape of Good Hope is shown swimming with unusual vigour, whilst below is an ornate Leatherjacket (Tobinia paragaudata) from Tasmania. The ground colour is greyish with blue and yellow lines and spots; tail bright orange, with black margins. Tobin drawing No. 13. The pages quoted on these drawings refer to Tobin's MS. journal.

[George Tobin, *del.*

known by the name of Ear Shell" (*Haliotis*), and a kind of lobster. He caught numbers of trout, probably *Galaxias*, and ate parrots, seagulls, and various shellfish, noting that the mussels contained, in general, numbers of a coarse kind of pearl.

In many of his Tasmanian drawings, Tobin shows the hollowed-out trunks of the Eucalyptus trees. He was doubtful whether these hollows were used as dwellings by the natives or had been used as ovens.

On February 23, 1792, "We now took leave of Van Diemans Land, shaping a course to pass Southward of New Zealand."

TORRES STRAIT.

Space does not permit details to be given from Tobin's very interesting and graphic remarks about O'tahytey (Tahiti); some of his drawings of Tahitian fishes were described in Shaw's *General Zoology*. George Holwell, a midshipman, also painted Tahitian fishes. Bligh particularly requested his men on no account to promulgate the unfortunate death of Captain Cook, but according to Tobin's marginal note in the journal "It was well known at Otaheite." After searching for *Bounty* mutineers at Whytootackay (Aitutaki) without success, Bligh's expedition sailed for Torres Strait, which was entered August 30th, 1792. A few birds were drawn (Nos. 69, *et seq.*), and some seasnakes noted, but there were several encounters with the warlike natives, so little natural history work was done. One of the seamen reported: "Fires were prepared on the beach by the women, who were licking their lips in hopes of making a meal of us." The Sea Cow or Dugong was noted by Lieutenant Portlock, whilst Tobin wrote (Journal, pp. 270–271):

> The shore abounded with Herons, Curlews and various kind of sand larks. The reptile tribe were Lizards, and an incredible number of large Grasshoppers or Locusts. Among the bushes we were much annoyed by the bite of a large green ant, whose nests were attached to the branches. The skin of a snake was found above nine feet in length, which appeared to have been recently quitted by its tenant. Various kinds of shell fish were about the beach; one in particular from its excellent flavour served our party to "fare sumptuously" on, and without any bad effects. It was of the Oyster kind, adhering so firmly to the rocks as to be with difficulty disengaged—It is true that we looked in vain for porter to our oysters, and even, of "Adam's Ale" were at a sadly "short allowance."

In their passage through Torres Strait, Bligh's ships sailed nearer New Guinea than what is now Queensland. Tobin's Key and Tobin's Island, so called by Bligh, are amongst the islands north or north-east of Cape York.

In December, 1792, St. Helena was reached and news obtained of the "Grand Theatre of Europe" for the first time for sixteen months. Then in January, 1793, the vessels crossed to St. Vincent, taking twenty-seven days, when some of the bread-fruit and other plants were landed and deposited in the Botanic Gardens. Other plants were landed at Jamaica in February, and the remainder taken to Kew. In August the ships sailed up the Thames, where a number of gibbets lined the banks, much to the disgust of their gentle Tahitian passenger, Mideedee. Bligh thanked his men publicly, and the ships were put out of commission.

TOBIN'S DRAWINGS.

A note by Tobin, signed 1797, states: "An Artist (W. Kirkland) was to have accompanied the Expedition, but he was left in ill-health at Haslar Hospital—This obliged us all to work with our pencils as well as we were able." Tobin's ability as an artist is unquestioned, the Mitchell Library series consisting of one hundred water-colour paintings.

Those made on the *Providence* in 1791–1793 are numbered 1–84, but later drawings, made mostly when Tobin was aboard the *Thetis*, are intercalated.

The general subjects dealt with are: The ships *Providence* and *Assistant*; Bread Fruit of Tahiti; Atlantic Scenery; Cape Town Views; Views of Adventure Bay, Tasmania; Coastline of St. Pauls and Van Diemen's Land; Island of Maitea; many drawings of Tahitian Scenery; Views of Aitutaki, Mayorga Islands, Bligh's Islands, and New Hebrides; coastlines and views of ships, Torres Strait; Views of Timor and Jamaica.

The *natural history* drawings show: Various marine creatures observed between England and the Cape of Good Hope; The animal of Adventure Bay [Ant-eater]; Birds of Van Diemen's Land; Fishes of Adventure Bay; Many drawings of Tahitian Fishes; Seven drawings of Tahitian Birds; Birds of Virginia and Nova Scotia; Barnacles; Gulph weed from the North Atlantic; Silver Eel [*Trichiurus*] of East Florida; Atlantic

Pilot Fish; Young Sunfish [*Mola*] and Catfish of Florida; Flying Gurnet of Block Island, North America; Boobie from the Coral Sea; Three Birds [Tern, Wideawake, and Dove] from Torres Straits; Cock and Hen Quail of Timor; Dolphins [*Coryphæna*, no locality]; Bird [Hoopoe] from off Spain.

Some of these drawings were published for the first time by Miss Ida Lee in 1920 and in Dr. George Mackaness' *Life of Bligh*, 1931. Others are here reproduced by special permission of the Mitchell Librarian from photographs made by Mr. G. C. Clutton.

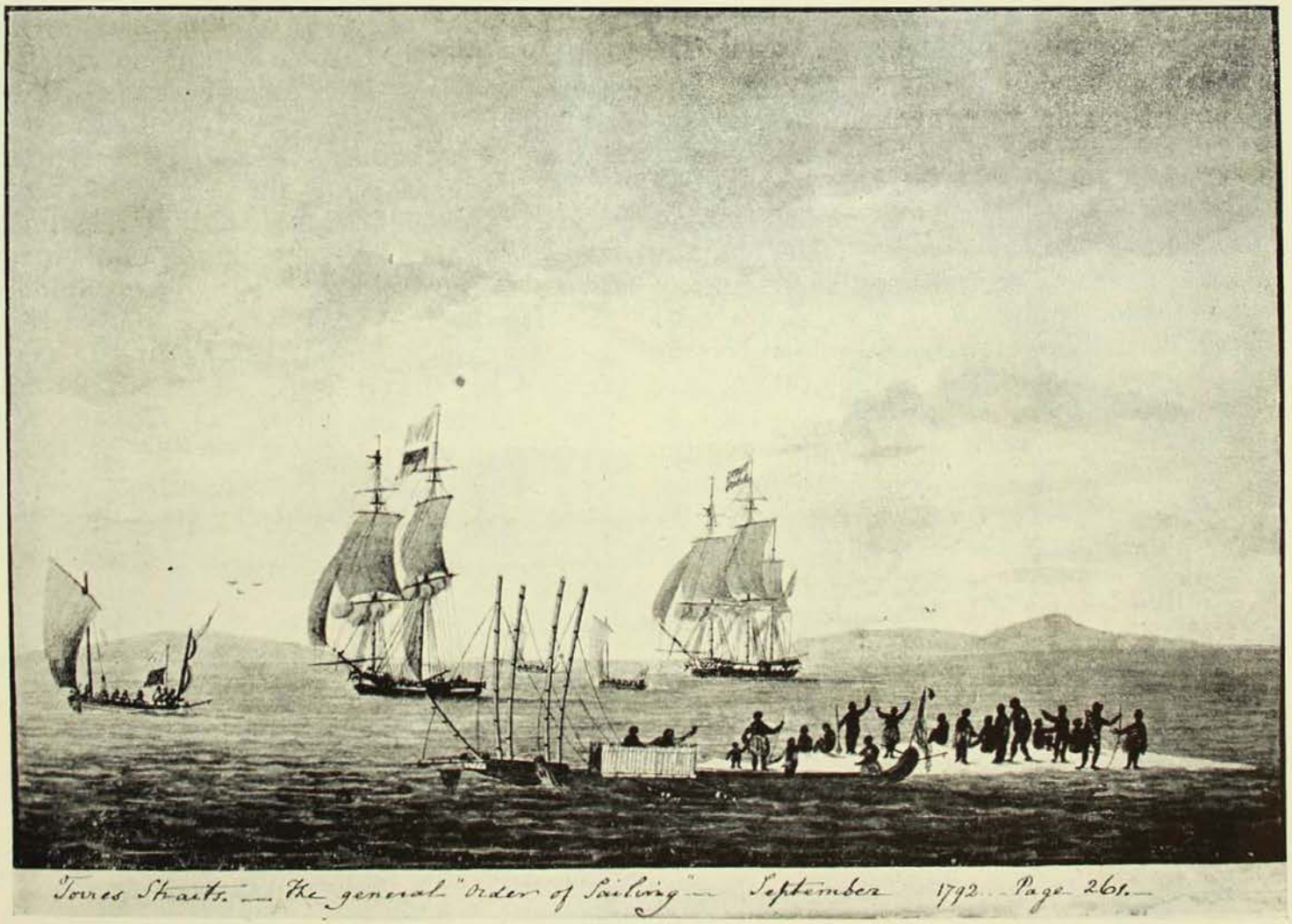
BIOGRAPHY OF TOBIN.

Mackaness described Tobin as a very careful and exact young navigator. His original journal is said to be at the Records Office, London, the Mitchell Library one having been written up from the original notes. I do not know when or where Tobin was born, but his journal shows him as a susceptible and gallant young man, with a well marked sense of humour. He says he could not speak French, but passages in his journal have a drollery and subtlety reminiscent of Rabelais or even Anatole France.

After leaving Bligh, Tobin was a civilian for about two months, when he was appointed to the *Thetis* wherein "except 7 or 8 months in the Admiral's" he cruised up and down the east coast of North America at least until 1797. In these years he wrote his journal in his stuffy six foot cabin by the light of a tallow candle.

In 1802 he was made a captain, and for some years served aboard the *Princess Charlotte*, *Andromache*, and other vessels.

In the 1820's and 1830's Tobin was in England, but before this he evidently lent his journal and drawings to various persons, notably Sykes, who had voyaged



Tobin's farewell to Australia. The Providence and Assistant leaving Torres Strait in September, 1792. The original painting is a colourful production, No. 75 of the Mitchell Library Series, and is entitled, The general "Order of Sailing." Note the care with which the details of the ships and canoe have been painted.

[George Tobin, *del.*

with Vancouver in 1790–1795, and obviously Dr. George Shaw, of the British Museum, saw them, too.

He became a post captain on half pay in 1831, and was made a Companion of the Bath. In January, 1837, according to the *Navy List*, Tobin was promoted to Rear Admiral of the White, nearly a quarter of a century after Bligh had won that distinction.

Miss Ida Lee tells us that Lord Nelson, through his wife, was connected with Tobin's family. The name Tobin appears to be an Irish surname of some antiquity, the family coming into considerable importance by the close of the seventeenth century.

The *Annual Register* records, amongst the obituaries of April, 1838, "At Teignmouth, Devonshire, aged 69, rear admiral George Tobin, C.B.," but for the present we may recall Tobin, in his prime, as one of the most capable artist-naturalists of the early days of Australia.

Special Exhibits

AN innovation, that of exhibits of special and topical interest and displayed at the entrance to the Exhibition Halls, has met with considerable public favour. Such an exhibit was that of various forms of life found on the Great Barrier Reef. The Barrier has always been a great attraction both to the scientist and the tourist. Saville-Kent, Banfield the "Beachcomber", Hedley, the Great Barrier Reef Expedition, not to exclude zoologists of this Museum who have contributed many articles to the pages of this Magazine, and others, have done much by writing and research to make known the wonders of this region. That their work is bearing fruit is shown by the increased interest taken in the reef, both locally and abroad.

The special exhibit now displayed is that of various species of injurious and venomous spiders. Recent fatalities have brought a harvest of inquiries. The exhibit shows *Atrax robustus* and *A. formidabilis*. The former was recorded as harmful to man in 1927, and since then various deaths have been attributed to its bite. The bite of the latter has been known to cause severe pain and illness. These spiders are commonly and incorrectly known as Trap-door Spiders, despite the fact that the entrance to their nests, instead of possessing a lid, has a funnel of silken web. They are, therefore, better described as Funnel-Web Spiders. Also shown is the Red-Spot or Red-Backed Spider (*Latrodectus hasseltii*), once considered to be our only injurious species.

From 8th January to 6th February, Mr. R. O. Chalmers, cadet, was in the Cox River district investigating the geology and the rock occurrence. He made an extensive collection of igneous rocks for the Museum.

* * * *

Amongst recent donations was a very well preserved and interesting collection of reptiles secured by Mr. H. C. Barry at Hermannsburg, Central Australia. Preliminary investigation reveals the fact that there is much interesting material, probably new forms, contained in the collection. Further zoological—or other, excluding botanical—specimens from "The Centre" would be welcome.

Sea-Stars and Their Allies

By A. A. Livingstone.

THE sea-stars, together with their relatives the sea-urchins, brittle-stars, bêche-de-mer and sea-lilies, form a compact group known scientifically as the Echinodermata. All members of this typically marine division of the Animal Kingdom conform, more or less conspicuously, to a common characteristic in the possession of a spiny skin, and it is on this account that the name Echinodermata, meaning "spiny skin," has been applied to them. In some types the spiny nature of the body is perfectly obvious, while in others it is considerably modified or hidden in the very texture of the skin.

OCCURRENCE.

In geological history the Echinodermata as a whole have been traced as far back as the older Palæozoic formations, and some classes have persisted throughout the succeeding ages to modern times. Today one finds members of the group living on the sea and estuarine shores between tide marks and in varying depths down to the dark and abysmal depths of the ocean. The distribution of echinoderms is universal. Some forms dwell in the waters of the ice-bound Polar regions, some in the milder waters of the Temperate Zone, while others again welcome a home in the warmer waters of the Tropics. A number of inter-tidal forms are extremely hardy and, living in exposed places, seem to find no discomfort when buffeted by the waves, or exposed between tides to the rays of the sun; others migrate from shallow to deep water and *vice versa* according to seasons, while others, being extremely delicate and fragile, seek either the permanent shelter of deep water or some secluded recess in a rock-pool or coral-locked lagoon. Usually, the various types adhere to their chosen habitat, and may be sharply defined from their immediate relatives according to location. Geographical distribution also is concerned in determining the habitat of certain species. Generally speaking, a distinct fauna exists in the three main belts of latitude, the Frigid Zone, Temperate Zone, and Torrid Zone, and the distinction is so apparent in most cases that a specialist has no difficulty in determining the zone whence a given specimen came.

When the tide recedes and leaves bare the sheltered sand and weed flats, then is the time to search for Astropecten polyacanthus. Sometimes examples lie in the surface sand with only the deep brownish-crimson upper surface showing, but usually the animal is wholly covered and the only sign of its presence is the curious humped outline of its body. The sea-star depicted on the left of the picture has been removed from its hiding place, which is seen to be the exact shape of the body.

[Photo.—*G. C. Clutton.*

THE SEA-STARS (CLASS ASTEROIDEA).

The sea-stars are readily recognized by their resemblance to a star in shape. Usually they are five-armed, but in some families the number of arms may be anything from five to twenty-five in number, excepting, of course, abnormalities and aberrant forms. The colours in life vary considerably both in species and

individuals. In one species the body is a uniform bright blue, in an allied form a bright biscuit yellow or orange, and in another dark green, or a drab brown. Some species have a colour pattern which may vary within the species or be constant in occurrence. Such patterns include white in their make-up as well as vivid colours like crimson, bright orange, mauve, pink, and various shades of blue.

STRUCTURE.

The dimensions of adult sea-stars range from about a quarter of an inch to twenty inches across the arms ; the vast majority, however, are of only moderate size, and rarely exceed ten inches across.

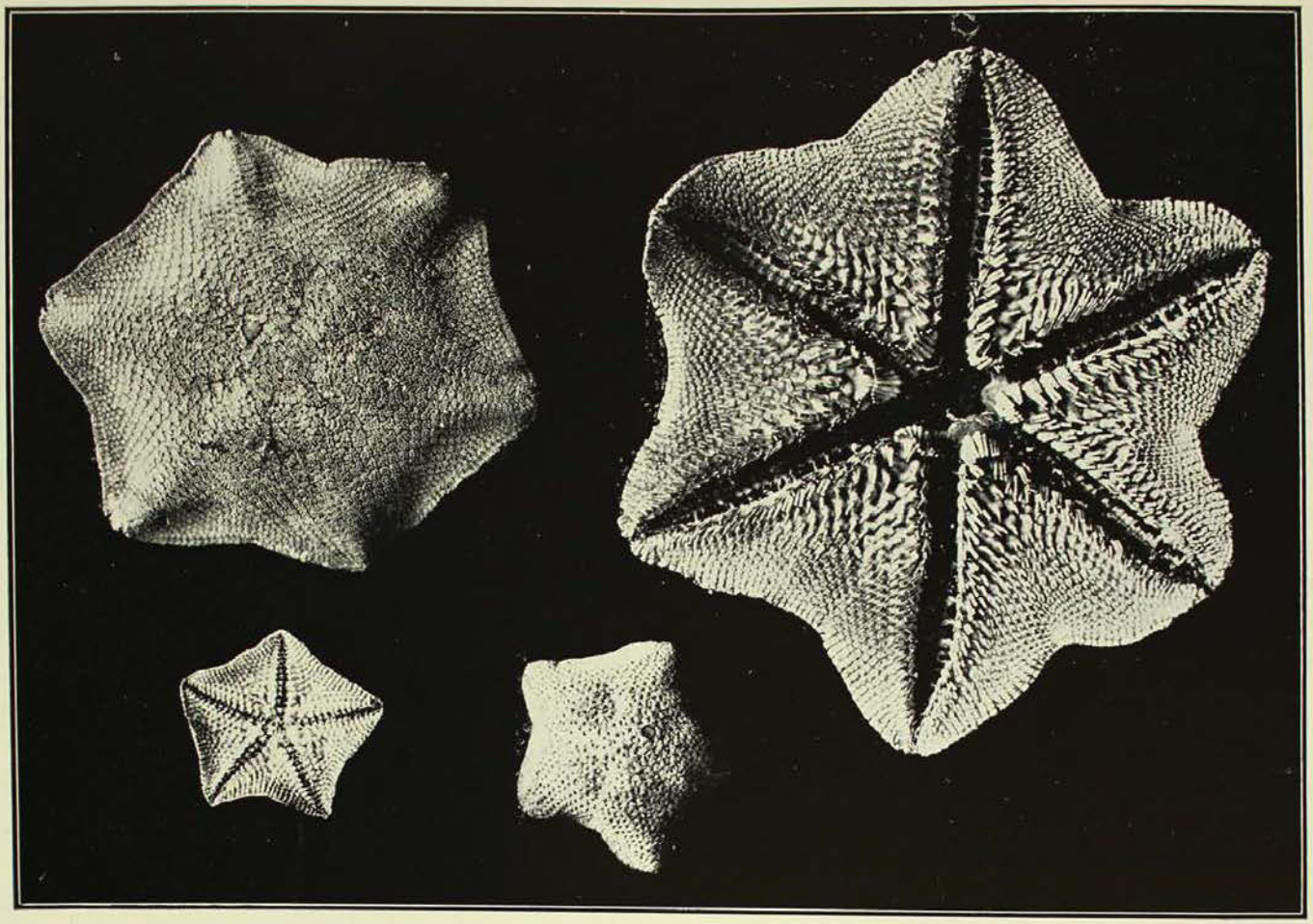
The body or disc is always central in position and may be either flat or elevated. The arms, which are not sharply and abruptly marked off from the body, taper either gradually or rapidly to their free extremities and vary greatly in shape. They may be round and finger-like, triangular in section, or depressed and flat. A thin transparent membrane covers the entire body, and beneath this frail covering lies the skeleton. This skeleton is usually made up of a number of calcareous rods or a mosaic of plates, which are held in place by a leathery integument.

The plates may be regular in arrangement and placed in definite running series, or, on the other hand, they may be placed here and there with seemingly careless abandon. In the vast majority of species the plates forming the skeleton are clothed in granules of a calcareous nature, which may be small and closely packed or coarse and comparatively widely spaced. Sometimes the granules are arranged in bunches like grapes and supported on an upright stalk, or they may be flattened and arranged like the petals of a flower ; others, again, may be likened to small bundles of spikes, resembling in miniature a vast array of native war clubs. In many species conical tubercles or sharply pointed spines may be seen attached to the plates of the skeleton and rising above the covering granulation. These protective structures often assume formidable d mensions, and are capable of inflicting severe,

The sea-star, Coscinasterias calamaria, prefers the sheltered and dark recesses of inter-tidal rock-pools as a habitat. When boulders are overturned the species is found clinging to the under-surface, as illustrated.
[Photo.—*F. A. McNeill.*

and painful wounds on the feet and hands of anyone careless enough to disregard them. Scattered here and there between the granules of many species are minute structures closely resembling pincers, and varying considerably, both in shape and size. These structures are called pedicellariæ, and through the agency of a special muscle system the animals can open and close the pincer-like jaws, much in the same manner as a bird would open and close its beak. Their function is to keep the delicate body skin free of small foreign organisms which would attempt to find an anchorage there.

The muscular system in the sea-star is poorly developed, and this, in association with a more or less rigid skeleton, will permit of only a slow and limited range of actual body movement. On the upper surface of a living sea-star, and sometimes on the lower surface as well, there springs from between the skeletal plates a number of small, transparent, and finger-like outgrowths called papulæ. These protruding organs are concerned with the process of respiration, wherein an interchange of gases takes place between them and the surrounding sea water, and the oxygen, so vital to the sea-star, is obtained. The



The two large upper illustrations are of the six-armed species Patiriella gunnii. The left one shows the finely granulated nature of the upper surface, while the right one illustrates the well-spinulated plates of the undersurface. The animal is usually found in rock-pools near the low-tide mark.
The two small lowermost photographs illustrate the common Patiriella exigua. The species is almost invariably five-armed and, like P. gunnii, is an inhabitant of the inter-tidal zone. On the left is the undersurface, showing the radiating ambulacral grooves along which the tube feet are distributed and the lack of spines on plates near the mouth. The upper surface is shown on the right. The granulation is seen to be coarser than that of P. gunnii.
[Photo.—*G. C. Clutton.*

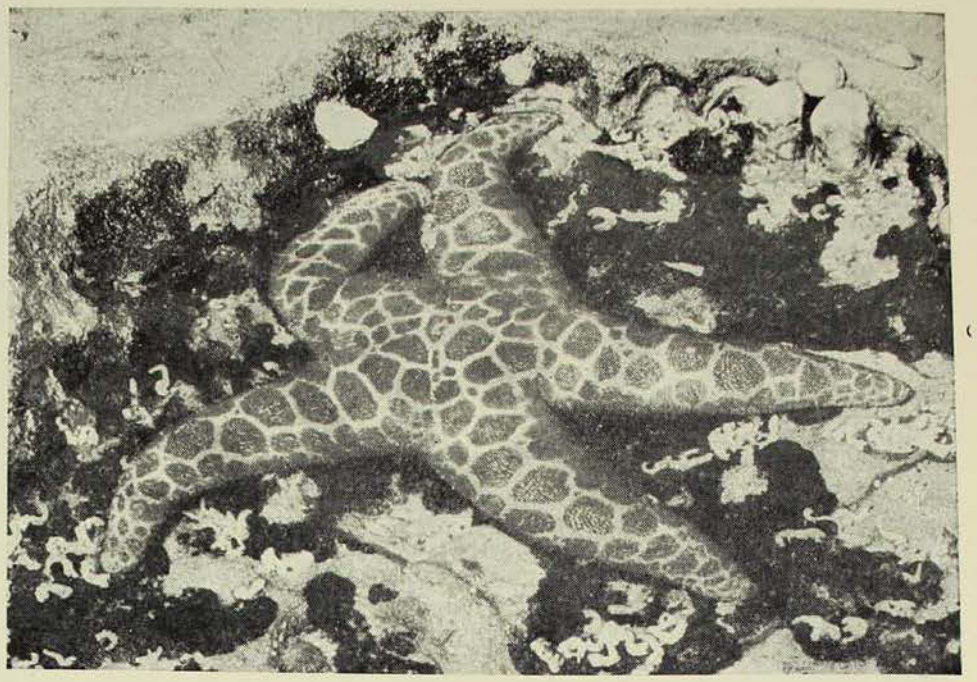
papulæ are so delicate that they seldom remain intact in preserved and dried specimens and the only trace of their existence is the presence between the skeletal plates of the tiny pores, through which they once communicated with the exterior.

The mouth occupies a central position on the under surface of the body. It is surrounded by special plates armed with spines, which no doubt serve to protect the soft tissues within the mouth aperture. The mouth is followed by an œsophagus or gullet, which leads into a spacious stomach. The stomach is produced laterally into pouches, which, in five-rayed examples, arrange themselves into five pairs. A pair projects some distance down each arm and in this manner the area of absorption is considerably increased.

MODE OF PROGRESSION.

On the undersurface of the body, and radiating from the centrally-placed mouth, are straight grooves or canals, which extend to the extreme tips of the arms. Projecting from these canals are small tubular structures of a sensitive nature called tube feet, the term feet being applied on account of the active part the structures play in the process of locomotion; the tube feet terminate in flat circular discs. In explaining the operations performed by the tube feet it is necessary to call attention to the presence of a small and specialized plate on the upper surface of the body, and usually placed a little to one side of the centre. This plate, which in some species may be accompanied by one or more of its kind, is known as the

madreporite, and differs from all other plates of the body, insofar as it is perforated by tiny pores or canal-like striations. Being perforated, it bears a likeness to a sieve, and it resembles a sieve in action. The madreporite sieves the water that passes through it and down a special canal leading into a ringed vessel around the mouth. According to the number of arms, so the ringed vessel gives off branches, one of which passes down each arm along the domed roof of the ambulacral canal or groove. Each branch of the ringed vessel, after communicating with the tube feet to supply them with filtered water, ends at the tip of the ray in the form of a tubular appendage which houses a rudimentary eye. By expansion and contraction of muscles in the tube feet their water supply is regulated, and they can be thus extended or contracted at will. When the terminal disc of a tube foot is applied to a surface, its centre can be raised by muscular action, thus forming a sucker, and, when the tube foot is then retracted, the animal is pulled towards the point of attachment. By throwing out the tube feet in one direction and securing a hold by suction the sea-star is able to pull itself along at a slow pace, the regularity and smoothness of movement giving the impression that the animal simply oozes along like a snail. It is recorded that when sea-stars are journeying over flat surfaces the tube feet act as walking legs and push the animal forward.



Plectaster decanus is known by the vernacular name, Mosaic Sea-star. It is normally an inhabitant of deep water, but occasionally examples wander into the intertidal zone and lie secreted on the undersurfaces of loose boulders. The life colours of the species are very brilliant, the upper surface consisting of deep red patches ornamented with a network of white calcareous ridges.

[Photo.—*A. Musgrave.*

FOOD OF SEA-STARS.

In the important matter of feeding the tube feet also play a prominent part. Being sensitive and capable of distinguishing food from foreign matter, they forage among the sand and weed in search of morsels and pass such as they deem fit to eat along towards the mouth with a sort of hand-to-hand movement.

Ordinarily, the diet of sea-stars consists of small animals and fragments of animal matter which can pass beyond the plates bordering the mouth, but at times a large and tasty morsel, far too big to be consumed in the ordinary manner, is encountered. Apparently oblivious to the seemingly impossible task of attacking such a feast, the sea-star raises itself on the tops of its arms and comes to rest with the mouth directly over the meal. The stomach is then actually "poured" out until it envelopes the prey, and it remains in this position until digestion has taken place. Bivalve shellfish form a favourite "dish" for some sea-stars, and even oysters find that they have enemies in this spiny-skinned tribe. To some of us oysters are at times hard to open, but to the sea-star, appreciating them as a change of diet, this difficulty does not seem to exist. Sorting out a likely victim, our sea-star proceeds to wrap itself about the uppermost valve or shell. Then bringing into play its numerous sucker feet, it establishes a firm hold, and by raising the body on the tips of its arms the sea-star is able to apply

a gentle upward lift. But meanwhile the oyster has sensed the touch of the enemy, and has clamped down its protecting upper shell in no uncertain manner. A single strong muscle in the oyster serves to hold its home intact, and indeed, so strong is this centrally-placed muscle that normally it can easily withstand the lifting of the sea-star. But the sea-star, encouraged by former victories, persists in its tugging methods, and soon the battle develops into an endurance contest. Time goes on, the oyster, in its fatigue, fails to hold out against its tenacious agressor, and its powerful adductor muscle relaxes. The merciless sea-star continues its upward tugging until the oyster, further weakened by the continuous struggle, is unable to prevent its conqueror lifting the lid from its shell.

SOME COMMON FORMS.

The sea-star, *Coscinasterias calamaria*, which occurs commonly on the local coastal and estuarine shores between tide marks, has been blamed for the greater part, if not all, of the mortality caused by echinoderms in oyster beds. This species grows to a considerable size, often measuring as much as ten inches across the body and arms, and it would seem to be a match for any of our oysters. *Coscinasterias calamaria* can be distinguished and separated from other local sea-stars by its large size and the large number (six to twelve) of finger-like arms, which are provided with long, stout spines. Living on the tidal sand-flats is a species known as *Astropecten polyacanthus*, and, although hidden from actual view, its presence can usually be detected by the curious outline its sunken body leaves in the surface sand at low tide. It can be recognized by the long, stout, cream coloured spines which border the arms, and the deep brownish-crimson colour of the upper surface. The species is almost invariably five-armed.

The sheltered seclusion of rock-pools is the habitat selected by the remaining three of our commonest sea-stars. The first, *Patiriella calcar*, is likened to the toothed wheel of a spur, and can be recognized usually by its eight short arms. The prominently domed nature of the body is

The eight-rayed sea-star, Patiriella calcar, and the five-rayed sea-star, Patiriella exigua. The colour markings of the former species, and sometimes of the latter, assist in forming a protective camouflage. Both species occur abundantly in pools left by the receding tide.

[Photo.—*A. Musgrave.*

another distinguishing feature. The predominant colour of this species is green, but here and there may be patches of brownish-red, yellow, orange, and blue, the entire colour scheme being suited to the immediate surroundings so as to produce a kind of camouflage. An allied species, *Patiriella exigua*, has a somewhat similar but less brilliant colour scheme, and, although it lives in association with *P. calcar*, it can be recognized by its usually smaller size, the presence of only five arms and the absence of minute spinelets on the inner plates of the undersurface. Sometimes found living in association with the two last mentioned species of *Patiriella* is a third form, *Patiriella gunnii*, which can be recognized by the presence of six arms, and can be separated from its nearest ally, *P. exigua*, by having all the plates of the undersurface spinulated or granulate.

The power to grow fresh limbs, which are more or less perfect reproductions of parts dismembered either accidentally or

as a result of self mutilation, is vested in the sea-star as well as in other types of animals. Some sea-stars, when handled or placed in some irritating fluid, will almost invariably throw off one or more arms. The lost limbs are replaced, sometimes imperfectly, but nevertheless effectively. In some species autotomy, or self mutilation, has reached such a state of perfection that it has been adopted as a method of reproduction. An arm cast off will give rise, by the process of regeneration, to a new sea-star, the body and the additional arms being grown from the single discarded limb.

Some species are preyed upon by fishes and may sometimes lose all their arms, but buds soon spring from the body, to grow and replace them. Regeneration is often accompanied by abnormalities. Sometimes the growing arms will fuse and grow together for their full length, or the rays will branch to give rise to a forked limb. At other times an arm will remain dwarfed and never attain a normal length. Despite these freak conditions, the abnormal limbs function and apparently carry out their purpose just as well as if they were normal.

Notes and News

A METEORITE FROM NEW IRELAND.

On 31st January of this year, at half past four in the afternoon, the natives working on Mr. H. L. Cameron's plantation on Dyarrl Island, near New Ireland, Mandated Territory of New Guinea, were startled by a series of explosions and a burst of flame in the sky. A meteor had entered the atmosphere and become shattered into pieces. One of the natives picked up a fragment weighing six ounces and handed it to Mr. Cameron, who, realizing its importance, kindly presented it to the Museum, and to him must be given the credit of obtaining the first meteorite found in the Territory of New Guinea.

The meteorite is now being investigated and a full description will be prepared for the *Records*, but reference may be made here to some of the features presented by this interesting fall. In several respects it resembles the "Morristown" meteorite, found in Hamblin Co., Tennessee, U. S. America, and one of its most striking characteristics is that it may be divided into two portions in respect of composition and grain size.

The Trustees of the Australian Museum are very grateful to Mr. Cameron for his generosity in presenting this meteorite to their collection, which now includes representatives of one hundred and eighteen falls. T.H.S.

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MALAITA "KILL STICK".

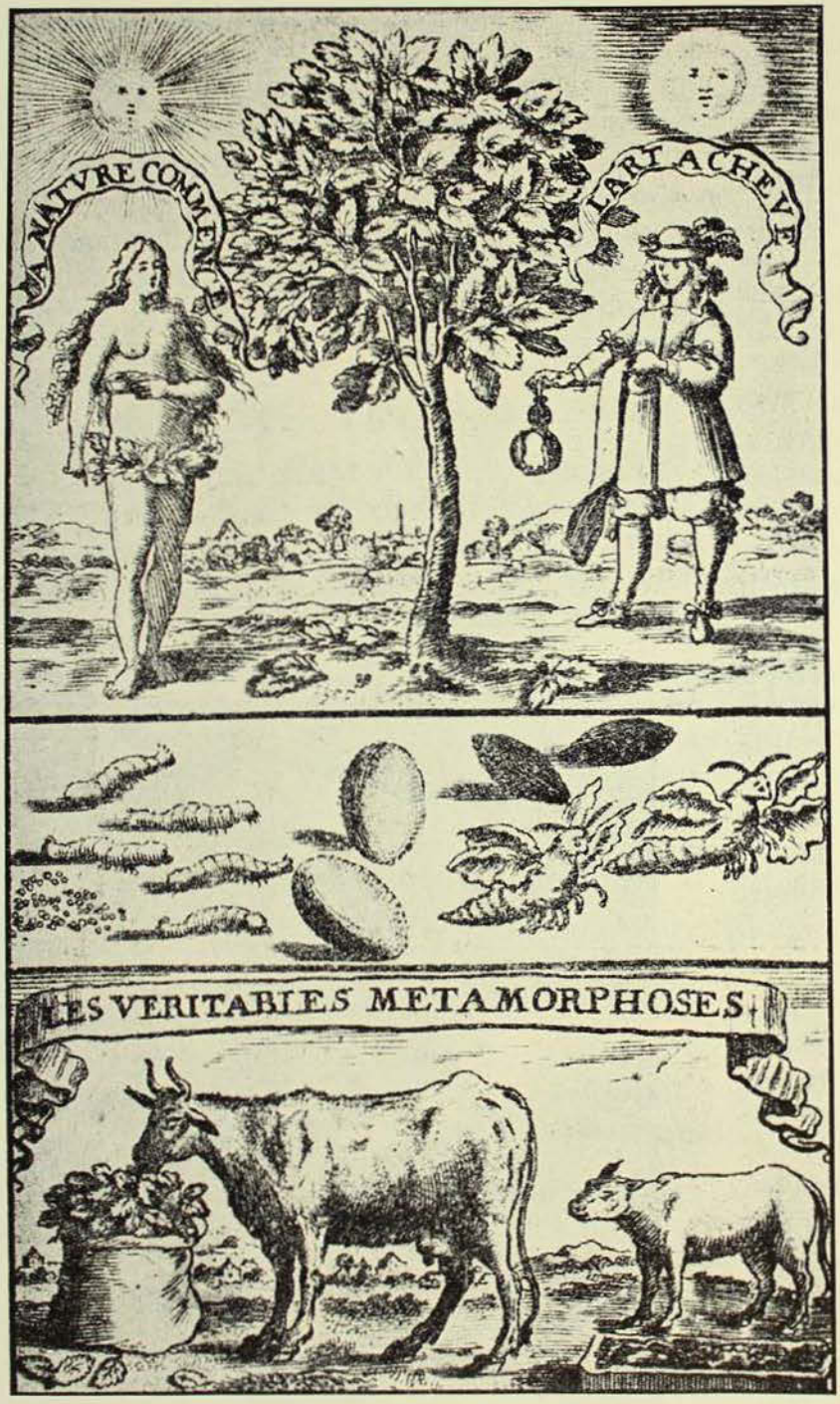
We are indebted to Mr. K. W. Bolton for the gift of a "kill stick", or "death pointer", from Malaita, British Solomon Islands. Such specimens are rare, and are used only by Malaita chiefs in one of their ceremonial dances. The stick is about fifteen inches long, and is neatly bound with coloured fibre and ornamented with inlaid pearl shell. On the end is a knob of parinarium gum.

During the dance the stick is gradually slid down the arm until its full length is exposed, and then it is pointed at the intended victim. "Red money" is hung up on the village post, and this is taken by whoever does the killing, which may not be carried out for a week or two.

This particular stick belonged to Ariasi, the old Chief of Terepina district, South Malaita, who has one hundred and twenty-two personal killings to his credit.

Silk Culture

By K. C. McKeown.



In a curious old work, the "Histoire générale des Drogues, traitant des Plantes, des Animaux, & des Minéraux &c.", by Pierre Pomet, chief druggist to King Louis XIV of France, published in 1694, it is stated that the best silkworms were those bred from the corrupted remains of a calf whose mother had been fed upon mulberry leaves; the calf was killed, chopped into small pieces, and placed in trays on the roof until the worms crawled out; these were then carefully collected and fed upon mulberry leaves. In a plate in this book, reproduced here, the whole process is shown from the cow onward.

MANY attempts have been made to establish silk culture in Australia, but none so far have been successful. There are no insuperable natural difficulties, for the mulberry tree, on the leaves of which the silkworm feeds, grows quite readily in Australia, and the climate is favourable to the growth of the insect. The industry, however, requires skill, care, and experience. At the present time of depression enquiries are being made regarding the possibilities of silk culture in Australia, and the following comprehensive article, which gives a historical survey, details regarding the rearing of silkworms and the preparation of the silk for the market, has been prepared for public information. The difficulties which have militated against the successful establishment of the industry in Australia have been fully dealt with.

INTRODUCTORY.

The production of silk by insects is a very fruitful field for research. Many representatives of very diverse orders of insects produce silk at some time of their lives, either in their larval or adult state. Among the caterpillars, the larvæ of butterflies and moths, the silk glands are modified salivary glands and the spinning organs are situated in the head, but in some of the other orders various parts of the body have been conscripted to the service; lacewing larvæ and the larva of a Carab beetle produce their silk from the malpighian glands, which are the equivalent of the kidneys in insects. Among the rare instances of mature insects which spin silk the Embiids

may be mentioned, in which the silk glands are situated in the front feet, an astounding example of the adaptation of different organs for the same purpose, and a striking instance of parallel development is to be found in the flies of the genus *Hilara*, where the organs are found in the same situation.

(a) *Historical.*

The cultivation of the silkworm in China is of great antiquity, and the earliest accounts of its origins are to be found in the Chinese classics, and are almost certainly apocryphal. The first rearing of the wild worms and winding of the resultant silk is credited to the Empress known as the Lady of Si-ling, wife of the famous Emperor Huang-ti (2640 B.C.), who encouraged the cultivation of the mulberry tree, the rearing of the worms, and the reeling of silk. The Empress is said to have devoted herself personally to the care of the silkworms, and she is, by the Chinese, credited with the invention of the loom.

The silk industry in China was almost a royal monopoly, and the greatest precautions were taken to prevent silkworms leaving China, or skilled artisans from taking their knowledge and experience into other lands. In spite of these precautions their efforts were nullified, for we learn, according to tradition, that the eggs of the insect and the seed of the mulberry tree were carried to India by a Chinese princess concealed in her headdress, a wedding gift to her Indian bridegroom. The introduction of the silkworm into Europe seems to rest upon an historical basis. The story is that two Persian monks, who had long resided in China and learned the whole art and mystery of silkworm growing, arrived at Constantinople and imparted their knowledge to the Emperor Justinian. By him they were induced to return to China and attempt to bring to Europe the material necessary for the cultivation of silk, which they effected by concealing the eggs of the silkworm in a hollow cane. From the precious contents of that bamboo tube, brought to Constantinople about the year 550, were produced all the races and varieties of silkworm which stocked and supplied the western world for more than twelve hundred years.

Silk culture was practised in Greece at a very early date, but the silk was apparently not spun from the cocoon, but direct from the glands of the larva, and used for the strings of musical instruments and for fishing lines. It will come as a surprise to many disciples of Izaak Walton to learn that such fine tackle was in use nearly five thousand years ago! We learn from the works of Pliny and Aristotle that a Coan woman, Pamphila, the daughter of Plateus, was famed for silken costumes, which were much favoured by dancers of the time, since they were so diaphanous and fine as to be scarcely visible.

(b) *The World's Silk Production.*

The area suitable for sericulture stretches in a broad belt between 25° and 48° of latitude right across Europe and Asia. The statistics available indicate that in spite of post-war depression and increased

Silk worms fully fed and prior to spinning their cocoons and pupating.
[*After* J. de Leon.

competition with artificial silk the production of silk is steadily increasing, but it is significant that this increase is almost wholly in the East. Rawlley, in his work *Economics of the Silk Industry*, states that "there is a marked improvement in the quality of the Far Eastern raw silks in recent years," and that this new factor has made competition difficult.

The most recent statistics available on the world's silk output are those given in the League of Nations report for 1927, as follows:

	Production in 1925.	Kilograms.	World Percentage.
Western Europe—			
Spain	100,000		
France	265,000	4,740,000	11·7
Italy	4,380,000		
Eastern Europe and Levant		1,065,000	2·6
The Far East—			
India and Indo-China	90,000		
China	8,120,000	34,055,000	85·5
Japan	25,845,000		
Approx.		39,860,000	

The actual production of China and Japan is far higher, the figures shown being merely those of exports of raw silk from these two countries. The home consumption of China is estimated at at least 55% of her total production, whilst in Japan about 30% is used at home.

In 1875 Western Europe produced about 46% of the world's commercial supplies of natural silk, but by 1925, barely 12%.

The latest figures available on the world's supply of raw silk are those compiled by the Silk Association of America (Inc.), which give the world production at 100,125,000 lbs., of which 65,036,000 lbs. are credited to Japan, 19,998,000 lbs. to China, and 11,243,000 lbs. to Europe.

It has been estimated that the output of silk in China is the lowest for the past ten years.

THE LIFE-HISTORY OF THE SILKWORM.

The mulberry-feeding silkworm (*Bombyx mori*), as in the case of other lepidopterous insects, passes through four stages, *viz.*: egg, larva or caterpillar, pupa or chrysalis, and the adult moth.

The egg, usually called the "seed" or "graine" by silk raisers, is round and somewhat flattened, and is about the size of a turnip seed. When newly deposited the colour is yellow, but if the egg is fertile its colour changes, according to the variety, to grey, slate, violet, or dark green, the colour becoming darker as the larva develops. Each female moth lays on the average from 300 to 400 eggs.

The larva or caterpillar goes through four moults, the periods between these moults being termed "ages." There are five of these ages:

(1) The period from hatching to the first moult, usually occupying 5–6 days.
(2) The first moult to the end of the second, 4–5 days.
(3) Second moult to end of the third is about 5 days.
(4) Third to fourth moult varies from 5–6 days.
(5) End of fourth moult to transformation to pupa, about 9 days.

The life of the caterpillar from the time of hatching to the spinning of the cocoon varies from about 28 to 30 days.

The chrysalis is a glossy chestnut-brown in colour. The pupal stage lasts from two to three weeks before the moth emerges.

The moth is of a conspicuous ashy-white colour, and through the result of hundreds of years of domestication is incapable of flight. The life of the moth usually extends from four to five days, but frequently for a fortnight or more.

METHODS OF CULTIVATION, ETC.

The fundamental factors in the production of raw silk are:

(1) The presence of suitable climatic conditions in the silk-producing centres.
(2) The abundance of mulberry trees, whether natural or cultivated.
(3) The availability of a large supply of agricultural or semi-agricultural labour.
(4) The presence of facilities for obtaining cheap power.
(5) Low rate of wages and cost of production.—Rawlley.

It is proposed in this section to deal with a few aspects of silkworm rearing and silk production upon which information is available in their effects on the world production of silk, and their especial bearing on Australia and Australian conditions.

THE MULBERRY.

The first consideration in commencing the cultivation of silk is an adequate supply of food. All varieties of mulberry have been used for rearing silkworms, but there is considerable variation in the resulting silk. The White Mulberry (*Morus alba*) is now universally recognized as the most suitable variety for cultivation in connection with commercial silkworm raising. The trees should be propagated by means of cuttings, and the young trees planted out fifteen to twenty-five feet apart in the manner of fruit trees, and pruned with great care to ensure a luxuriant growth of leaf and to keep the trees low in order to facilitate the gathering of the leaf. The trees may be stripped after about two years' growth, but great care must be exercised or the trees will be permanently weakened. It is generally considered inadvisable to strip trees before their fifth year of growth.

The yield of mulberry leaves per acre varies considerably, and appears to be due to a number of factors—soil, water supply, manure, methods of cultivation, and the number of pluckings or strippings. It has been found that the mulberry tree will grow luxuriantly in situations where, from the nature of the leaf put forth and from other circumstances, silkworms cannot be profitably reared.

It will be realized that a very large quantity of leaf must be available in order to bring the silkworms to maturity. Laurent de l'Arbusst showed, in 1905, that 1 oz. of "seed" or eggs of 30 grammes, producing 30,000 to 35,000 silkworms (30,000 may be depended upon to reach the cocoon stage) will give a harvest of 130 lb. to 140 lb. of fresh cocoons and ultimately yield about 12 lb. of raw silk properly reeled. The amount of nourishment required for this rearing is as follows: hatching to first moult, amount 9 lb. of leaves of tender growth, equal to about

The cocoon of the silkworm showing the surrounding "floss" which is spun off and forms the silk of commerce.
[*After* H. Bastin.

40–45 lb. of ripe leaves; first to second moult, 24 lb., representing 100 lb. ripe leaves; second to third moult, 80 lb., representing 240 lb. ripe leaves; third to fourth moult, 236 lb., representing 472 lb. ripe leaves; fourth moult to pupation, 1,430 lb., representing 1,540 lb. ripe leaves, totalling up to about one ton of ripe leaves for a complete rearing. The *Queensland Agricultural Journal*, Vol. XXVIII, Pt. 2, gives a considerably higher estimate—"For 739 lb. of mulberry leaves, 70 lb. of cocoons are obtained; 10,000 cocoons give 8½ lb. of silk."

At the present time in Australia there are no large plantations of white mulberry trees; the few existing would probably be found in private gardens, and there would be great difficulty in obtaining sufficient cuttings for propagation, and, after an area had been planted, a wait of say from three to five years would be necessary before the trees would be old enough for stripping.

EGGS.

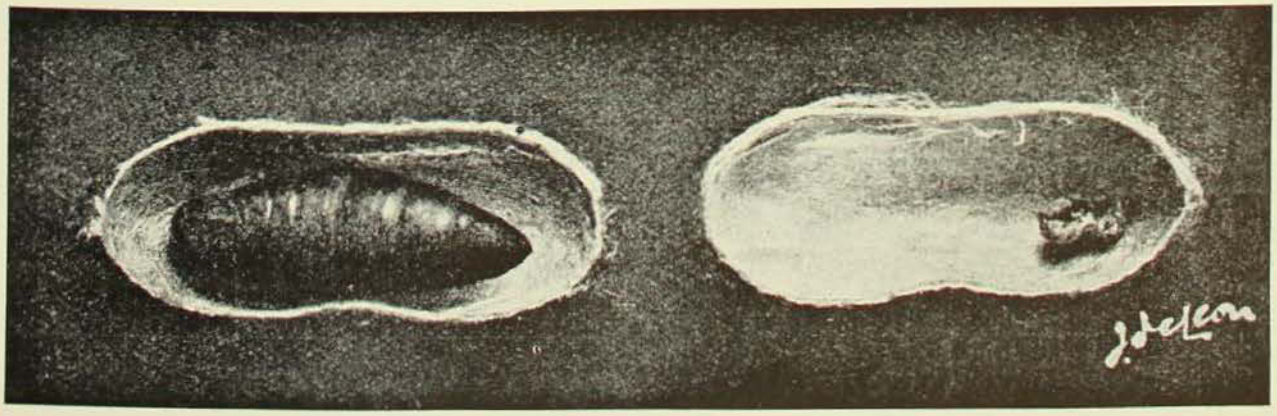
Approximately 30,000 larvæ may be reared from 1 oz. of eggs. In order to avoid premature hatching the eggs are kept for about six months in cool storage at 25–40° F. until hatching is required, in order that an adequate supply of mulberry leaves in the proper condition may be available. The eggs are then placed in special incubators with a temperature starting at 65° F. and raised 2° each day until 77° is reached, at which temperature hatching takes place.

Jameson (*Report on the Diseases of Silkworms in India*, 1922) states:

"Sound seed is essential, but the best seed will give bad results if carelessly reared in unsuitable houses, consequently no scheme for supplying seed can be considered satisfactory that does not attempt at the same time to improve the rearing."

It is extremely doubtful if sufficient eggs or "seed" are available in Australia at the present time for any increase in silkworm rearing, and it is certain that those available would be of mixed and unsatisfactory strains, and possibly so degenerated by such methods of rearing as have been employed in the past as to be commercially worthless. In the event of an attempt being made to establish the industry in Australia it would be necessary to import "seed" for the purpose. The price of seed appears to range from about £2 to £10 per ounce, according to strain. Owing to the danger of diseases, many of which are hereditary, the closest supervision would have to be exercised over any importations and all seed subjected to microscopic examination by experts.

The silk moth (Bombyx mori) laying its eggs.
[*After* H. Bastin.



A section of the cocoon of the silkworm showing the enclosed pupa and the cast skin of the caterpillar.
[*After* J. de Leon.

REARING.

The following information is based mainly on an article on sericulture by D. Gunn, Acting Government Entomologist to the Transvaal, in the *Queensland Agricultural Journal*, Vol. XXIV, Pts. 1 and 2, 1910, pp. 26, 64.

"One of the most important features to be considered in connection with the rearing of silkworms is the provision of a suitable building, as success primarily depends upon the accommodation which is provided. A brick building with a thatched roof is undoubtedly the best for this purpose. An iron building is considered to be most unsuitable, as it becomes very warm during the day, and too cold at night, consequently it is extremely difficult to conveniently regulate the temperature. An open fireplace or hot-water pipes would be the best means of heating such a building . . . If the temperature of the rearing room should happen to fall below 68° F. an ordinary paraffin stove could be used to raise the temperature.

"The silkworm is not a tropical insect, and attains the best development between the temperatures of 68° and 77° F. Sericulturalists should, therefore, remember that the temperature of a rearing room should not fall below nor exceed the above-mentioned limits, as if such should occur it would undoubtedly prove detrimental to the worms and, consequently, seriously affect the quantity and quality of their spinnings.

"The rearing room should be dry, free from draughts, with a supply of fresh air, and protected from direct sunlight. It should be evenly lighted, so that the progress of all the worms may be similar, because if it is dark they eat little and their growth is retarded."

The equipment necessary for rearing the worms is simple, and the more indispensable items are :

Light movable stands on which the shelves are placed ; the shelves should be at least three and a half feet wide, and a space fully eighteen inches left between each shelf.

A thermometer for registering the temperature.

Trays for holding the worms.—"For young worms which have newly hatched from the eggs the most serviceable and inexpensive tray to use is mosquito netting stretched over light wooden frames, twenty-four inches long by eighteen inches wide. After the worms have attained a larger growth fine wire-netting, five-eights of an inch, should be used."

Cleanliness is absolutely necessary in connection with sericulture, and all sheds, *et cetera*, should be disinfected at frequent intervals.

The space required for rearing one ounce of eggs and bringing the worms to full development has been estimated at 1,210 square feet.

When the worms are fully developed they should be supplied with dry bushy branches, free from gum, upon which to spin their cocoons. Sufficient space must be provided to prevent overcrowding, as when two cocoons are spun together their value is considerably reduced. The transformation to the pupa occupies seven to ten days from the time at which the worms first begin to spin.

DISEASES.

There are five diseases which commonly attack the silkworm, and several of these have proved of great economic importance.

(1) Pebrine. This disease attacks the worm, chrysalis, and moth in all stages. It is hereditary, and the disease may easily be introduced into a clean district by means of the eggs of infested silkworms. It is in consequence of this disease that a microscopic examination of the eggs is necessary. There is no known cure for pebrine, and all insects should be destroyed in order to prevent its spread.

Between the years 1865 and 1883 the annual crop of cocoons in France was reduced by this disease from 57,200,000 lb. to 8,800,000 lb.

Pebrine appeared among silkworms near Albury in 1880–1883, with disastrous results.

(2) Flacherie, or indigestion, attacks well grown worms, and the main causes appear to be careless feeding, poor ventilation, dust, and overcrowding.

(3) Gattine attacks the worms in their early stages, and is probably caused by poor sanitation. The affected worms should be destroyed, as the disease is contagious.

(4) Muscardine is due to a micro-organism, and is thought to enter the body by way of the leaves; the disease is most infectious.

(5) Grasserie is another infectious disease which causes heavy mortality among silkworms.

Rats, mice, ants, and cockroaches are serious pests of silkworms in rearing establishments. *Anthrenus* and *Dermestes* beetles also take toll of stored cocoons.

In a succeeding article the handling of the silk and its economics will be discussed.

The Collection of Coins and Medals

DURING the past few months the numismatic collection has been catalogued and listed, with a view to building up the incomplete series. The collection comprises between nine and ten thousand coins, tokens, medals and decorations from all parts of the world, and though this is indicative of a fairly representative series, there are many gaps to be filled. The Greek series is small, and though there is a representative series of brass coins, there are very few of silver and none of gold of this historic civilization. The British series, likewise, is lacking in gold coins.

The collection is also wanting in modern coins, especially post-war issues. The outstanding deficiency of the medals and decorations is a Victoria Cross, for which numbers of enquiries are made regularly.

The collection of ancient coins of the Chinese Empire acquired over a long period of years by Hwong Ping Sing, and now in the possession of this Museum, is among those recently arranged. These coins, numbering 1,010, are the choicest of those which came into the hands of Hwong Ping Sing, a Chinese gentleman, who made it his business to collect and arrange coins for enthusiasts who sought his co-operation. Of the Tchou Dynasty (700 to 200 B.C.) we have specimens of Spade, Weight, Pu, Knife, and Shell Money, each type being characterized by its own peculiar form. The bulk of the collection, however, consists of the ancient Round Money, which dates from about 950 B.C., and contains issues of both emperors and rebel leaders. The Charm Coins are particularly interesting in that they reveal certain old Chinese beliefs and customs with regard to the supernatural and exorcism of evil spirits. The Horse Coins were issued by grateful owners of horses that had served their masters faithfully; one owner claims of his horse that it would "trot one thousand miles a day"! The collection also embraces coins from Annam, Japan, and Korea.

Owing to lack of space, however, it is impossible to exhibit the collection in its entirety. At the entrance to the Exhibition Halls is a small display which is changed monthly, the best that limitations of space permit. That a greater and permanent exhibit cannot be made is regretted, as such a collection is an essential part of every important general museum, and one of recognized interest and educational value.

Leeches

By W. Boardman.

IN the window of a chemist's shop situated in a busy part of one of Sydney's main thoroughfares is a prominently displayed notice—LEECHES SOLD HERE. A newspaper interview with the proprietor published some little time ago indicated that there is still a limited demand for leeches, principally for the purpose of drawing off bad blood from black eyes. The injured one makes his purchase and carries it away in a match box. Our parents, and more so our grandparents, knew these worm-like animals well and used them often, but for many years the practice has been almost unheard of apart from isolated instances and occasionally in hospital eye departments. In fact, when the leech is referred to most of us appreciate the sense of adhesion conveyed by the word, particularly in such phrases as "sticking like a leech," but beyond that little is conveyed.

Hikers and picnickers not infrequently have opportunities of studying these annelids at first-hand. In the damp brush along the creek banks in the National Park just south of Sydney their unwelcome attentions are often forced upon the rambler, and after a shower of rain on the drier, more open scrub and slopes, great numbers of leeches may be encountered where an hour previously an odd specimen could have been located only with difficulty. Writing of their seemingly miraculous appearance after rain causes one's mind to hark back to some years of very early youth when on a hot summer's afternoon a bee-line was invariably made for a nearby beach. This beach was approached by a track which led down a long grassy slope and passed through a perpetually shaded copse behind the sand. In dry weather there would rarely be seen a sign of a leech, except perhaps in a damp part of the copse, but after a shower of rain the hillside literally swarmed with them. Not unusually the walk down was quite comfortable, but, rain falling before the ascent was commenced, the return journey meant running the gauntlet of a veritable barrage of small ravenous leeches. The long grass of the slope harboured them in thousands, resulting in one's upward progress being constantly punctuated by de-leeching activities.

External Characters and Sense of Smell.

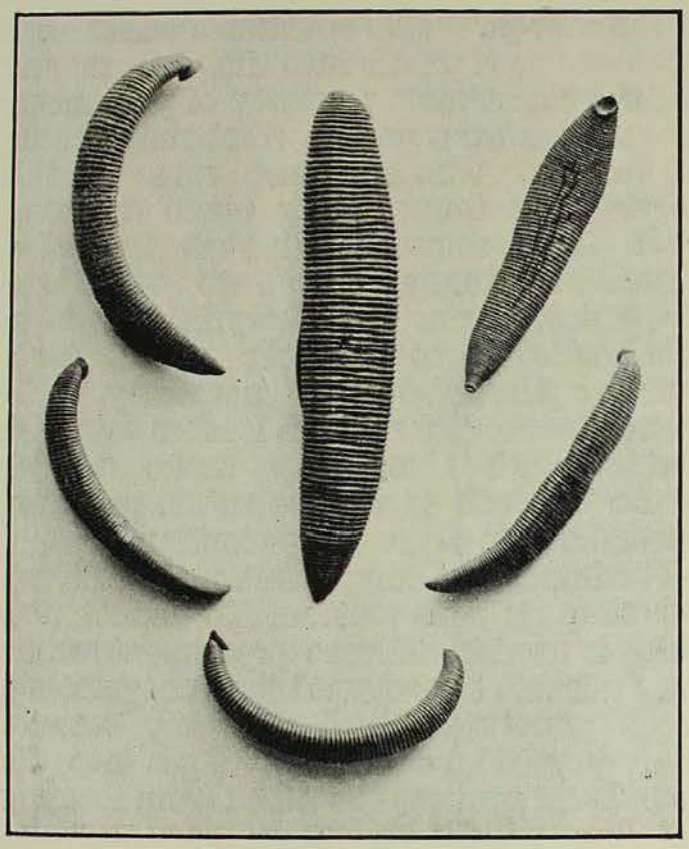
Leeches have two suckers, one at each end of the body. The sucker at the head end is quite small, and surrounds the mouth, but that at the tail end is large, circular and muscular, has no connection whatever with the interior of the body, and is the principal organ of attachment. By means of the large tail-sucker leeches anchor themselves to grass and herbage, especially in damp shady places in the vicinity of water, and are ever in readiness to become detached in favour of the skin of some suitable animal as it passes by.

An extraordinary sense of smell enables them to perceive the presence of prey when still at a considerable distance; nor do they wait idly for what may be a long overdue meal, but, guided by their unerring sense, will actively search it out. My friend and colleague, Mr. A. Musgrave, writing in these pages in 1923 concerning his experiences in the Upper Chichester Valley, makes the following apt and interesting remarks.

". . . We had many wet days, and during the rain the leeches would stand stiff and straight on the grass stems, and, on our brushing against them, would immediately fasten on to us and proceed to suck our blood. They thrive only in damp situations and are unable to travel on dry dusty surfaces, so that it was interesting to see them enter the hut as far as the line of dampness extended,

and halt there, pathetically waving their heads as they sniffed our whereabouts."

Externally the leech body appears to be composed of numerous narrow rings. Five of these rings, known as secondary segments, make up one true or primary segment (except at the head and tail, where the number is less and variable).



A half-dozen specimens of Limnobdella australis collected at Parramatta, near Sydney. The large tail sucker (relatively more contracted by the preservative) and characteristic annulation of the body are clearly shown.

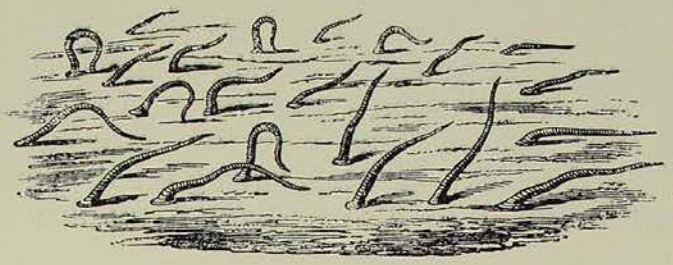
[Photo.—*G. C. Clutton.*

The limits of the primary segments are difficult to determine without the aid of a strong lens, certain pores and papillæ serving as a guide to their position. The various systems of internal organs are mostly segmentally arranged in accordance with the disposition of the primary segments. In all there are thirty-four of these primary segments and the number is constant in all leeches that have hitherto been studied. In the fixed number of segments the leech differs from its relatives, the earthworms and marine annelid worms, wherein the number is very variable, being not even fixed for a particular species.

The following remarks on anatomy refer in the main to *Limnobdella australis*, which is perhaps the commonest of the forms found in the New South Wales coastal belt, but may be regarded as fundamentally applicable to the group generally.

LOCOMOTION.

On land leeches use the suckers to progress with a looping motion similar to that of a geometer caterpillar, which enables them to move with considerable



Voracious land leeches (Hæmadipsa zeylanica), which are such a curse in the damp rising grounds of Ceylon, advancing towards prey that has been scented. The typical "looping" movement of land leeches generally is well illustrated.

[*After* Tennent.

rapidity. Species normally terrestrial, should occasion demand it, are good swimmers as well, progressing with a graceful writhing action.

The body is as a rule soft and elastic, being capable of remarkable attenuation and contraction. A specimen under ordinary circumstances as thick as a lead pencil can penetrate easily the meshes of an ordinary coarse woollen sock, and will escape from a screw-capped jar if the cap be not properly screwed on.

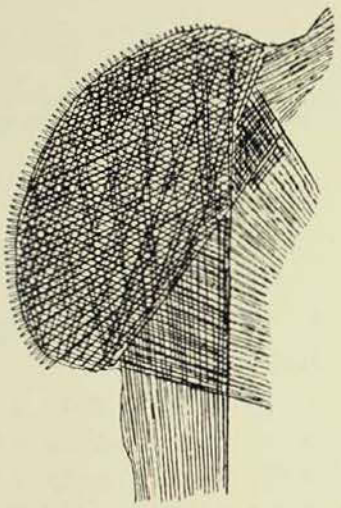
EYES.

On the dorsal surface of the segments beneath which is the anterior sucker there are five pairs of small black spots, one pair to each of the first five primary segments ; they are arranged in an arc round the anterior end and are placed towards the lateral borders of the segments. The eyes, for as such the spots have been identified, are decidedly primitive in structure and are certainly not capable of transmitting images to the brain (if the speck of nerve tissue at the head end may be so designated) as in higher animals. They are essentially modified sense organs and can probably perceive little more than the difference between light and day.

THE MOUTH.

To be bitten by a leech or two is not very serious or very unpleasant, in fact many folks are victims of their attentions and do not make the discovery till the animal has nearly had its fill or has actually dropped off gorged to repletion, leaving behind as evidence only a tiny skin puncture from which a steady trickle of blood may issue for an hour or more.

The small mouth opening which is within the boundaries of the anterior sucker is surrounded by three jaws, each of which is flattened and has its free edge evenly curved and serrated into well-defined teeth. Muscles acting on the jaws enable them to move through an arc in



Jaw of a leech highly magnified.
[*From* Parker and Haswell, *after* Leuckart.

the direction of their edges, and it is their rasping motion, pressed by the sucker against the skin of the prey, that makes the characteristic triradiate leech wound.

The mouth leads into a muscular sac, the pharynx, which is connected by a system of radiating muscles to the body wall, the action of the muscles being such as to cause the pharynx to contract and expand, thus pumping blood from the wound.

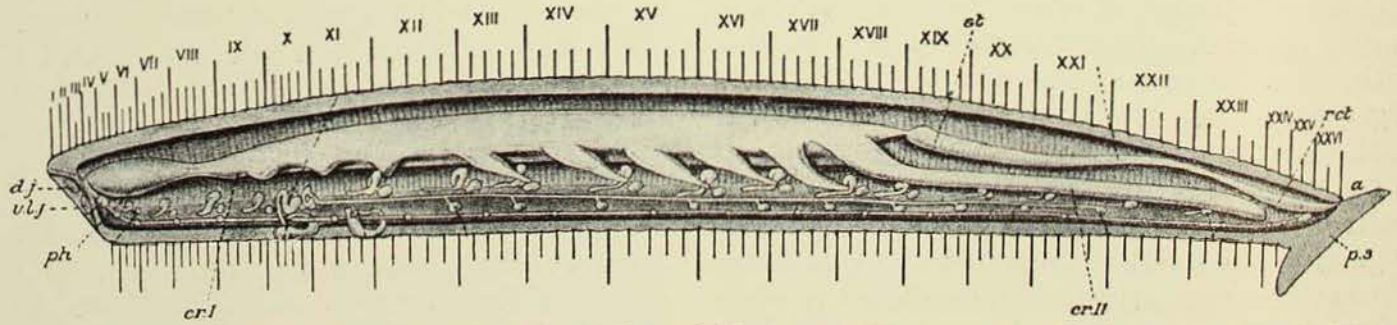
THE SALIVARY GLANDS.

Numerous minute glands discharge their secretion through very fine ducts into the alimentary canal in the immediate vicinity of the mouth. This substance mixes with the blood as it passes into the pharynx and has the remarkable property of preventing coagulation for a period which may extend to months. The immense value of this provision is immediately made apparent when it is remembered that the large distensible storage crop into which the blood flows from the pharynx is able to hold sufficient to feed the animal for a year or thereabouts if necessary. The chance methods by which leeches establish contact with their prey make a long period between successive meals probably more the rule than the exception.

The important component of the salivary secretion is an extractible substance, which is used in delicate experiments when it is desirable to prevent blood coagulating. Leech punctures bleed profusely because small quantities of the saliva get into the wound and prevent the blood from forming the film which under ordinary circumstances stops the flow of blood.

THE CROP AND STOMACH.

The crop is a very large elastic- and thin-walled tube which extends from the eighth to the eighteenth segment. Laterally it has eleven pairs of pouches, the last pair being of considerable size and extending backwards almost to the end



A semi-diagrammatic drawing of a dissection of Limnobdella australis from the left side showing the disposition of the alimentary canal. The longer vertical lines indicate the primary segments, the shorter lines the secondary segments. a, anus; cr. I, first diverticulum of crop; cr. II, last diverticulum of crop; d.j., jaw; ph., pharynx; p.s., posterior sucker; rct., rectum; st., stomach; v.l.j., jaw.

[*After* Parker and Haswell.

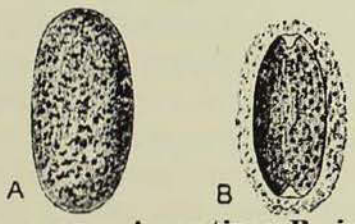
of the body. The blood storage capacity is thus a high percentage of the internal volume of the animal.

The crop communicates with a small slender stomach by a tiny aperture through which the stored blood filters very slowly. Digestion of the blood takes place in the stomach, where it undergoes an immediate change of colour from red to green. The stomach leads into a short intestine and thence to the anus, an inconspicuous opening on the dorsal surface between the posterior edge of the hindermost segment and the caudal sucker.

DEVELOPMENT.

Leeches are hermaphrodite animals, that is to say, a complete set of male and female generative organs is present in each individual, but ripeness of the elements at different times prevents self fertilisation.

In many land leeches the eggs are deposited in a cocoon which is originally formed as an exudation from the outer surface of segments nine to eleven; the exudation dries and toughens to some extent and encircles the three segments as a ring. Having formed the cocoon ring



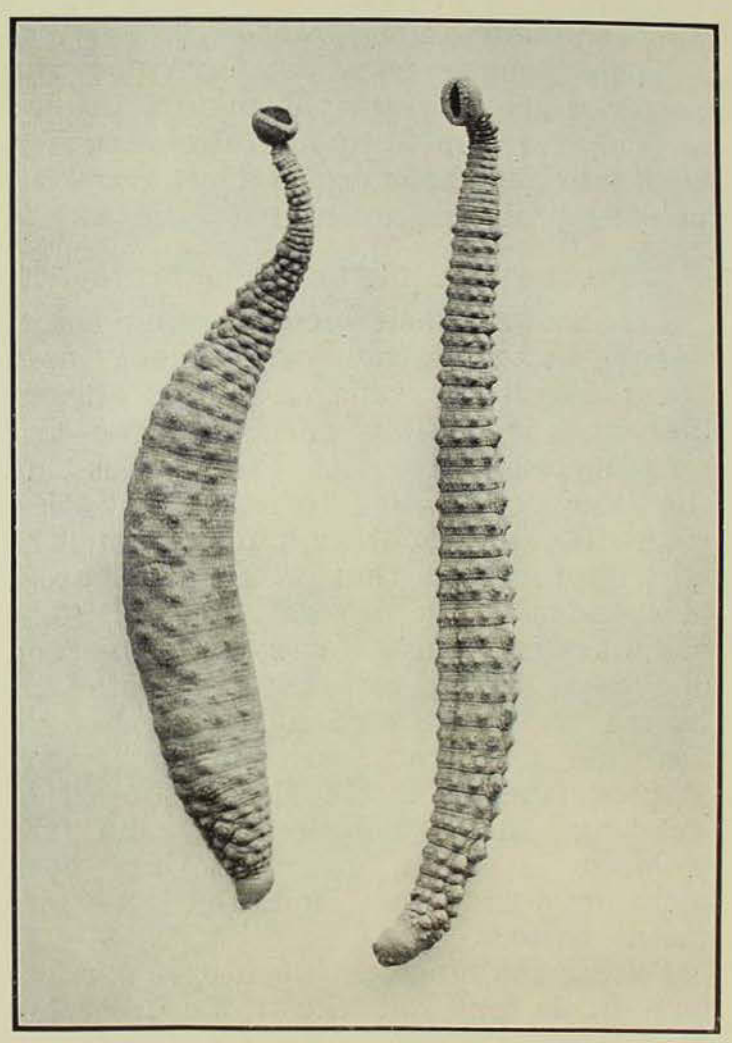
A leech cocoon. A, entire; B, in section.
[*From* Parker and Haswell, *after* Leuckart.

the leech proceeds to deposit within it eggs, male elements received from another leech to fertilize the eggs, and a quantity of food for the developing young. The ring with its contents is then worked off the body over the head end, and when free the two open ends close up, efficiently sealing the contents. Development proceeds and ultimately results in the formation of juveniles resembling closely the larger adults. When sufficiently progressed they escape from the cocoon and commence to fend for themselves. The whole process of cocoon formation is very similar to that of the earthworm, which is also an hermaphrodite animal.

Not nearly all leeches make a cocoon, some species simply depositing their eggs in an agglutinated mass upon a convenient stone. Others carry the eggs about adhering to the ventral surface of the body; in this position the young hatch out and when liberated from the egg remain attached to, and sheltered by, the parent for some time.

BREATHING.

Leeches do not breathe with any specially modified structure that is comparable with the lung of higher groups, and only a few aquatic species have gills along each side of the body. The general method of respiration is directly through the skin, utilizing the numerous exceedingly fine blood vessels which ramify through it.



Two fine examples of Pontobdella muricata from the Mediterranean. All the species of Pontobdella are marine and attack sharks and rays in many parts of the world, including the Australian seas.
[Photo.—*G. C. Clutton.*

MARINE AND FRESHWATER LEECHES.

The ordinary land and freshwater forms, which attack animals only intermittently and when gorged with blood drop off their

prey, could scarcely be referred to as true parasites. There are, however, a number of aquatic leeches which live permanently attached to their hosts and thus justly deserve to be referred to as parasites. Certain species favour freshwater fishes, and the well-known genus *Pontobdella* parasitizes sharks and rays.

Branchellion is another interesting genus habitually adhering to the skin of the skate and marine fishes. It is not unusual to discover a family of these leeches localized on a small area of the skin of the host, individuals in all stages of growth being represented. Respiration is performed by a series of short delicate outgrowths or gills placed along each side of the body and in this respect the genus is almost unique among leeches.

These aquatic parasites have powerful posterior suckers, but the mouth, instead of being surrounded by an anterior sucker, is situated at the end of a short retractile piercing proboscis not armed with jaws.

PHLEBOTOMY OR BLOOD LETTING.

Leeches and their blood-sucking habits have been known from very remote times, being frequently referred to in ancient literature. Possibly their use for this purpose originated with the Hindus and the knowledge was carried to other countries; on the other hand, it is not at all improbable that the art arose independently in several places. The earliest references, however, to this method of blood letting certainly refer to the Indian region. The Sanskrit System of Medicine of Susruta, written 2,000 years ago, explains in careful detail the art of selecting and using leeches, and the technique therein described has been more or less closely followed by more recent writers.

During the nineteenth century, particularly in its first half the traffic in leeches in Europe attained enormous dimensions. It is recorded that in the year 1832 57,500,000 were exported to England from France, so that the leech farmers and merchants must have carried on an extremely lucrative business, as a high percentage of those placed on the market were raised artificially. The great demand for the annelids had so depleted the natural sources of supply that hirudiniculture as a means of coping with the requirements was of necessity extensively resorted to. In this manner leeches were also raised in England, but not on a scale comparable with that in France. Marshes were constructed for the purpose in the Gironde and other districts of southern France, and in the neighbourhood of Nantes leech farms were common.

Dealers classified the worms principally according to weight, to increase which dishonest merchants were quite prepared to resort to the subterfuge of gorging the leeches just before sale. The European market received supplies from as far afield as Africa, Syria, and Egypt.

In the last fifty years rapid advances in medical knowledge have gradually lessened the demand, so that today, leeches, the use of which probably antedates written history, are scarcely known except for an occasional encounter in the bush or when peered at through the glass of a museum showcase.

Despite unpleasant associations that leeches may conjure up in the mind, an unbiassed observer could scarcely deny that they are beautiful objects. The lithe supple body is, in our Australian species, often marked with pleasing colour combinations, embodying mostly browns, greens, and yellows, the patterns being most frequently longitudinal stripes.

"So beautiful are they that the fastidious ladies who adorned the *salons* at the height of the leech-mania, during the beginning of the nineteenth century, used to deck their dresses with embroidered leeches, and by repeating the design one after the other, constructed a chain of leeches which, as a ribbon, was inserted around the confines of their vesture."*

SOME GENERAL CONSIDERATIONS.

Few travellers have visited tropical or sub-tropical climes and failed to bring back with them tales, often graphic, sometimes gruesome, of experiences with leeches. From among many accounts two quotations are chosen, one referring to the East, the other to a locality in our own country.

* *Fide* Sir Arthur Shipley's historical preface to the *Hirudinea* volume of *The Fauna of British India.*

Tennent, in his splendid work on Ceylon, has much to say of their activities.

"Of all the plagues which beset the traveller in the rising grounds of Ceylon, the most detested are the land leeches . . . Horses are driven wild by them, and stamp the ground in fury to shake them from their fetlocks, to which they hang in bloody tassels. The bare legs of the palankin bearers and coolies are a favourite resort; and, their hands being too much engaged to be spared to pull them off, the leeches hang like bunches of grapes round their ankles; and I have seen the blood literally flowing over the edge of a European's shoe from their innumerable bites . . . during the marches of troops in the mountains . . . the soldiers, and especially the Madras sepoys, with the pioneers and coolies, suffered so severely from this cause that numbers of them perished."

And again, this time from Semon, writing of his excursion to the Upper Burnett River, Queensland.

"Nor was the fauna of this Cania scrub, which, however, I have not closely studied, identical with that of the common brigalow scrub near the Burnett, since on coming home from our ride several of us had blood on our clothes, and on undressing we found a number of leeches, which had crawled up our bodies during our rambles through the wood . . . They are, however, a perfect curse in the forests of the East Indian islands, and abound likewise in the woods of the Australian coasts, and they were the plague of my existence during my stay in the tropical forests of Cooktown."

Leeches are not as a rule much larger than two or three inches, but in South America there is a marine form reputed to have a length of twenty inches or more.

Limnatis nilotica, a small slender species widely distributed in Egypt, Palestine, Syria, and Persia, has habits which make it a serious inconvenience to man and beast and it is quite capable of causing death. The Talmud describes it as "a most dangerous leech" and issues a warning against drinking from rivers and pools. Unable to pierce man's outer skin it seeks out the softer flesh of the mouth or nasal passages, and once established therein, instead of falling off when satisfied, remains attached. Some can be easily removed, but others in positions difficult of access have been known to set up a perpetual hæmorrhage, which has resulted in anæmia terminating fatally. The natives, who know and fear these leeches, carefully strain drinking water before using.

There is an interesting reference in the Pali work "The Questions of King Milinda" in which the leech is upheld as a paragon for those who would imbibe truth.

". . . just as the leech, wheresoever it is put there holds on tight, drinking the blood, so should the strenuous Almsman (*i.e.*, 'priest') concentrate on a theme of thought, drinking the ambrosial draught of Deliverance (*i.e.*, 'Salvation')."

In the Middle Ages and later, physicians were commonly referred to as leeches, and some writers have facetiously suggested that analogy of outlook caused this widening of the use of the name. However, a study of the history of the word in its various meanings shows that it was probably the reverse process that actually occurred, that is, the worm came to be so called from the frequency of its use by the physician or leech.

At the request of Mr. C. Barrett, Honorary Organiser of the Fisheries and Fauna Exhibition, held in Melbourne from 5th to 7th April, in aid of the funds of the Melbourne and Queen Victoria Hospitals, a number of exhibits were sent to Melbourne in charge of Miss Joyce Allan, Assistant in Conchology. While in the southern capital, Miss Allan delivered lectures, and took the opportunity of examining the conchological collections in the National Museum and of doing some marine collecting.

Ernst Johannes Schmidt

(1877–1933).

THE regrettable news has just reached Australia of the death of Professor Johs. Schmidt, D.Sc., Director of the Carlsberg Laboratory, Copenhagen, Denmark, and a leading figure in the Conseil International pour l'Exploration de la Mer, a branch of which he hoped would be formed in Australia some day. Professor Schmidt was a brilliant fisheries investigator who inaugurated and supervised a tremendous amount of detailed work (such as counting the vertebræ, fin-rays, and scale-rings of even the smallest fishes) to distinguish the races, growth-rate, migrations, and distribution of commercially important fishes. Similar work will have to be performed in Australia before we can progress very far with our own fisheries.

Professor Schmidt is best known for his researches on the freshwater eels of the world; he was particularly interested in Australian species, and had just completed arrangements for securing New Guinea specimens. His writings, published in several languages, over a period of thirty years, cover such subjects as fisheries, larval fishes (notably sunfishes), the eel problem, local races of the Viviparous Blenny, fish-marking experiments, botany, physiology, and genetics. He was presented with the Agassiz medal by the National Academy of Sciences, U.S. America, and, in 1930, was awarded the Darwin medal of the Royal Society for his oceanographical work and his genetic studies in animals and plants.

On two occasions Professor Schmidt visited Australia, when he was admired for his quiet and unassuming manner: once, in 1926, when on a six months' survey of the Indian and Pacific Oceans, and again, in 1929, with the *Dana* Expedition. The trawler *Dana* (360 tons) was one of several research vessels employed at various times by the enterprising Danish Government in collecting specimens for study. Early in 1929 she came to Sydney from New Zealand, on her world cruise. Professor Schmidt was in charge and, at a reception given here by the Government, said: "I cannot disguise my surprise to find that, although there is ample evidence that Nature has endowed Australia with an abundance of good food fishes, you are importing more fish than you are catching. Can any greater evidence be found for the necessity for the systematic investigation of your waters? I hope to see in the near future an investigation vessel or vessels carrying out work of this nature, and I look forward with keen anticipation to the time when you will have a marine biological station, conducting research into fisheries problems. I am sure you will find, as we have found, that such investigations pay handsome dividends."

At that time Mr. T. C. Roughley, of the Technological Museum, and the present writer were invited to accompany the *Dana* on her Tasman Sea investigations. Two cruises were made between New South Wales and Lord Howe Island and between Sydney and Brisbane, but a severe cyclone rendered work impossible for some days. Nevertheless, numerous extraordinary fishes were dredged from deep water off our shores and these specimens are now receiving the attention of European specialists.

GILBERT P. WHITLEY.

Notes and News

Miss Elsie Bramell, B.A., Dipl.Ed., has been appointed to the position of Scientific Assistant in the Department of Ethnology of this Museum. Miss Bramell has devoted considerable study to the subjects of anthropology and ethnology, particularly sociology, and in the near future we hope to present to our readers contributions from her pen.

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Mr. F. A. McNeill, Zoologist in charge of the Department of Lower Invertebrates, has been appointed to the Committee of the *Nature Study and Horticultural Bulletin*, a supplement to the *Educational Gazette* issued by the Department of Education of this State. Interest in marine zoology has grown considerably of late, and Mr. McNeill's objective will be to assist in supplying information on this subject.

* * * *

During his recent vacation on Lord Howe Island, Mr. A. A. Livingstone, of the Department of Lower Invertebrates, made extensive zoological collections, especially of echinodermata, or sea-urchins. In the phylum particularly mentioned, he continued the work initiated by Dr. H. Lyman Clark, of the Museum of Comparative Zoology, Harvard, in collaboration with himself a year or so ago.

* * * *

Through the courtesy of the Royal Agricultural Society of New South Wales, the Museum was enabled to place an exhibit of insectivorous birds and venomous snakes in a prominent position in the Agricultural Hall at the Easter Show, just concluded. The exhibit was prepared with the object of interesting the primary producer in particular, and it contained specimens of the White Ibis, Barn Owl, Nankeen Kestrel and other birds. With these were bottles showing the food contents of the stomachs, crayfish, wood-boring grubs, grasshoppers and centipedes being in great evidence, these forming the major portion in the dietary scale of these birds. With the venomous snakes were labels and diagrams showing the differences between bites of various typical species and the methods of applying ligatures in cases of bite. The exhibits were arranged by Mr. J. R. Kinghorn, Herpetologist and Ornithologist.

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Mr. Melbourne Ward, Honorary Zoologist, whilst in Papua and the Mandated Territory of New Guinea, did a considerable amount of zoological collecting. With customary regard for the collections of this Museum, he generously presented a large quantity of extremely interesting material.

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Recent visitors to the Museum include Miss L. E. Cheesman, *en route* to Papua to collect insects for the British Museum; Mr. G. Bourne, University of Western Australia, who is investigating the adrenal glands of marsupials, and examined the spirit specimens in our collection; Dr. C. H. Edmondson, Bishop Museum, Honolulu, who is interested particularly in fishes and crustaceans; Dr. James Dunlop, formerly Commissioner of the Scottish Northern Lighthouse Service, who called to enquire regarding Australian sea birds.

Reviews

Gulliver in the Bush: Wanderings of an Australian Entomologist. By H. J. Carter. (Angus and Robertson, Ltd., Sydney, 1933.) 8vo., pp. 234, illustrated. 6s.

This recent contribution to Australian entomology describes the collecting experiences of the author throughout Australia during the past fifty years. Mr. Carter is well known in scientific circles for his many contributions to the journals of learned societies on systematic entomology relating to the order Coleoptera (Beetles). He is therefore well fitted to write on the subject of collecting, for there are probably only three or four entomologists who have had such experience in the field. The headings of the chapters indicate the wide scope of the author's collecting activities, *viz.*: Collecting in General and My Start in Entomology; Sydney and the County of Cumberland; The Blue Mountains; Coastal New South Wales; Highland Rain-forests; Alpine Australia; Inland New South Wales; Victoria; South Australia; Tasmania; Queensland; Western Australia. Each collecting locality receives due consideration from a collector's point of view, its topographic features and those of the outstanding flora and fauna are discussed, together with the beetles secured. The author, gifted with a facile pen and endowed with a knowledge of his subject that has placed him among the leading entomologists of the Commonwealth, has given us a book pleasant to read and containing a wealth of information not readily found elsewhere. The addition of a preface and an index would have still further enhanced the value of a work upon which author and publishers are to be congratulated. A.M.

The Rabbit Menace in Australia in 1933 and the Way Out. By David G. Stead. (Sydney, 1932). 6d.

From all quarters come reports of the great damage which the rabbit is now doing to our pastures, and the probability that the position will become more acute unless effective measures are taken to mitigate the pest. The rapid increase in the rabbit population is easily explained. A succession of good seasons has favoured prolific breeding, prices for carcasses and skins have been low, so that trapping (never a satisfactory method of rabbit destruction) has not been a popular industry, and, on account of the depression, landholders have not been able to cope with the evil.

Mr. David G. Stead, formerly Special Rabbit Menace Commissioner to the Government of New South Wales, is the author of the booklet, which deals with the various aspects of the rabbit problem and the many remedial measures which have been tried. He advocates the use of cyanogas as an effective fumigant which can be used at a comparatively low cost. He points out that the rabbit's burrow, which is its fortress, can, by the use of cyanogas, be turned against it and become its grave.

From the facts adduced by the author it does seem as though the employment of cyanogas, combined with effective fencing and properly constructed gates, would enable the settler to clear his holding and, if a co-operative effort is made, there are hopes that the pest may be held in check.—C.A.