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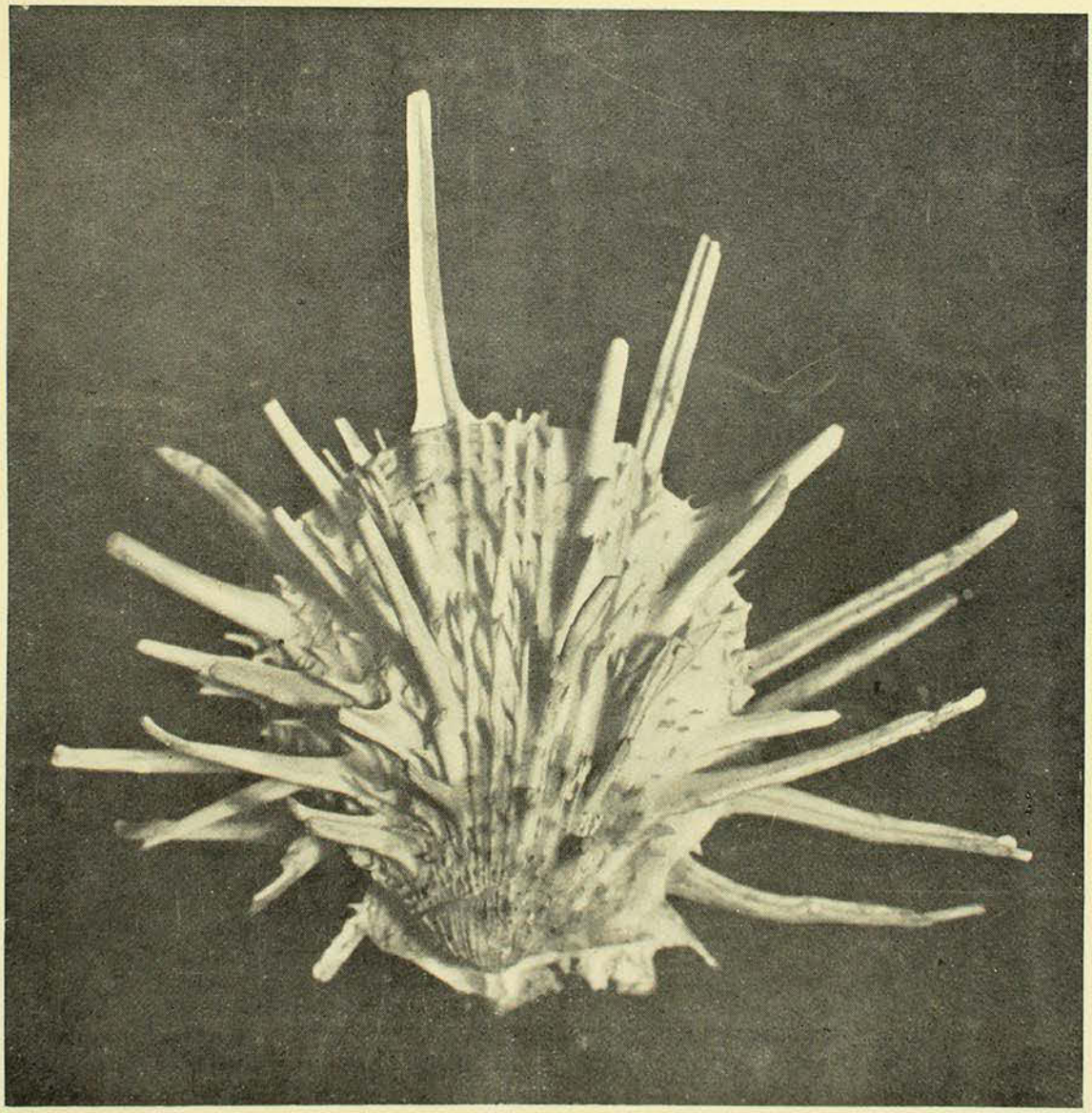

The Long-spined Thorny Oyster.

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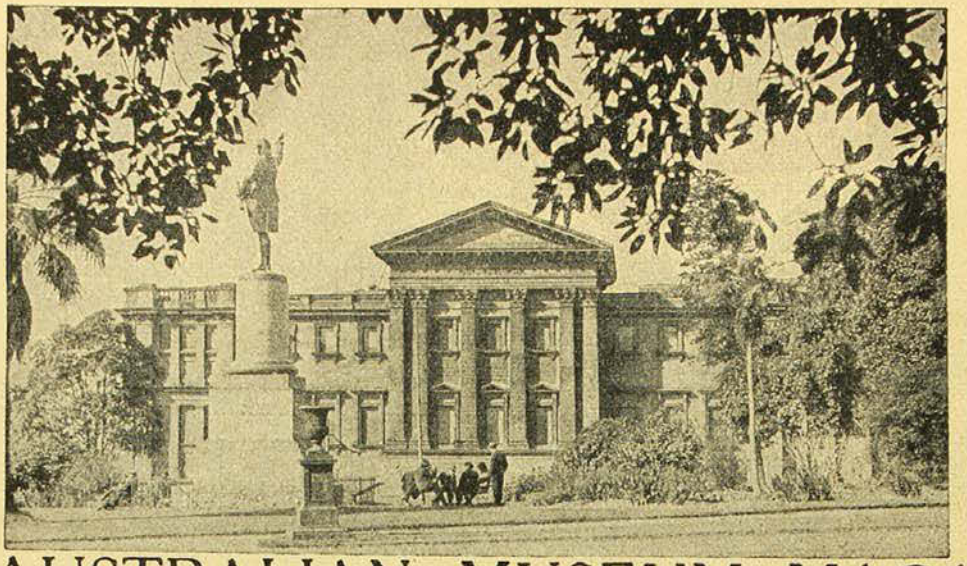

THE AUSTRALIAN MUSEUM MAGAZINE

● OUR FRONT COVER. The Long Spined Thorny Oyster, *Spondylus victoriae* Sowerby, is one of the most graceful members of a family containing a number of very handsome shells. This particular specimen came from Moreton Bay, Queensland, but the species occurs in other northern Australian localities, particularly along the Great Barrier Reef. It is a bivalve shell which, like other members of the family, attaches itself firmly by its lower valve at the hinge-line to a small piece of rock, dead coral or other marine growth. Specimens are usually obtained by dredging.

Thorny Oysters, which are not related to true oysters, were known by name and greatly admired by early Greeks long before most shell families had been discovered. Their shape is sometimes very distorted because they grow in a crowded manner, often on one another.

The largest and most brilliantly coloured Thorny Oysters come from California and the West Indies, where, attached to coral rock, they are brought up from depths of 15–18 fathoms. Some of these are exhibited in the Conchological Gallery of this Museum.

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FOLDED ROCKS NEAR BLUEPOOL, BERMAGUI, NEW SOUTH WALES.

Photo.—Elizabeth C. Pope.

On the South Coast of New South Wales, for a distance of 150 miles, there outcrops a well-defined belt of altered sediments of considerable age. These rocks can be traced fairly continuously from Termeil, between Ulladulla and Bateman's Bay, right to the border where they pass into north-eastern Victoria. Between Bermagui and Tathra they occur on the coastline.

The age of these rocks is uncertain, but in the last-named locality at least, they are either Cambrian or Ordovician. When deposited back in the mists of geological antiquity they consisted of the common sediments, sandstones and shales. Since these far-off times they have been subjected to two series of orogenic (mountain building) movements which have caused considerable alteration in their nature and structure. One result of these movements has been to alter by the agencies of heat and pressure the original sandstones and shales into the metamorphic rocks, slate, quartzite, phyllite and schist. Also the tremendous pressure involved has caused intense folding of this originally level bedded sedimentary series.

This photograph of these ancient folded rocks was taken near Blue Pool, Bermagui, looking north. Here the metamorphism has been a little less severe, because the rock still retains some of its original sandy character. Such a folded rock lends itself to the formation of numerous crevices and cavities by the action of marine weathering. These form admirable shelters for many kinds of sea creatures and hence the locality is a good collecting ground for the marine zoologist.

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The Museum in Teaching

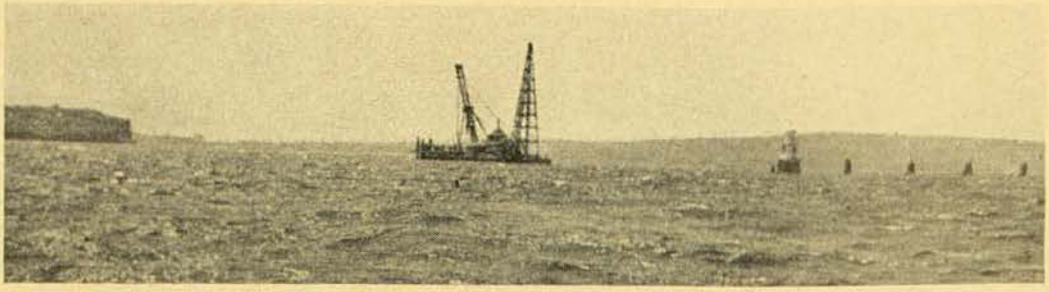
EDUCATION which uses eyes and ears and the touch senses and makes close contact with subject material reaps efficiency in the learning process. Teaching must avoid the abstract in building the child's store of concepts.

Museums contain great untapped fountains of wealth. These are a source of constant enthusiasm to the enterprising educationist, but without some marshalling and organization, the museum may be a maze and a chaos to the uninitiated.

Recently there has been attached to the Australian Museum an education officer. This officer, a teacher with a scientific training, has as his special task the furtherance of a scheme which uses museum facilities for a child education plan. The school teacher draws up a programme for the term and seeks assistance from the museum where correlation means benefit to the child. Discussions between teacher and education officer lead to the planning of a scheme of work, supply of information, loan of materials, visits by the education officer to the school and, on occasions, a visit of the class group to the museum. There is follow-up work and the education officer keeps in touch with the schools and may give further assistance, gradually becoming known to teacher and pupil as guide, philosopher and friend. The museum is no longer the unfathomable sacrosanct.

In correlating with the school curriculum, museum work may act as an opener to the study of a special project, as a stimulator during the progress of the work, as a clarifying medium for some particular feature, or as a summary of the activity. Often it serves on more than one of these counts, often in still other directions; at all times there is a new approach to the subject-matter in parallel with the teacher's work. The outstanding educative factor is that the demand comes from the teacher who knows the requirements of the child and the task in hand. The breadth of the scheme is as great as the facilities of the museum will permit or the demands of the child's education will require in the future—always the progress of the child stands as the keystone.

Efficiency and contact with a maximum number of children require the elimination of travelling time for the child and the rapid movement of the "travelling museum" from school to school.



The sheerlegs punt removing piles from the boom near Sow and Pigs Reef, Port Jackson. To the right of the beacon four of the dolphins which formerly supported the nets may be seen.

Photo.—E. C. Pope.

Denizens of the Boom Piles

A Little Known Marine Community

By ELIZABETH C. POPE

DURING the war the ferry traveller to and from Manly regularly passed through a movable gate in the boom defence which had been placed across the mouth of the main arm of Sydney's harbour, Port Jackson.

If these passengers followed official instructions, they said nothing about the boom to anyone—in fact pretended it wasn't there at all. In this way, it was hoped that the enemy would not learn of its presence. But no amount of official mandates could stop these travellers from thinking about the boom that caused them so much delay and inconvenience, and some of them must, no doubt, have wondered what sea creatures, if any, grew on these piles and nets.

Keen bream fishermen didn't wait to be told of the amazing marine growths which quickly established themselves there. They saw the millions of mussels growing on the piles and, putting two and two together, realized that thousands of Black Bream must be tempted to come and feed on these dainties which they crush up between powerful jaws. So they moored their boats to the boom and dropped their lines overboard. In the season, their success was amazing, and few complained that the fish didn't bite or came home empty-handed after fishing trips to the vicinity. They, if nobody else does, will mourn the passing of the boom —for one of the first post-war jobs undertaken was the removal of this hindrance to harbour traffic and pleasure cruising.

Through the courtesy of the Maritime Services Board and its officers, the author and several naturalist friends were permitted to be present at the drawing of the piles of one of the "dolphins", as a group of piles is called, near the Sow and Pigs Reef—a region of the harbour which has always been noted as a marine collecting ground.

Because of the favourable position, and also because the piles were eighty feet long, sixty feet of which extended from the mud-line to the surface of the water, we expected to find a great variety of creatures living there. Most would be old friends we knew, but we hoped some new or rare forms would turn up. We were not disappointed.

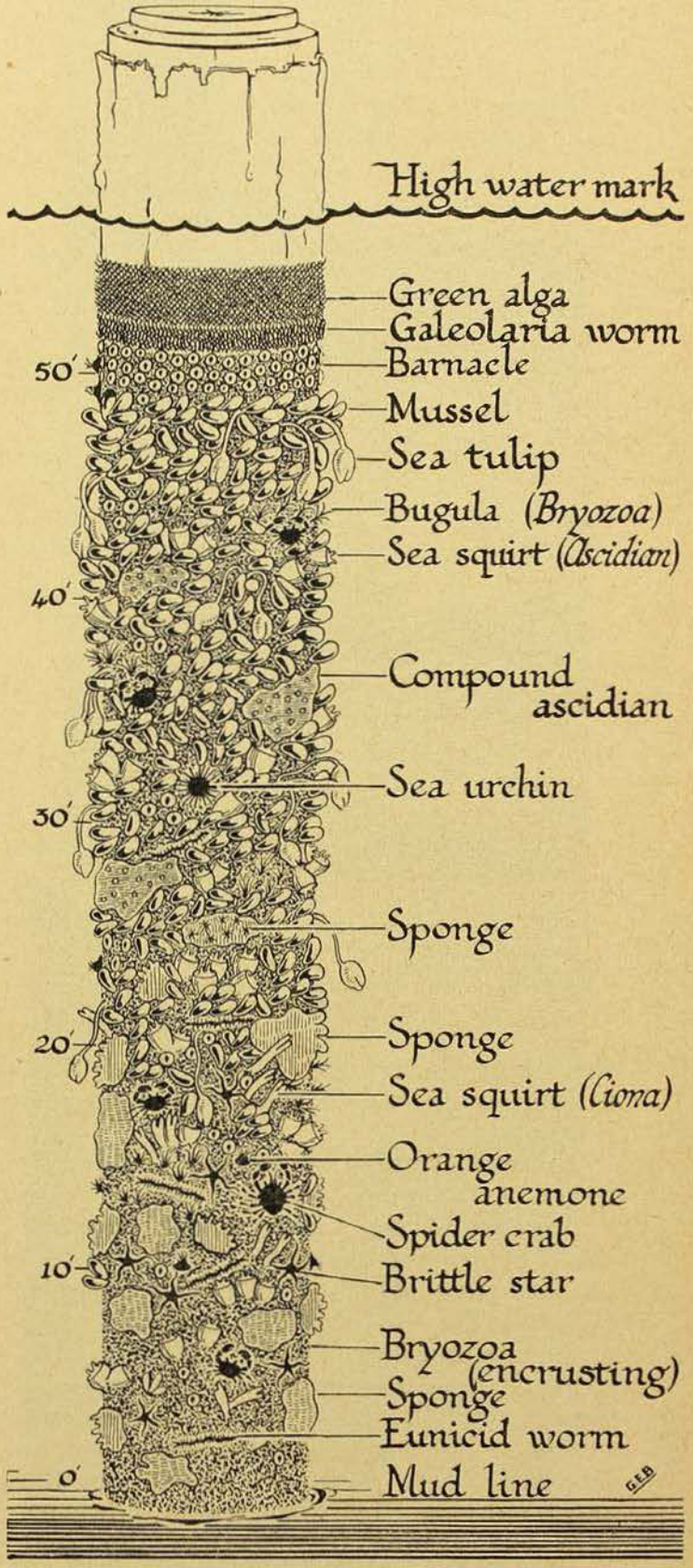
Before a pile can be drawn it has to be loosened from its fellows by cutting through all metal connections such as bolts or binding strips of iron, and to do this, an oxy-acetylene flame is used. A wire-rope sling is then passed round the pile and attached to the hook from the tackle of a large and powerful floating crane. It is then a comparatively simple job to raise the pile through a few feet vertically and so free it from the bottom,

for even an eighty-foot pile is driven only ten feet or so into the mud.

The crane we visited was a sheerlegs punt, her captain—or maybe he should be termed her leading hand—welcomed us aboard just in time to witness the final stages of the drawing of what had been a somewhat troublesome "stick".

This pile had been in position four years, but being of a type which had no natural resistance, and not having been given preservative treatment, it had been attacked in no mean fashion by Teredinine borers or Shipworms, locally known as Cobra. The Shipworm is, of course, not a worm at all, being in actual fact a mollusc, as its small bivalve shells bear witness, but the long worm-like body misled the early naturalists and their popular name for it has stuck. Our local popular name, Cobra, is an aboriginal word and is greatly to be preferred to the misleading overseas word "shipworm".[1] So advanced had been the boring activities of the cobra in this particular pile, it had snapped off just below the level of the low water mark. As the illustration shows, very little of the original wood had been left by the borers whose tunnels through the pile appear on the snapped end as black pits. As a result, when the crane exerted its pull the pile had snapped in two, approximately ten feet from its top end and caused a great deal of trouble. However, the men operating the crane were quite equal to the occasion and the two portions soon lay on the punt where the crane heaped up the piles as they were removed.

Although this snapping of the pile was a nuisance to the workmen it was a most fortunate occurrence for us zoologists and we eagerly examined the broken ends of the pile and collected splendid specimens of the cobra shellfish by sawing off a chunk of wood and preserving it in its entirety. The mining molluscs could then be carefully dug out from their



The crowded community of a Boom Pile. A diagrammatic sketch of one of the piles, removed in 1946 from the boom in Sydney Harbour.
G. E. Binstead, del.

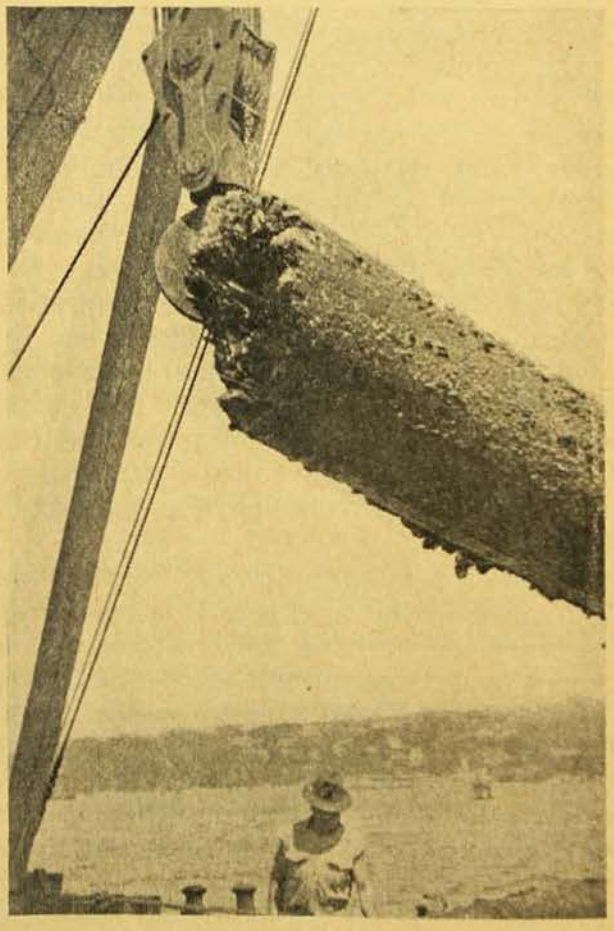
[1] There are alternative spellings recorded for the native name for the shipworm and of these, "kobbara" would seem to be preferable to the one which is current today. There would be no chance of confusing "kobbara" with the Indian snake, as there is when the spelling "cobra" is used. Another version of this word is "Cah-bro", and we find it in the name Cabramatta—a suburb of Sydney.

In the drawing process, one side of the pile has been scraped almost clear of growths as it ground against the side of the pontoon. Elsewhere, the thickness of the growth may be appreciated.
Photo.—E. C. Pope.

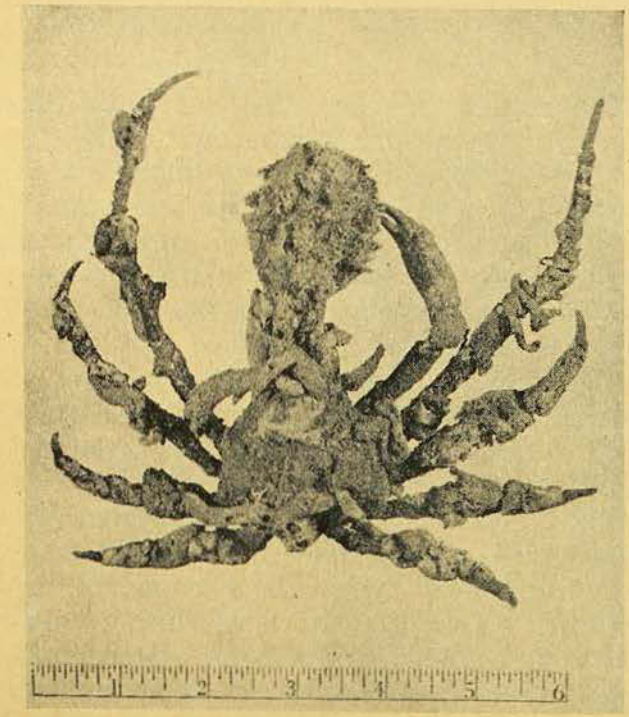
shell-lined retreats at a later date. They ultimately proved to belong to the genus *Bankia.*

These molluscs, inhabiting the inside parts of the pile, formed however, only a fraction of the creatures which make their homes on the piles. Most of the animals live attached, like the mussels, either to the outside surface of the pile or to one another. In the time available to us, it was almost impossible to make even a rough guess at the enormous numbers of each species clinging or fastened there. A glance at some of the accompanying illustrations will, however, help the reader to visualize the vast numbers of creatures we found. A giant skyscraper full of people would not house nearly as many inhabitants as one of these "skyscrapers" of the sea, with its basement below the mud-line and the rest extending, level by level, sixty feet up to the water surface and then ten feet into the air. Few, if any, of the species we found cared to live at all levels on the pile. Some preferred the "lower floors", near the mud-line, for here there would be less water movement, less light and the pressure would be 1½ to 2 times as great as in the upper parts of the pile, to mention only some of the more important conditions which affect the inhabitants.

The lowest region of the pile, extending for a distance of 15-20 feet from the mud-line upwards, housed, on the whole, a very different population from the regions above. To begin with, the mussels and sea tulips (*Boltenia*) so prominent on other parts of the pile, appeared hardly at all and the commoner animal types were the lace corals and sea mats (techni-



Cobra or Teredinine borers have eaten away so much inside-wood that the pile snapped as it was drawn. The jagged points at the end of the pile show the work of the borers.
Photo.—E. C. Pope.



The Spider Crab, Hyastenus diacanthus, decks itself out in a coat of many sponges by way of camouflage. So long as it remains stationary on the piling it is almost sure to escape detection.

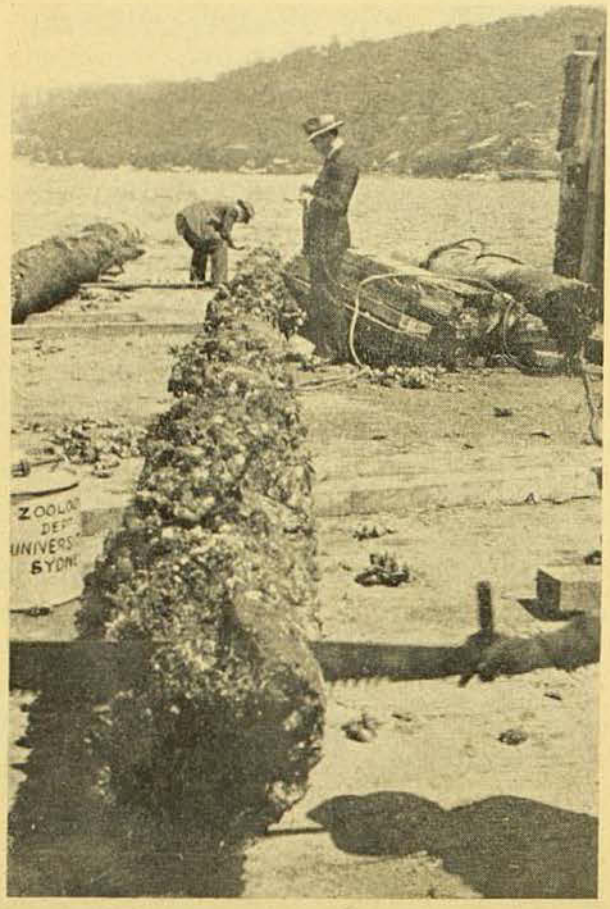
cally known as encrusting bryozoans), sponges, and sea-squirts or cunjevoi. The lace corals, sea mats and some of the ascidians were colonial kinds of creatures, where many individuals are joined together by a common flesh to make up the whole. In fact the colonial habit of life seemed to be the most popular one for this region of the pile. Some strongly individualistic animals, however, made their homes here. Numbered among these were the largish spider crabs belonging to the genus *Hyastenus*. These creatures deck themselves out in suits made of clumps of sponge and mud. This is by way of camouflage and is so effective that the crab is seen only when it moves, and the ordinarily sedentary sponge "walks" about. Smaller Sponge Crabs (*Dromidiopsis*) also indulge in similar dressing-up habits. Numerous specimens of the queerly flattened little crab of the genus *Halicarcinus* were also found and, along with them, the Smooth-handed Crab, *Heteropanope,* which so often carries that strange, sex-changing parasite (*Sacculina*) under its tail.

On the lowest region of the pile, numbers of small delicate brittle-stars (*Ophiactis resiliens*) were to be found, but it was most difficult to collect a complete individual, for the reason that they had thrown off parts of all or some, of their five arms, as is their usual custom when their living conditions are suddenly changed and become unfavourable, or when enemies attack them.

One of the acorn barnacles, *Balanus trigonus,* was also found on "the basement" area of the pile, but its shells were so often coated with thick mud, that they tended to be overlooked. While this particular species was the only barnacle found on the very lowest region of the pile, it was not absolutely confined to this area and numerous specimens could also be seen on the upper regions.

On the other hand, the most abundant acorn barnacle on the piles in this part of Port Jackson proved to be a close relative of the above called *Balanus*

White and yellow sponges, sea squirts (like Cunjevoi) and closely encrusting sea mats or Bryozoa (towards the right of the picture) clothe the lowest parts of the pile.
Photo.—E. C. Pope.



The lower sixty-five feet of the snapped pile shows the thick growth of mussels in the middle region. The remainder of the pile lies to the right of the stack of sleepers.
Photo.—E. C. Pope.

amphitrite. It was found from low water level down to a depth of fifty feet. Below this point it was rarely encountered, but above it, the whole of the pile was almost completely encrusted with its hard limy shells. Many of these barnacles, however, had long since ceased to house their builders who were smothered by later growths of sea-squirts (cunjevoi) and mussels which arrived to squat on top of the first settlers. And these late arrivals now appeared to be the dominant growths, having succeeded the barnacles to this title. Once having settled, the newcomers had soon made living conditions intolerable for the majority of the barnacles which proceeded to die off. In the long run, however, the barnacles often get their own back (even if it is a posthumous triumph) when their dead shells drop off the piles carrying with them the interlopers whose own weight, dragging on the dead barnacle-shells, literally is the cause of their own downfall.

The region of the piles carrying the heaviest marine growths was the middle section—from about ten to fifteen feet above the mud-line to a region about five to six feet below the high water mark. Here not a square inch of timber was to be seen—so tightly packed were the inhabitants.

As already indicated, there was a general undercoating of barnacles in this middle region, and on top of these in places grow clumps of the brilliant orange-coloured, long-stalked sea-tulips (*Boltenia*) which are relatives of the more orthodox types of sea-squirts or cunjevoi. Despite its somewhat plant-like shape, the Sea-Tulip is an animal which, like the nearby sponges, grows anchored to the pile for the whole of its adult life and sucks in currents of water from which it extracts food and oxygen for living purposes.

Another prominent type of growth in this part was the more orthodox-shaped sea-squirt and five distinct species could be recognized, once their coatings of mud were brushed off.

Crabs, worms and small snapping prawns and even small fish such as gudgeons wriggled and climbed about through the tangled mass of growth, while an occasional sea-urchin turned up to swell the numbers. In every one of the numerous lumps of the fern-like Bryozoan (*Bugula*) was a seething mass of strange skeleton shrimps (*Caprella*). These tiny creatures are from one-half to one inch long and grip the Bryozoans firmly with their short, curved back legs, their bodies swaying in the currents in the most grotesque manner. The movements of their front legs armed with enlarged chelate hands are reminiscent of a gymnasium scene where shadow boxing is in progress.

On some of the piles we examined, the middle region carried amazing quantities of the common black mussel, *Mytilus obscura*, as may be seen in the photograph of the pile lying on the deck of

the pontoon. Strangely enough not every pile carried a heavy growth of mussels. Two may be drawn which bear a heavy coating of these molluscs and a neighbouring pile may come up with very few growing on it—instead, one sees heavy incrustations of cunjevoi and sponges. To account for these differences, especially in cases where the piles concerned were put down at the same time, would take a long and tedious research. This we have not been able to do and so the reason must remain obscure for the present.

The upper region of the pile, extending from the water-line to a depth of ten to twelve feet, carried its own particular kinds of growth. Uppermost near low-water mark was a coating of fine green filamentous weed. Below this was a belt of calcareous worm tubes (*Galeolaria caespitosa*), called by the dock workers "Sydney Coral", and indeed its appearance is faintly reminiscent of the true corals of the tropics until one looks closely, and sees the small dark worms which inhabit the limy tubes. This belt was one foot to eighteen inches wide and merged below into an area where barnacles (*Balanus amphitrite*) reigned supreme. The barnacle-covered area may be several feet wide and merges, as a rule, gradually into the heavily coated middle area of the pile already described.

This account is, of course, only a brief preview of the animal community which lives on the piles of Sydney's harbour. One could make a lifetime study of it and write whole books upon the subject. One fact emerges plainly, however, even after so brief an examination as this. The kinds of animals which live on piling are similar in shape to those which live attached to the rocks and their habits and mode of life are much the same. They show little affinity with the communities of creatures which inhabit either the sandy beaches of our ocean coast or with the animals of the estuarine strands or the mud of mangrove swamps.

IT is with deep regret that we learn of another victim of the recent World War, Dr. Jirí Baum, formerly Honorary Assistant-Director of the National Museum, Prague, Czechoslovakia, and who died in a concentration camp in Warsaw early in 1944.

Dr. Baum, who was born on 20th September, 1900, became well known as a scientist, explorer and writer. It was as the first-named that the author of these lines met him at the Prague Museum in October, 1934. Then I learnt of his proposals to visit Australia the following year and travel from west Australia to east Australia by motor caravan, studying spiders in particular while *en route*. This trip he duly accomplished and, in 1938, appeared his little book *V rísi pavouku* ("World of Spiders"), a copy of which he sent to the Museum Library. In this he mentions many of our local spiders.

In the course of his career Dr. Baum "took part in ten different expeditions which took him to every quarter of the globe". The scientific material obtained on these expeditions was placed in the National Museum, Prague.

Between 1930-1938 he wrote some ten scientific papers, including one, "On the Habits of the Australian Spider *Dinopis subrufus* L. Koch", in a Czech scientific journal, *Věstník ceskoslovenské zoologické Společrosti v Praze* (= Memoirs of the Czechoslovakia Zoological Society of Prague), Vol. v, 1937, pp. 28-33, 4 pls. He also lectured at home and abroad to scientific and other audiences about his travels.

He was in Africa in 1939, but returned to his country to assist her in her struggle. He joined the underground movement, but was arrested by the Gestapo, 10th June, 1943.

To his wife, Ruzena Baum, who accompanied her husband to Australia in 1935, and who has furnished us with the sad details of her husband's death, we extend our sympathy.

A. MUSGRAVE.

Australian Insects. XXVII.

Coleoptera 4—Water Beetles

By KEITH C. McKEOWN, F.R.Z.S.

THE Water Beetles are so strikingly adapted to the needs of an under-water life that it may surprise many to learn that these insects are essentially terrestrial forms which for some reason, possibly the intense competition encountered in a life on dry land, where every avenue of life is thoroughly exploited, have adventured with considerable success into this watery world.

Although the larvae of some aquatic beetles developed gills as a means of securing oxygen dissolved in the water, many have to ascend to the surface from time to time to gain access to the free air above by pushing the tip of the tail into the air. The perfect beetles must always rise, at frequent intervals, to the surface to obtain the air necessary to them. If a water beetle, crawling over the mud or among water weeds, or swimming with leisurely strokes of its long hind legs, is watched carefully, it will be noticed that every now and then it releases its hold or rests upon its "oars" and, the body being lighter than water, rises, head-downwards, to the surface. As the tip of the wing-covers break the surface, they are raised slightly to allow the air to flow into the hair-lined cavity between the elytra and the upper surface of the abdomen. The whole operation is extremely rapid; then, with a deft stroke of the hind-legs, the insect descends again to resume its temporarily interrupted activities. In most insects, the spiracles—the openings to the air-tubes which form an intricate network throughout the interior of the body—are placed along the sides of the abdomen. In the water beetles they have shifted to the back, where they have unrestricted access to the air stored in the cavity. The illustration will make this clear. The water beetle's method of carrying its supply of air is simple but ingenious.

Abdomen of Dytiscid beetle seen from above, showing hair-covered dorsal surface and position of spiracles. Elytra and right wing have been removed.
After Miall.

Should it be necessary, owing to the drying-up of the waterhole in which it lives, or for some other reason, the perfect beetle unfolds its flying-wings from under the protective elytra, and takes flight to another pond. Another evidence of their incomplete adaptation to water-life is their habit of pupating on land.

Other adaptations to its mode of life, which are at once apparent, are its smooth, streamlined form, and the modification of the long hind legs into efficient oars to propel it through the water. These legs are densely fringed with long, stiff hairs, and these, when the limb is drawn forward, fall back and so offer but little resistance to the water; but, when the legs are forced strongly backwards, the hairs stand stiffly erect, and so increase the area of resistance to the water. So, with each stroke, the insect is driven rapidly forward. Other

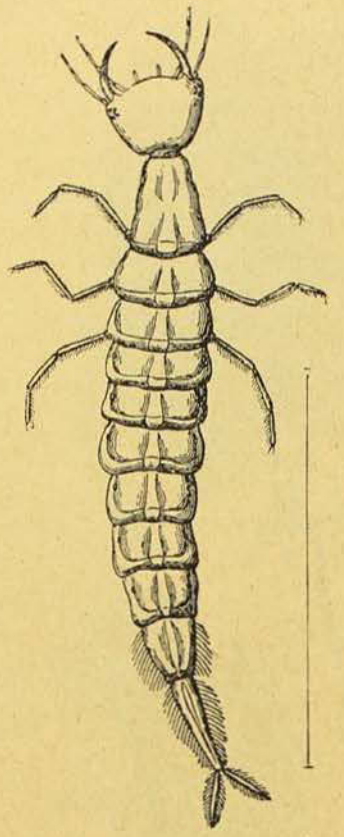
adaptations will be mentioned in dealing with members of the various groups, when it will be seen that the above general account, while true for the majority, does not hold in entirety for all.

In the present article of this series three families of aquatic beetles are dealt with; the Hygrobiidae (sometimes called the Pelobiidae), the Haliplidae, and the Dytiscidae. Of the first two families we know extremely little, and as their species are very small insects, they receive but little attention from the general observer. Their Australian representatives are few, only two species of the former, and five of the latter having been described.

One genus only—*Hygrobia*, from which the family gets its name—is included in the family Hygrobiidae. The perfect insects are but slightly modified for an aquatic life, although the hind-legs are formed for swimming. Nothing is known concerning the life-histories of the Australian species, and details of but one of those occurring elsewhere have been recorded; this is *Hygrobia hermani*, a European insect. The adults of this are found in the mud at the bottom of ponds. The eggs are laid in rows upon the stems of aquatic plants. The larvae feed upon worms or the immature stages of insects weaker and less active than themselves. When fully fed, the larva pupates in a cell formed in the soil.

Of the Haliplidae even less is known. The larvae have the mandibles grooved for sucking, so we may assume with reasonable certainty that they live upon the body-fluids of smaller insect-life. The whole of the body of the larva is studded with fleshy processes. *Haliplus* is the only genus represented in Australia. Since these insects are so small, and their habits so obscure, there seems no good reason for giving details of their structure here as these may be found in the text-books.

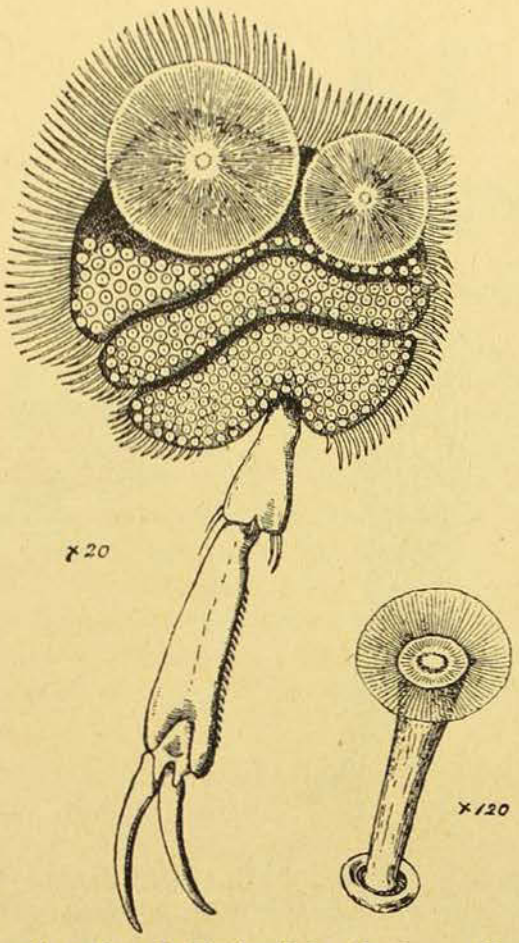
The Dytiscidae are "Water Beetles" in the truest sense. They are a large family, and nearly two-hundred species have been described from Australia, ranging in size from very small forms to beetles more



A typical Dytiscid larva. Note the slender, curved mandibles with which the prey is seized and pierced. After Miall.

than an inch in length. The illustrations will give a far better idea of their appearance than a mass of dry descriptive detail. The insects comprising this family seem to be wholly predaceous in both the larval and adult stages, their food consisting of practically all forms of aquatic life. Some of the larger species have been recorded as preying upon small fish, tadpoles and frogs. In feeding, the beetles bite off small portions of the victim and swallow them bit by bit. The larvae, in contrast, take only liquid food, the body-fluids of their prey, by means of a narrow channel extending from the tip to the base on the inner margin of each slender, curved mandible. The larvae, too, inject a digestive secretion into the body of the host, which assists in liquefying the tissues.

The larvae—as shown in the illustration—are active, slender, and large-headed. They are popularly known as "Water Tigers", a very fitting name, for they prove themselves to be veritable tigers to the small aquatic life in the water-weed jungles in which they lurk. They will attack and kill creatures

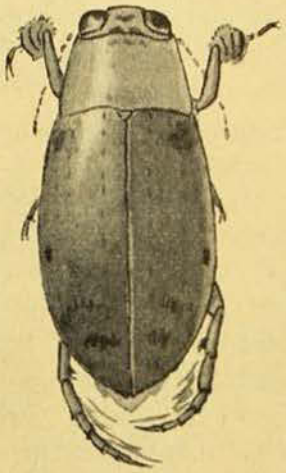


Fore-leg of male Dytiscid beetle (magnified) showing clasping organ. Below: one of the small cups greatly enlarged.
After Miall.

several times larger than themselves. When the larva is fully fed it leaves the water, and pupates in a somewhat rounded or oval cell in mud, soil or under stones.

The eggs are, as a rule, deposited in slits cut in the tissue of the leaves and stems of aquatic plants by the specialized ovipositor of the female, but there is no uniformity in the habit, for, in some species, the eggs may be laid in masses in the mud or deposited singly upon the surface of floating leaves. The life-history, usually, occupies about twelve months subject, of course, to variation in the temperature of the water and other factors, as the abundance or scarcity of food, etc. The life of the adult insect may be several years.

The males in the genera *Eretes* and *Cybister* bear a remarkable sucker-like modification of the feet—or tarsi—of the forelegs. This expansion of the tarsus bears a dense brush of hair-like structures which, at two points, form crater or cup-like areas (see illustration). These adhesive structures are used by the male to hold the smooth, slippery body of the female when pairing. Their effectiveness is demonstrated by the fact that it is not unusual to capture female Dytiscids to which the adhesive "claspers", torn from the limbs of the male, are still firmly adhering.



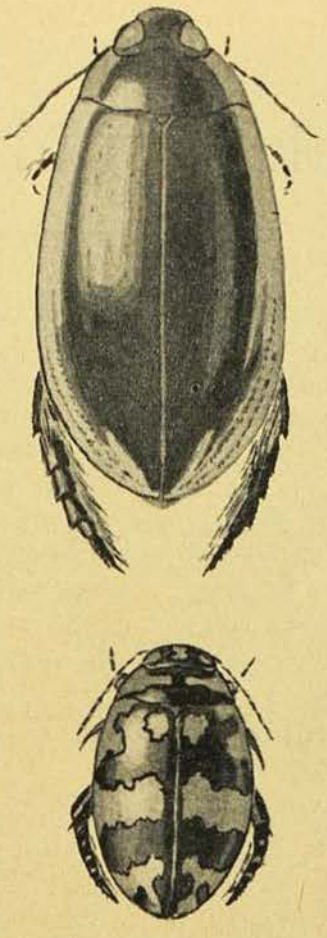
Eretes australis, male. A small but widely distributed water beetle.
N. B. Adams del.

Possibly the commonest of the Australian Dytiscidae is *Eretes australis* Er. (illustrated), a rather narrow, yellowish-olive species with a somewhat mottled appearance, which abounds in streams and waterholes throughout Australia. It is by no means unusual to find this insect making mass migratory flights in search of new homes, a habit to which reference has already been made. Mr. H. M. Hale, Director of the South Australian Museum, has recorded, in the *South Australian Naturalist*, details of two such flights supplied him by Mr. F. W. Shepherd, of Broken Hill. In the first of these (vol. vi, 3 May, 1925, p. 43) Mr. Shepherd writes: "On Thursday, 30th of April, 1925, about 9 o'clock in the evening, a friend of mine was attracted by a noise as if heavy rain or hail were falling on the roof of his house; it being a bright moonlight night he went outside to investigate and found, as he said, countless thousands of the above beetles [*Eretes australis* Er.] swarming

on his roof and filling up the water-spouting all round the house. He became alarmed and called on me to see if the pests were harmful; of course I allayed his fears on that score, and told him how these insects flew out of the water at night time and went looking for fresh watery homes, and that evidently they had mistaken his roof for a pool of clear water. The reason I came to that conclusion was that the gentleman had just had a new iron roof placed on his house, and it shone in the moonlight like a lake of water." In a subsequent account (ix, 3 May, 1928, p. 55), Mr. Shepherd wrote: "Some years ago I wrote to you about water-beetles migrating and covering a new iron roof in the moonlight. Since then until a few days ago there has been no movement of these beetles *en masse* on account of several years drought. Since the March rains nearly all the dams and water-holes have filled, and on April 1st and 2nd these beetles have passed over this city [Broken Hill] in countless thousands and many attracted by reflected moonlight, alighted on the shining black roads, and hundreds of thousands, attracted by the city lights, swarmed on windows and footpaths."

Another common species, and one of our finest, is *Cybister tripunctatus* Ol. (see illustration), a large insect, more than an inch in length, smooth and of regularly oval form; its colour is deep olive-green with a broad border of yellow around the outer margins of the elytra and extending along the sides of the prothorax. Its range extends over the whole of the continent. It is often attracted by the meat bait in nets used by small boys in fishing for fresh-water crayfish or "Yabbies". *C. godeffroyi* When., from Queensland, is larger—about an inch and a quarter in length—broadening considerably towards the posterior. In colour it is similar to the preceding species.

Sandracottus bakewelli Clark, from northern New South Wales and Queensland, is outstanding in this group in that the prothorax and elytra are blotched



Top: Cybister tripunctatus. Bottom: Sandracottus bakewelli.
N. B. Adams del.

with bright yellow. It is stoutly built and measures about half an inch in length. The illustration well shows its striking appearance. *S. guttatus*, Sharp, found in South Australia, has smaller yellow spots. *Hydaticus vittatus* Fabr., from New South Wales, Queensland, and the Northern Territory, has the black elytra ornamented with two yellow stripes, one long and one short.

Hyderodes shuckardi Hope, extending from Victoria to Tasmania, is a thick-set, blackish beetle, and remarkable in the fact that the elytra of the male are smooth, while those of the female are rough and coarsely shagreened.

Any attempt to discuss the small forms here would be of but little value, since in general appearance, they are very similar and their characters distinguishable and of importance only to specialists.

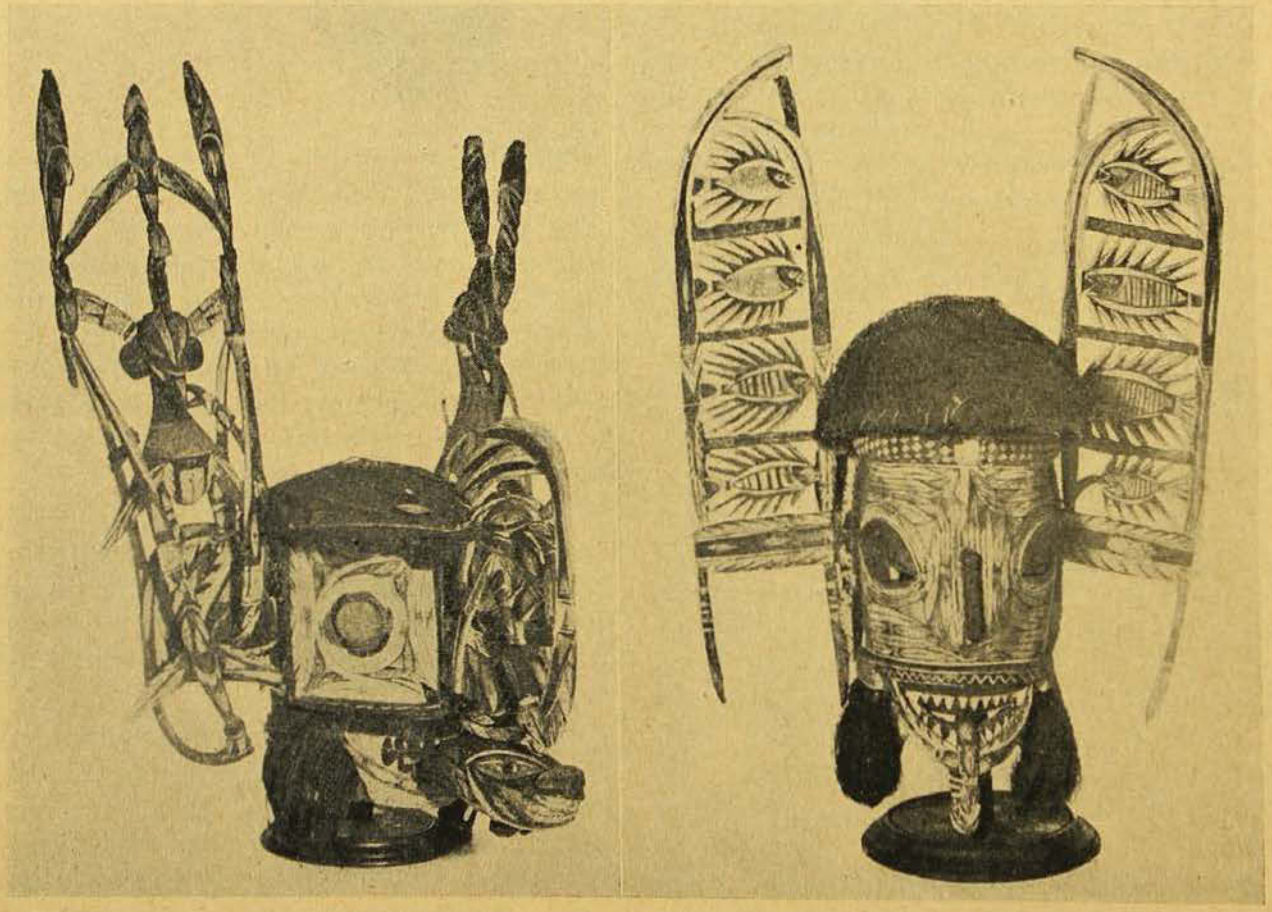
Practically no detailed information is available on the life-history of any Australian species.

The Malangan Masks of New Ireland*

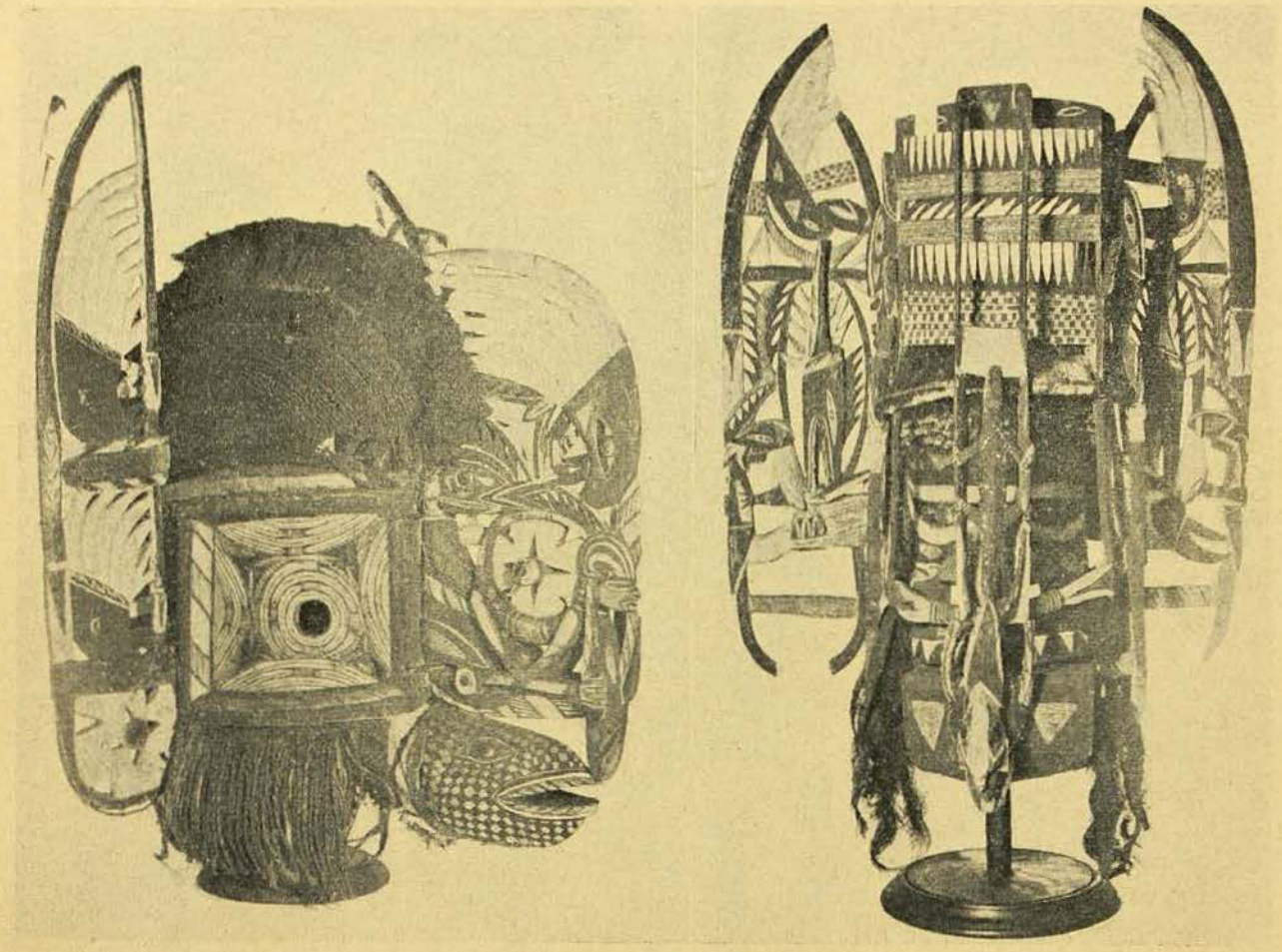
By FREDERICK D. McCARTHY

AS children we all enjoyed wearing a mask to conceal our identity or perhaps to assume another personality on Guy Fawkes Day. The Melanesian natives also enjoy wearing a false face, sometimes in dances which are humorous or entertaining, but chiefly in ceremonies which have a ritual significance. Masks are, in fact, a prominent and integral feature of many sacred rites throughout New Guinea and Melanesia. They are worn by a man who represents a spirit, perhaps of a totemic clan or a dead ancestor, visiting its living relatives, or he may represent a demon or beneficent spirit who by this means visits a village. Some of the masked dancers enact incidents in the life of a culture-hero to whom is attributed the creation of the community and of its customs. The masked dancers of all kinds, it is interesting to note, are always men and in many Melanesian communities all powerful male secret societies impose their will

* See also "The Art of Malangan in New Ireland", AUSTRALIAN MUSEUM MAGAZINE, Vol. viii, No. 11, 1945.



On the ears of the mask on the left are birds, flying-fish and snakes in complex designs whilst a flying-fish protrudes from the mouth. A simple but effective series of fish decorate the ear panels of the mask on the right, on which a bird is attached to the bottom lip.

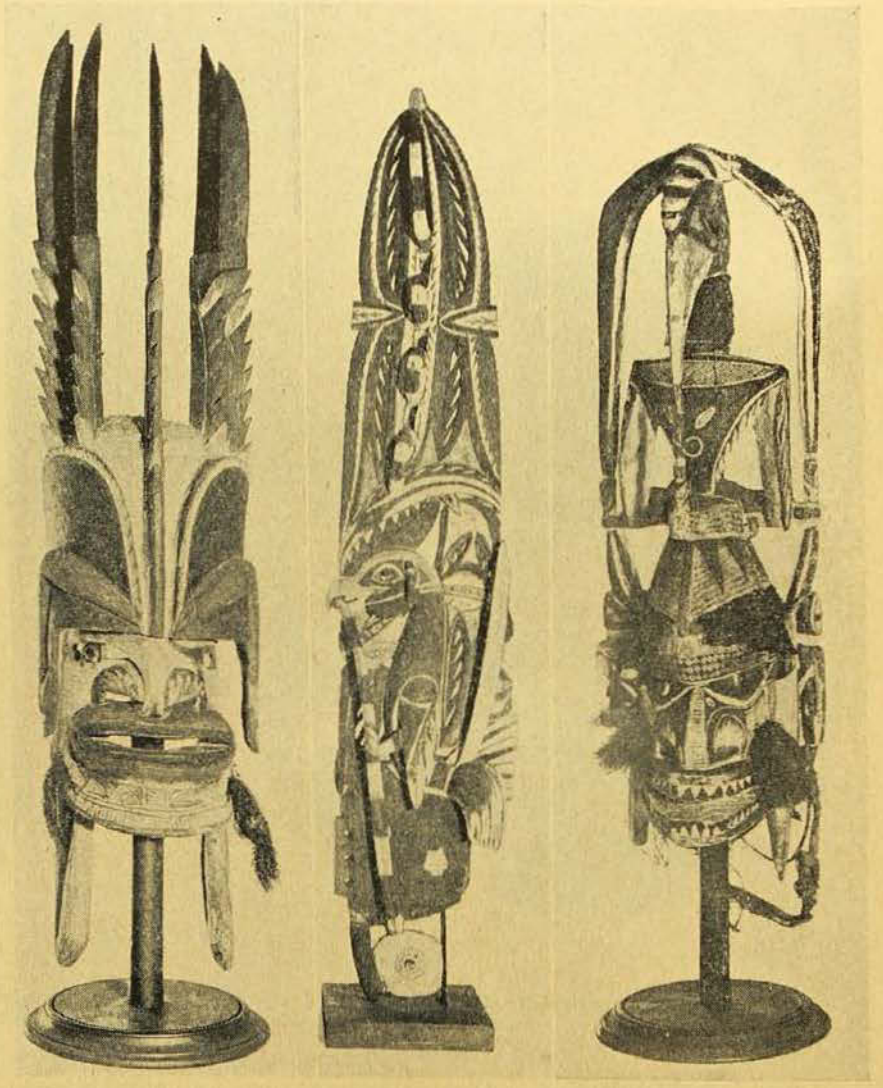


Two elaborate masks of the enlarged ear type in which bird, fish, lizard and snake motives are embodied in complex patterns.

upon the community for the purpose of acquiring prestige and wealth and, in some cases, of punishing law-breakers by invoking spiritual sanction and supernatural awe. Melanesian masks vary greatly in type, but in some parts of New Guinea are to be seen striking compositions of brightly painted bark-cloth or of beautiful feathers on a cane frame up to eighteen feet long. The oval type of Awar, the naturalistic forms of the Papuan Gulf and the feathered kind of Port Moresby are among the most magnificent of New Guinea masks.

The Malangan communities of the Gardner Islands and adjacent New Ireland coast use masks during certain stages of these rites, particularly at the display of the unpainted Malangan carvings during the final ceremonies, and when the initiation of youths forms part of the rites. The Malangan masks are not big ones, but they are very skilfully designed and strikingly coloured portrayals of a human head carved out of one piece of wood in the same manner as the Malangan slabs and posts.

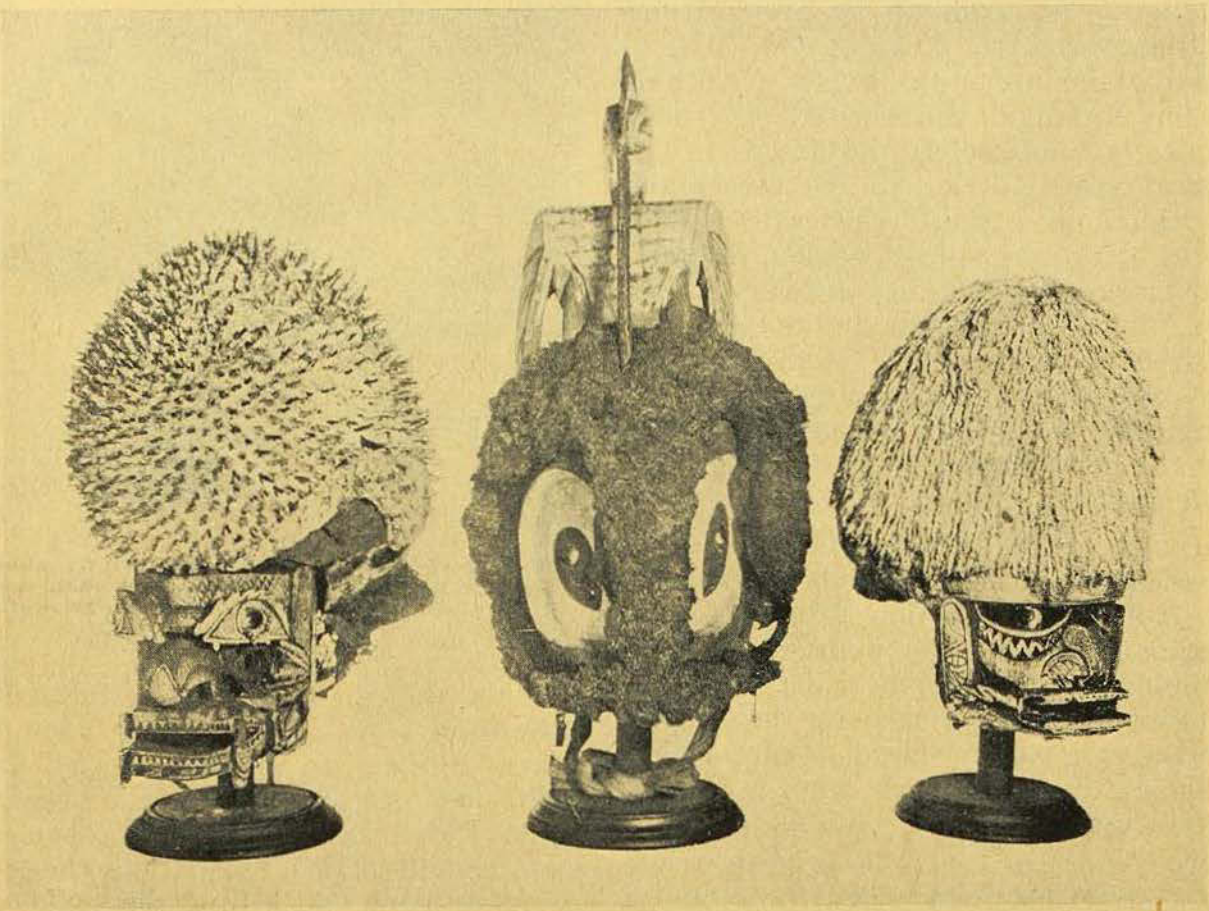
There are two kinds, one of which has enlarged ears which are attached to the side of the head. Bird and fish totems are incorporated in these masks and it is probable that specific mask compositions belong to a particular Malangan design and are used only in its ceremonies. Thus each mask represents a dead relative or ancestor and the dancer wearing one is paid for his services. From the artistic point of view, it is of great interest to consider the composition of these masks. The fierce and hideous expression is noteable and is achieved by the use of strongly marked lines and contrasting colour-



The mask on the left is unusual owing to its lack of an animal motive. On the head of the mask on the right a hornbill is seated, and in the middle is shown an enlarged ear panel displaying a bird and snake design.

patterns. The features, however, are portrayed in a variety of ways. The eye, for example, is commonly shown as a Turbo-shell operculum set in a hollow crescent, but it may be a circular hole surrounded by concentric circles in red and white; it might also have projecting lips or be shown as a cylinder of wood. The mouth is usually an open crescent, with the teeth prominently shown on a rounded or squared jaw. The hair is represented by fibre, grass or pith. In one variety of this type of mask the face is carved behind a screen of vertical and curved ribs in the form of snakes, fish and birds. Another variety has an open-work panel projecting from the middle of the face from forehead to chin and within it is carved a complicated pattern of totemic animals. In both kinds a large open-winged bird may be postured as though climbing up from below the chin. The simplest of these masks show totem animals on the ears, with perhaps a snake or fish in the mouth.

The ears, however, proved to be the pièce-de-resistance to the carvers. They are enlarged panels from twenty to thirty-six inches long and from five to seven inches wide, and thus provide an admirable surface for the designs. The distended and perforated lobe of the ear is frequently shown and sometimes within it is carved a star-like kap-kap ornament. Above are carved in an open-work style a vertical snake, one or more eagles, or perhaps a tier of four or five fish; on some panels several kinds of birds are



Three helmet-shaped masks with normal ears. The mouth and nose project well forward, snakes form a zigzag across the cheeks of one mask and a bird clings to each corner of the mouth of the other one. The middle example is an owl-mask.

combined in a complicated pattern. One has a snake at the top and another one at the bottom holding the foot of a standing bird. Fish and snakes form the outer bands of the ear panels. There are many other interesting compositions of totemic animals and secondary decorative motives, and sometimes the latter are used entirely.

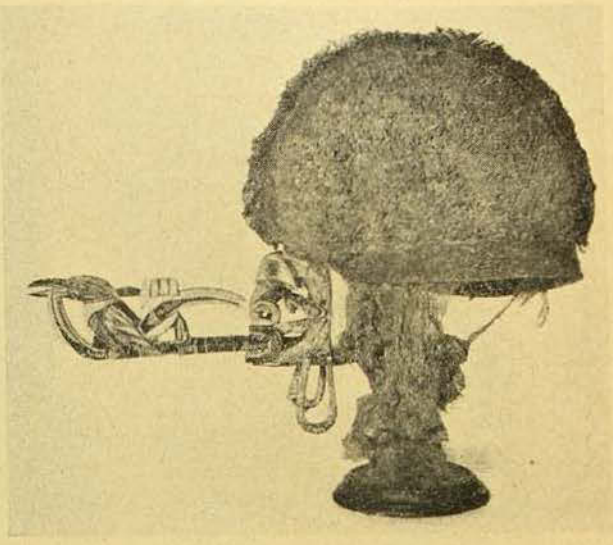
The other type of mask has normal ears and is helmet-shaped. It is used in dances by the men, but appears to have no sacred significance apart from displaying the totems of the dancer. These masks are discarded after the dance, which represents the men wooing the women, and are made of wood. The face is similar to that of the larger ear-masks, but the coiffure is elaborate and represents that of a mourner in which the sides of the head are shaved and painted white with lime and a long median crest of hair is left, extending from the forehead to the nape of the neck. This crest is stained yellow with burnt lime. On other examples the hair is shown all over the head as short stems of pith or twigs, or perhaps by grass-fibres covering the head in the natural manner of hair. The perforated ear-lobes hang well below the lower jaw. The most notable animal motive on these masks is the snake which may extend from the inner corner of the eye, across the hollow cheek to the top of the ear, with another one crossing it from the eye to the lower jaw. On some, a single snake joins the ear and the mouth with a pair of tiny birds across the lips. Two have a projecting tongue in the form of a bird.

The masks are made by the men in their club-house which is taboo to the women. As soon as they are finished the men begin rehearsals of the dances and, as the day approaches for the beginning of the

Malangan rites, the whole time of the community is taken up by preparations and the assembling of great quantities of food for the numerous feasts. Nothing else but Malangan is discussed, everybody is wholly and solely absorbed in its magical spell. Prior to the ceremonies the men hold a final rehearsal of their dances before the village women, to flaunt their masks of which they are very proud. At a big Malangan, an audience of five hundred or more people is present, the men and boys being seated near the village club-house, the women and girls view the performance from the other side of the dancing ground.

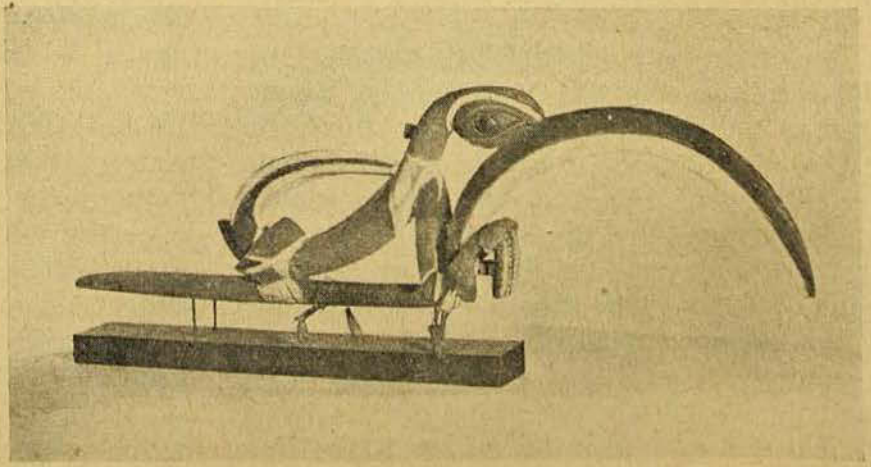
In one of the masked ceremonies, a procession of six men proceeds at a solemn gait from the cremation ground to the village and return; they wear shell rattles on their arms and wrists and peer round as though seeking someone; they represent the spirit of the dead paying a visit to their living relatives who wail and mourn again for their dead ancestors.

Miss Powdermaker (*Life in Lesu*, 1933) said that the men of Lesu village in one dance painted their bodies red, to conceal their identity, and wore a grass or leaf petticoat in addition to a mask. As each dancer entered the arena, an old man blew some powdered lime from his hand in front of the dancer to make him dance his best. The dance consisted of a circle and line performance of a very strenuous nature in which only the young and strongest men participated. A variation



A helmet-shaped mask, side view, showing the perforated ear-lobes, the open-work nature of the carved face, and a bird motive on the tongue.

of this dance was also performed by groups of fourteen or fifteen men from other villages. In another masked dance eight men sit in a line, to represent a snake which wants to eat the other eight men, and the dance dramatizes the latter group fighting and killing the snake with their spears. Then, in a love dance, a line of masked men pursue a line of women and the couples embrace at the end of the dance amid the laughter of the audience. Owl-masks are worn in one dance and the entire body of the performers is covered with leaves; they form two lines, one to represent ghosts and the other living men, and enact a sacred dance-drama.



This beautifully designed tongue from a helmet-mask is the work of a gifted carver. It represents a lizard standing on a mantis, but the significance of the crescent is not known.

Ceremonies of this nature form an impressive spectacle, consisting as they do of an intensely interesting composition of colour, movement and music. To the dancer himself, the performance is a serious and exalted experience; when he dons a mask he becomes a medium between the living and the dead, a bridge between the known and unknown. Thus the masked dance-dramas of the primitive Melanesians, sanctioned by religious and social bonds, are in no way to be compared with the imitative function of masks in our own culture where they are worn principally to represent a character in a play.

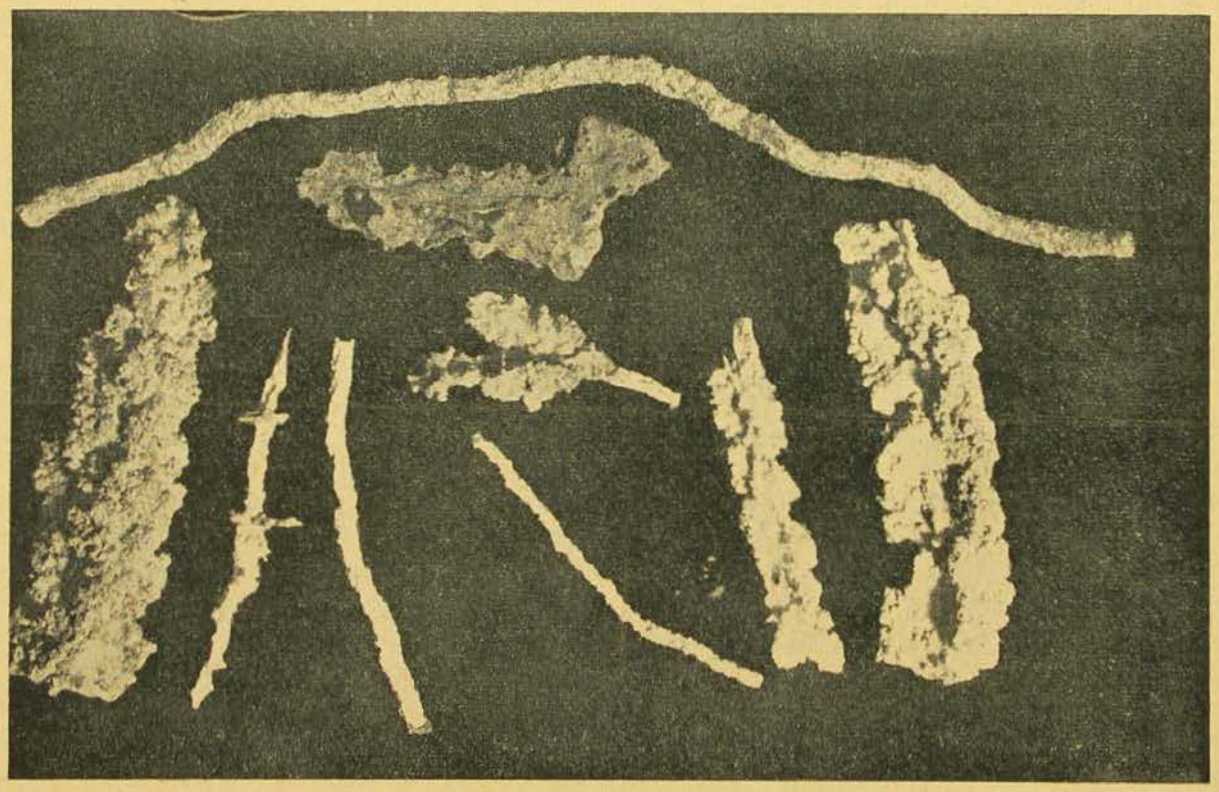
The Australian Museum possesses a magnificent collection of Malangan masks, the majority of which were acquired from Captain Farrell between 1883 and 1892.

Lightning, Meteorites and the Atomic Bomb

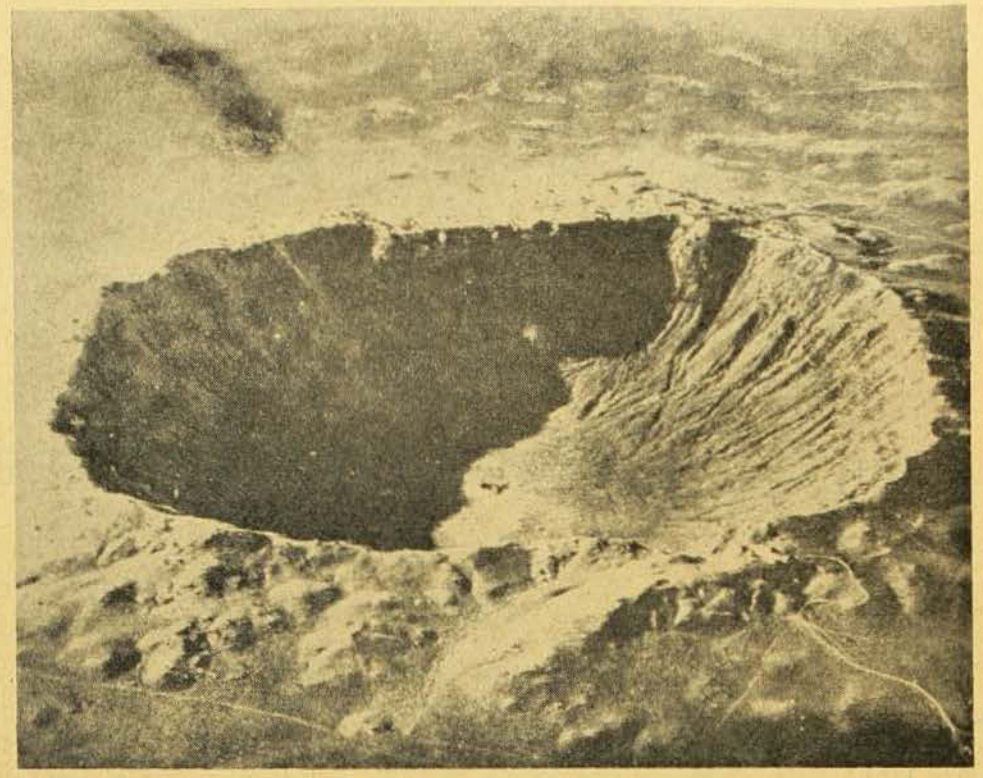
By R. O. CHALMERS

ONE of the striking effects of the discharge of lightning at the earth's surface, and of the impact of very large iron meteorites on the earth is that great heat is generated. This heat is sufficient to fuse the material of the earth's crust.

In sand dunes at times there are found curious elongated tubular masses of an opaque or semi-translucent white material. The surface of these objects is usually irregular and pitting may occur. In certain areas of U.S.A. they have reached the surprising length of sixty



Australian fulgurites. The top one and the one immediately beneath it are from sand dunes at Bondi. The one on the extreme left and the one on the extreme right are from sand hills at Kensington. The rest are from sand dunes at Port Macquarie. The length of the top one is eleven inches.



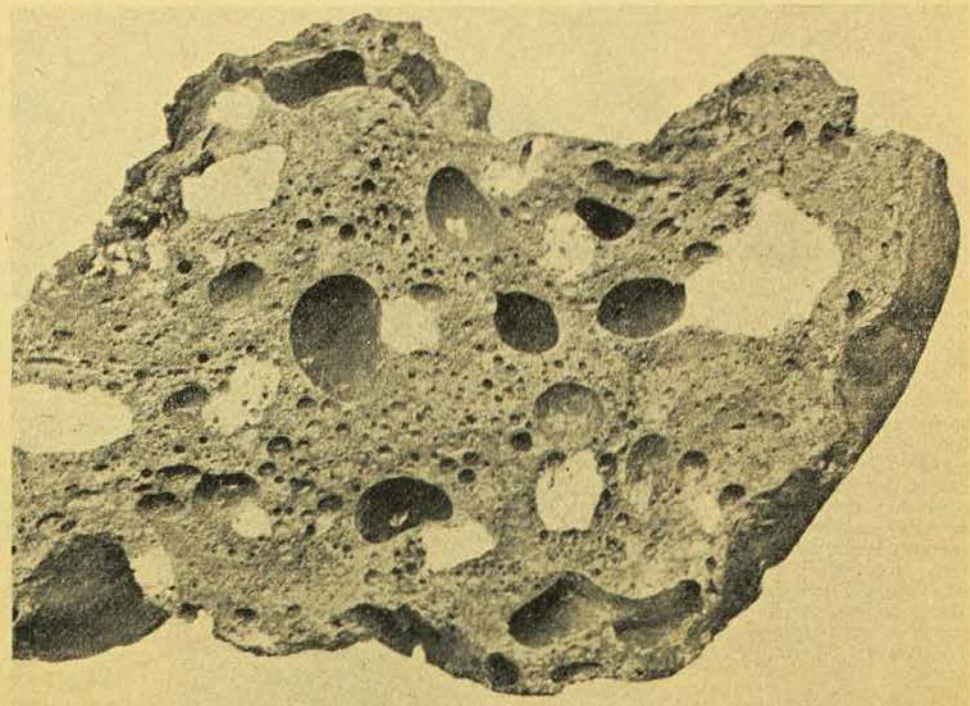
The Arizona crater. It is situated in the desert of north central Arizona. Note the outer slope of the rim which rises 160 feet above the desert plain. The building in the centre of the crater was erected by a company which carried out extensive drilling operations in a vain attempt to locate the main mass of the meteorite.

feet, while twenty to thirty feet lengths are common. This material though hard is also brittle so that an attempt to remove them from their position in the dune usually results in their breaking. These are fulgurites and are formed by lightning, striking the earth, generating heat, and thus fusing the sand to form silica glass. Sand consists mainly of small grains of crystalline silica which melts or fuses at a temperature of 1,700° C. The grains of crystalline silica in the immediate vicinity of the lightning flash are raised to this high temperature, fused, and then the whole object cools so rapidly that it returns to a non-crystalline or amorphous state, that is, it becomes a glass. Fulgurites are branched at times, because the lightning flash sometimes branches in passing through the sand. Fulgurites are found exclusively in sandy areas such as dunes, probably because sand drains easily and is usually fairly dry. Therefore it is mostly a good non-conductor of electricity.

Here and there on the Earth's surface are crater-like depressions the origin of which at times has been difficult to explain. Four of these examples are now known to have been caused by the impact of single large iron meteorites or showers of large iron meteorites. The Arizona meteorite crater is a single one, approximately circular in outline with a diameter of three-quarters of a mile and a depth of 570 feet. On Henbury cattle station, 50 miles south of the MacDonnell Ranges in Central Australia, within an area of half a mile are found thirteen meteorite craters. The largest one is oval in outline measuring some 600 by 300 feet across and 60 feet deep. At Wabar in the Arabian desert two distinct craters have been discovered, the larger one approximately circular, with a diameter of 300 feet and a depth of 40 feet.

Scattered on the outer slope of these craters, and for some distance further out as well, are found masses of meteoric iron. These are particularly plentiful at Henbury, where outside the crater walls some 800 fragments have been recorded. These range in weight from 300 lb down to a few grams. Many of the smaller pieces have been twisted and bent by some tremendous force.

The Wabar craters are more noted for the presence of plentiful amounts of

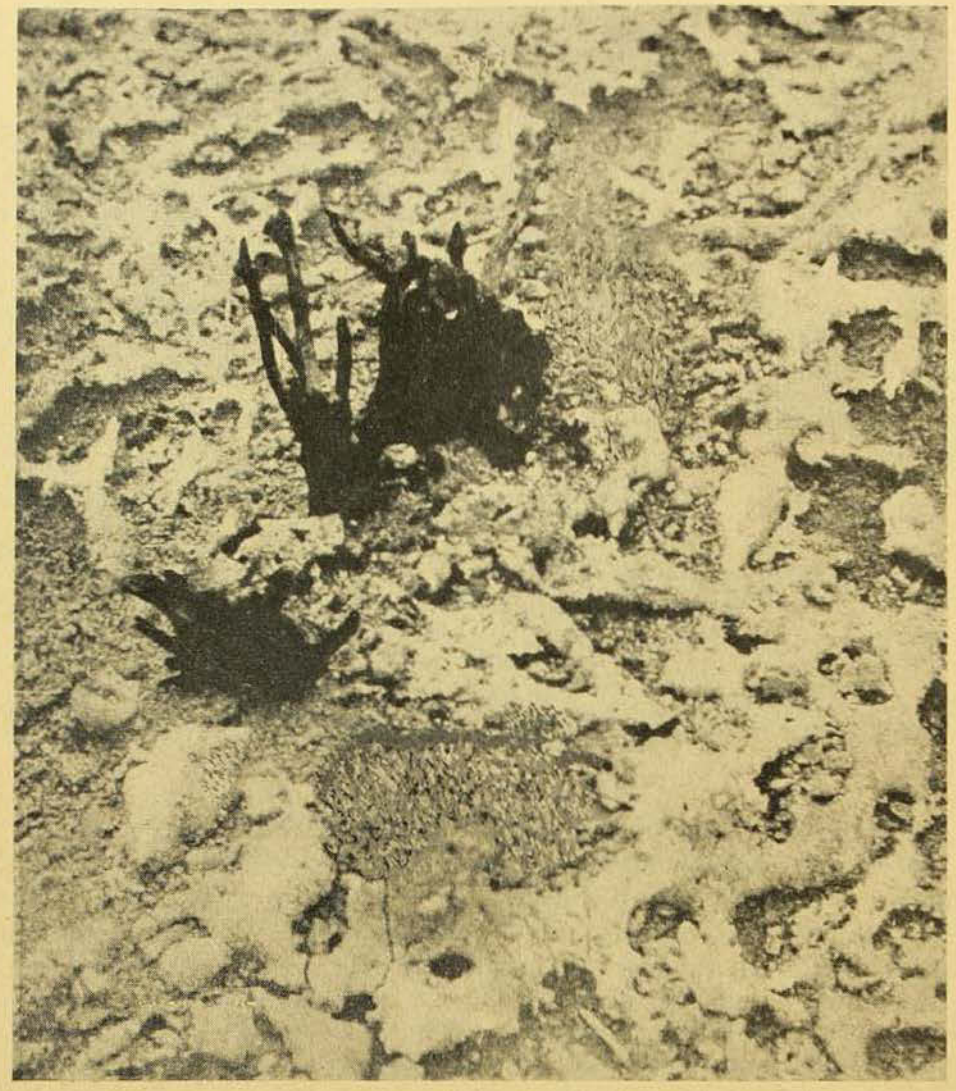


Silica glass from Wabar. Broken surface of a bomb showing angular fragments of white glass with small bubbles embedded in grey and blue glass with large bubbles.

silica glass. The outer slope of the craters are thickly strewn with cindery masses of this glass, and indeed, the crater rims themselves mainly consist of this material. Many of the individual masses are bombs, spherical, or drop-shaped and extremely cellular in structure. Some of the larger bombs show ropy surface structures indicating distinct flowage of the material when it was in a liquid state. One of the main reasons for such a unique occurrence is that the Wabar meteorites fell on clean desert sand. Around the largest Henbury crater a more impure silica glass is found, not in the same perfection and abundance as at Wabar, but nevertheless similar cellular and ropy structures, and bomb-shaped masses are found. The country rock is an impure sandstone and not a pure desert sand as at Wabar.

The circumstances in Arizona must have been somewhat different, because sandstones in the neighbourhood of the crater are only sintered and do not show the effects of complete fusion as at Wabar and Henbury.

The heat generated by the impact of these large meteorites gave rise to exceedingly high temperatures. The evidence of the craters, the iron meteorites, and the silica glass has enabled Dr. L. J. Spencer, formerly Mineralogist at the British Museum, to piece together an impressive sequence of events as follows: As a large meteorite approaches the earth travelling with planetary velocity, in front of it there develops a cushion of highly compressed air at a very high temperature. When the mass stops suddenly, due to impact with the earth's surface, the kinetic energy which it possessed by virtue of the fact that it was in motion, is transformed into heat with the development of a temperature high enough not only to fuse but actually to vaporize the rocks in the vicinity and part, perhaps the greater part, of the meteorite itself. Dr. Spencer envisages a pool of boiling silica into which drizzled millions of tiny drops of molten iron and nickel, condensed from the vapours of these metals. The cellular structure of the silica glass bombs indicates that boiling took place and the drops of molten iron and nickel are now found as tiny metallic spheres scattered within the



Close up of the surface of the crater in the New Mexico desert formed by intense downward pressure resulting from the explosion of the first atomic bomb. Note the abundant silica glass and the charred remains of a desert plant.

glass. At the time of impact this sudden formation of highly heated silica, iron and nickel vapour, together with large quantities of steam from the moisture contained in the rocks, was sufficient to cause a very large explosion which formed the crater, shattered what solid parts of the meteorite remained, and hurled meteorite fragments and innumerable splashes of boiling silica, iron and nickel right outside the crater itself.

Just what temperatures were attained during these happenings is difficult to estimate. At normal atmospheric pressure the boiling point of iron is 3,200° C., of nickel, 3,377° C., and of silica 3,500° C. As the pressure increases, so these boiling points increase, and since the pressures at the time of impact must have been of a high order, so the temperature must have been far in excess of 3,500° C. For comparison, the temperature in the vicinity of the observation points of a blast-furnace is only about 1,200° C.

These craters therefore are not merely dents in the ground made by the percussion of a meteorite. They are true explosion craters, and at the time of Dr. Spencer's investigation the only comparable man-made craters were those formed by military mines and high explosive shells in the 1914-1918 War, as at Hill 60, near Ypres in Belgium.

To-day if an observer in an aeroplane were to fly over the deserts of New Mexico, near the foot of a mountain called Sierra Oscura he would notice a curious reflection of greenish light from a circular area

some 2,400 feet in diameter, especially in the rays of the setting sun. In the middle of this greenish splash of light he would note a shallow sloping crater some 300 feet across and 25 feet deep. This is the crater made by the explosion of the first atomic bomb in July, 1945, which was detonated on top of a tower 100 feet high. Dr. Clyde Fisher of the American Museum of Natural History considers it to be a pressure dent rather than an explosion crater. The greenish light is caused by reflections from the great circular splash of sea-green silica glass that surrounds the crater to an extent of about one-quarter of a mile on all sides. This glass, of course, was formed by fusion of the desert sand due to the heat liberated by the atomic explosion. As in the case of meteorite explosions, it is difficult to speak of exact temperatures, but we do know that the temperatures associated with the liberation of atomic energy approach solar temperatures in magnitude, that is in the order of millions of degrees centigrade.

The first impressions one receives from photographs is that the whole of the surface area of sand affected was fused instantaneously, and then ran together before solidification. Closer examination shows numerous single fragments which may be silica bombs like those found at Wabar and Henbury, suggesting vaporization of the silica. If vaporization occurred, the present unique structure of the glass may have been formed by the constant rain of drops of molten silica condensing from the enveloping atmosphere of silica vapor, and falling back on the surface of the desert, flattening out, and then solidifying.

No actual specimens of the glass have reached Australia yet, to my knowledge, and one cannot speculate from photographic evidence, but such tremendous temperature suggests that evidence of actual vaporization and boiling of the silica will be shown on examination of the glass.

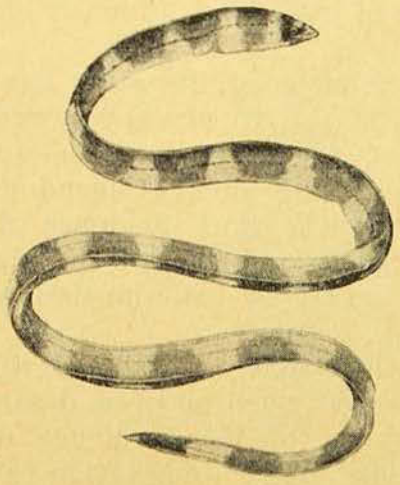
In a photograph here reproduced the presence of charred remains of a desert plant in the midst of this evidence of violent and instantaneous destruction can hardly be believed. Perhaps after sudden charring of the woody material further combustion was rendered impossible by the presence of an atmosphere of vaporized silica. This is the merest speculation admittedly, and an examination of this unique man-made phenomenon is awaited with interest as a means of throwing some further light on the mechanics of the liberation of atomic energy.

Certain other natural glasses of restricted geographical distribution are known. These are the tektites and although Australian geologists believe them to be of straight out meteoric origin, geologists elsewhere by no means unanimously accept this view. For further information on tektites the reader is referred to a previous issue of this magazine.[1]

[1] Hodge-Smith, T.: Tektites, AUST. MUS. MAG., v, 1933-35, 225-227.

Mr. Allen A. Strom, A.S.T.C., has been appointed Education Officer of the Australian Museum. Reference to the duties of this officer is made on page 39.

Mr. F. D. McCarthy, anthropologist, at the invitation of Mr. R. Lindsay Black, accompanied him and his son Langdon on a collecting trip to western New South Wales. From a number of old campsitessites on Tarella, Yancannia, Wangalilli, Bundra, Purnanga, Glendara, and Tongo stations in the north-western part of the State, and at Lakes Olepoloka and Peery on the Paroo River, more than two thousand five hundred implements were gathered. These have enriched the Museum's collections considerably, for these sites were previously unrepresented.



Snake Eels which mimic one another. Left, the Culverin (Stethopterus).

Australian Marine Eels

By

GILBERT WHITLEY

Right, the Harlequin (Chlevastes). After D. S. Jordan.

EELS, a certain humorous gramophone record assures us, are very funny fishes, and there are freshwater eels, saltwater eels and conger eels, the latter being "whoppers". The comedian's classification (it may be remarked without sardonic inference) agrees very well with modern scientific classification. Almost all fishes which have a long, snake-like body and no ventral fins have been classed as "eels", so that a large and incongrous assortment so that a large and incongruous assortment has resulted. The celebrated "Electric Eel" of South America is not an eel at all but an entirely different kind of fish.

The freshwater eels and their "glass eel" larvae have already been dealt with in this magazine.[1] So in this article only our marine ones (of which there are seventy odd) will be considered.

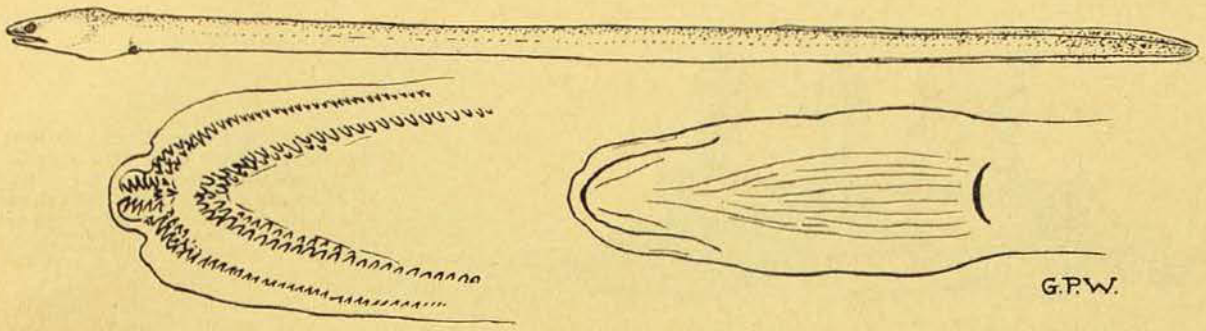
Once regarded as primitive, but now considered as degraded types, the Rice Field Eels have the gills opening into a single slit or pouch. In some the fins and even the gill-filaments are rudimentary, when accessory sacks and bloodvessels enable them to gulp air into the gill-cavity and breathe it direct. They inhabit fresh and brackish water, especially in paddy fields, canals and ditches of the Orient. *Synbranchus* is known from N.W. Australia, but I suspect that *Amphipnous* and *Fluta* may have been introduced by Chinese for food many years ago and are not native to Australia. Rice Field Eels can live a long time out of water, and bury themselves in the mud during drought. Some protrude the tail from the mud and move tail first; this was regarded by Dr. Herre as a protective device, since an enemy might seize the wriggling tail and leave the head and body unharmed.

A distinct group of small Shore Eels (*Alabes*) is common in our rockpools and has only one gill-opening, behind the lower part of the head.

CONGERS.

Congers, the "whoppers" of the comic monologue, are said to grow to 10 feet long and 100lbs in weight in Europe, but a Tasmanian one 6 feet 6 inches long is the largest Australian one known to me, most examples being 3 feet long or less. In New Zealand, a 6 feet 9 inches specimen weighing 37lbs has been reported. Conger eels are frequently sold at 4d. to 6d. per lb whole in Victorian markets and are skinned before being retailed as cutlets at about 6d. or 8d. a lb, according

[1] H. K. Anderson and G. P. Whitley: AUST. MUS. MAG., ii, 8, 1925, p. 270; Whitley: *ibid.*, iii, 10, 1929, p. 348; F. Walford: *ibid.*, iv, 4, 1930, p. 139.



One-gilled Eel (Synbranchus) from the Northern Territory. Lower left, teeth on roof of mouth, enlarged; right, lower surface of head showing mouth and single external gill-opening.

G. P. Whitley del.

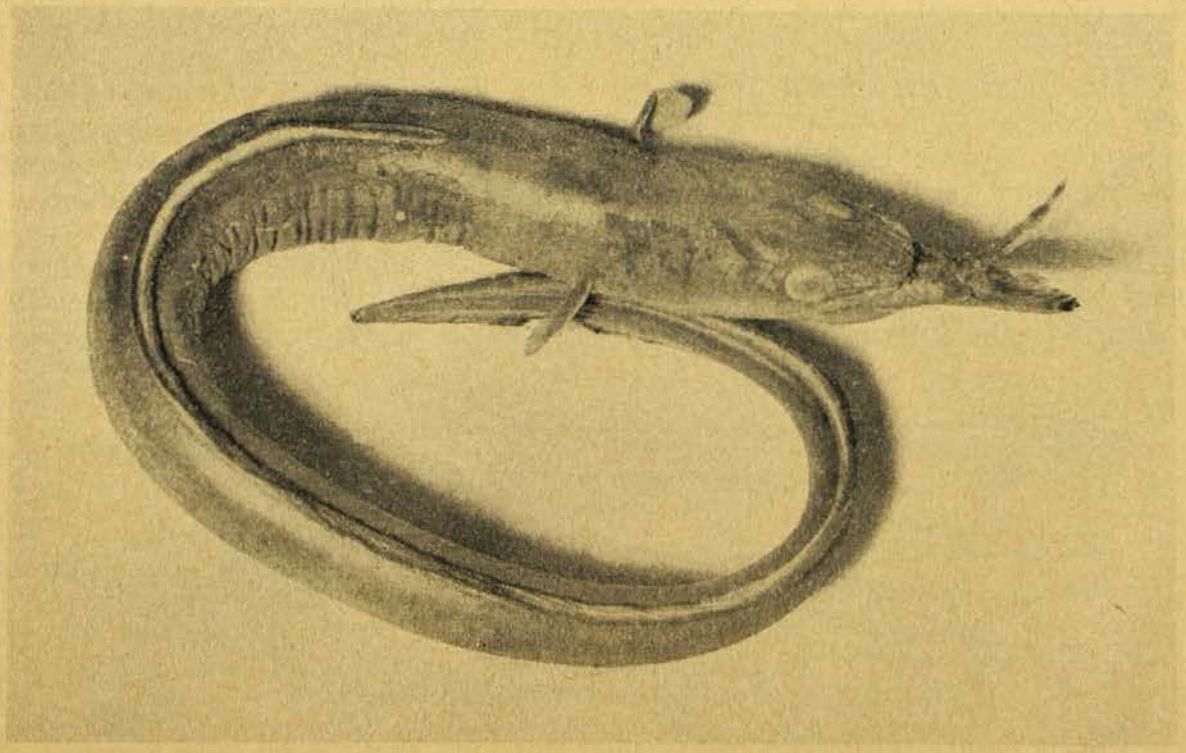
to Mr. Casey, City Council Inspector at Melbourne Fish Market. These mostly come from eastern Victoria and southern New South Wales.

The eggs of congers are much larger than those of freshwater eels (yet more than 3 million may be laid by a single female) and the young are "glass eels", the classic *Leptocephalus* which is used as the scientific name of the Conger group.

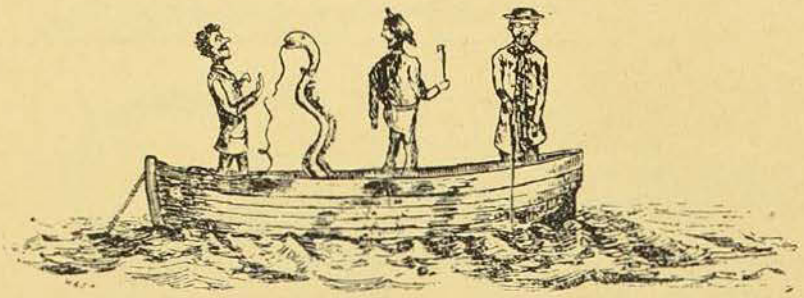
Allied Australian kinds are the Little Conger, *Poutawa*, up to 16 inches long, which is eaten by Flathead and other commercial fishes, and the Ladder Conger (*Scalanago*) which has a remarkable series of tubes arranged like a ladder along each side. Both these eels are sometimes washed ashore after storms.

The Silver or Pike Eel (*Muroenesox*), sometimes landed by the trawlers has large shearing teeth along the roof of its mouth and its tail is flattened sideways; it grows to a large size (at least 5 feet) and is very fierce.

The cosmopolitan Duckbill Eel (*Nessorhamphus*), up to 10 inches long, has been found in the warmer parts of the Tasman Sea. Further north, in Queensland, the



A Conger Eel (Leptocephalus wilsoni) caught eating a Goatfish in Watson's Bay, Sydney.



When a Conger is caught, it takes charge of the boat. An amusing sketch by James Hannington, First Bishop of Eastern Equatorial Africa.
After E. C. Dawson.

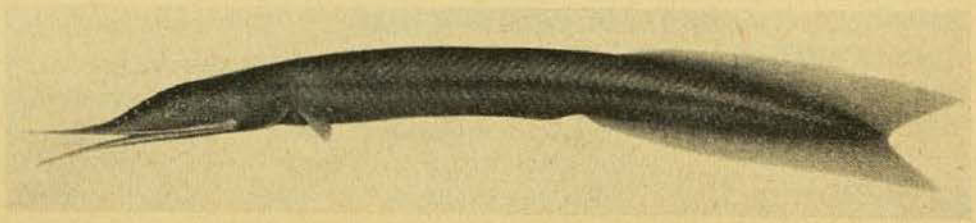
odd Wire Eel (*Dictrichthys*) has an almost painfully slender head and body (its depth is about one-fiftieth of its length, which is 14½ inches).

The Worm Eels (family Echelidae) burrow in mud and sand in harbours and at the sea bottom, but little is known about them. They mostly lack pectoral fins (the little "lugs" behind the gills in some eels) and have the hinder pair of nostrils situated in the upper lip near the tail giving an arrow-like shape and the colour is almost black. The *Leptocephalus*-larva is unusually deep and oval, with pointed jaws; it remains thus about two years and only grows to about 5½ inches long when adult.

SNAKE EELS.

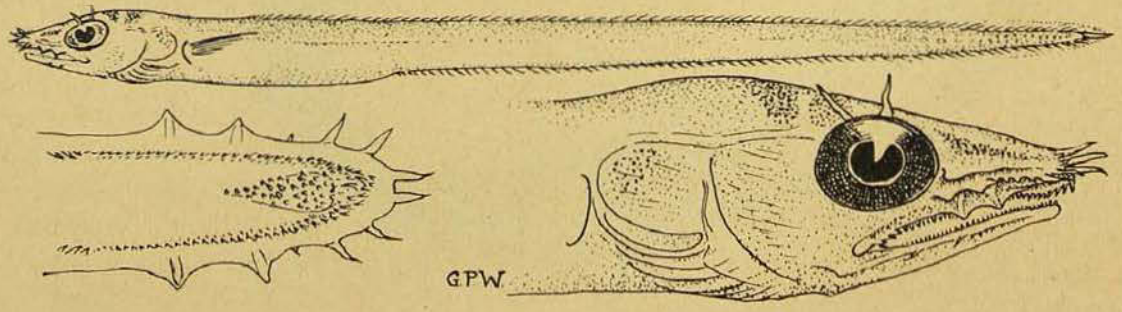
The Snake Eels (family Ophichthyidae) form a fascinating group, often brightly coloured, spotted or banded, very snake-

Arrow Eel, Cyema atrum.
After A. Brauer.



eye. They rarely exceed 20 inches in length.

Even more bizarre is the Arrow Eel (*Cyema*), found well to the south of Australia and Tasmania. The jaws form needle-like beaks which do not close properly so that it is difficult to visualize their feeding; the fins meet in a forked tail ending not as a fin but in a firm point. Possibly they mimic certain poisonous sea snakes or imitate one another in form and colour. (See figures flanking the title of this article.) Certainly one has to examine them closely first of all to see that they have gills and scaleless skins and are thus fishes and



A novel Conger (Fimbriceps umbrellabia) from New South Wales, with filaments on the snout and rib-like supports to the lips. Lower left, teeth on roof of mouth.
G. P. Whitley del.

A Serpent Eel (Leptognathus), 8 feet 1 inch long, trawled 8 miles off Wollongong, New South Wales.

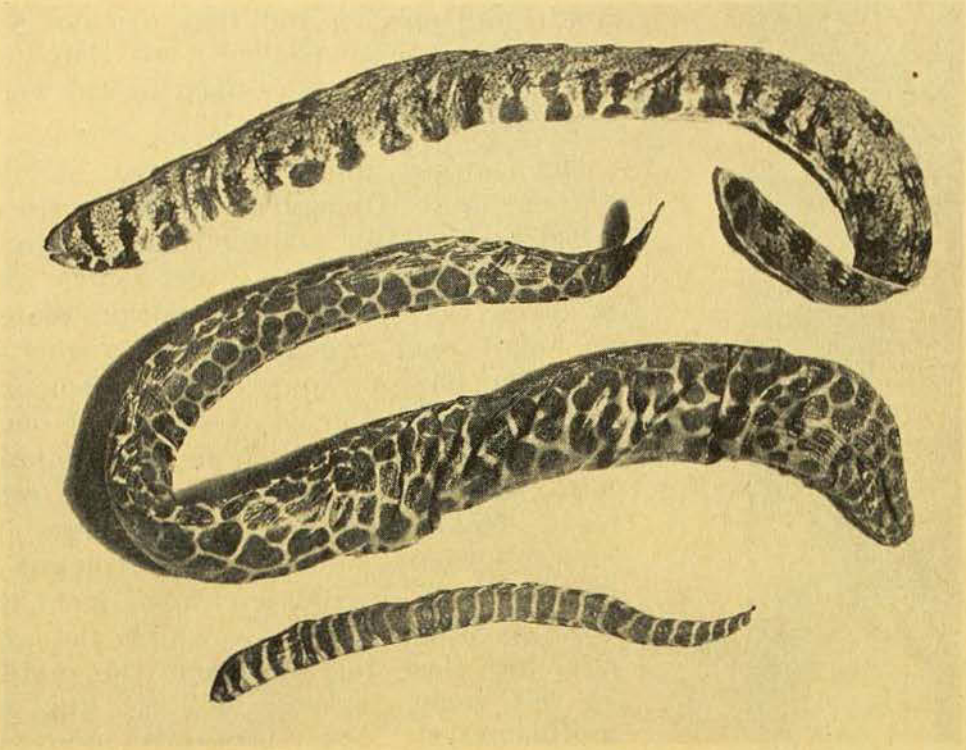
not snakes and, secondly, to detect the distinguishing features of the various species, some unrelated forms being extraordinarily alike superficially. They are eaten by sea snakes at times. One species from Ceylon has been observed by Deraniyagala insinuated in the urinogenital passages of large perch-like coral fishes; in another kind (*Stethopterus*), he noted that the male bit the larger female and clung to her during breeding time. The conical or thorn-like tail enables snake-eels to burrow head or tail first in sand, or they may occur in groups, waving like some marine plant-growth or tentacles writhing out of the coral. Unfortunately, we know nothing of the life-stories of Australian species and they are not yet even properly classified, so that an interesting field is here open to any keen and patient naturalist.

Our largest and best known is the Serpent Eel or *Ophisurus* (*Leptognathus*) with its beak-like snout; this eel grows to a great length, up to 8 feet 1 inch, and is often trawled in New South Wales, or small ones are found burrowing in sand in our harbours. It is sombre-coloured, like some of the tropical ones, but other snake eels such as *Malvoliophis*, with its bands recalling "cross-gartered hose", *Ophichthus* and *Stethopterus* are strikingly banded. An aberrant genus is the slender Chingilt (*Yirrkala*) from the Gulf of Carpentaria, in which the gill-slits are close together near the middle of the under surface, and the fins are rudimentary, the pectorals entirely lacking.

The Thrush Eel (*Aphthalmichthys*), of which two tropical Australian species have been noted, belongs to another group of eels with very slender, worm-like bodies with the dorsal and anal fins represented only by inconspicuous folds, confluent around the tail, where alone a few short fin-rays are discernible. They lie buried in mud near river mouths and have the eye covered by skin.

REEF EELS OR MORAYS.

Thick-bodied, slimy, tough-skinned, large and savage-fanged, the Reef Eels or Morays lurk amongst rocks or coral and often do not hesitate to swim after and try to bite anyone wading near them. The dorsal and anal fins of Reef Eels are often fatty or even reduced in size through lack of use, and there are no "lugs" or pectoral fins. In *Echidna*, the teeth are like molars, but in the numerous species of *Lycodontis* and the Sydney Green Eel, they are razor-sharp fangs, said by some to be poisonous, though this is not proven (like the antique stories that morays had tendency to hydrophobia!). The coloration is extremely



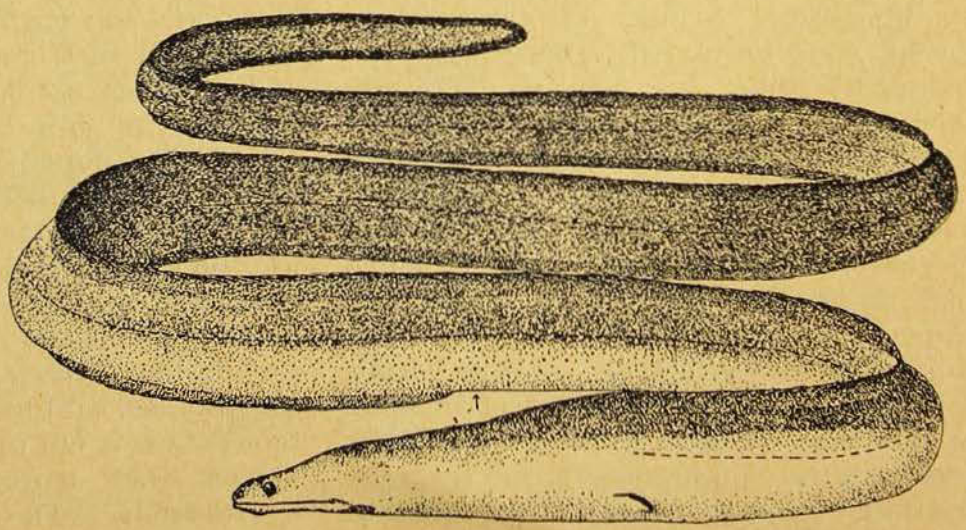
Tropical Reef Eels.
Top to bottom: Clouded Reef Eel, Echidna nebulosa. Giraffe Eel, Thaerodontis favagineus. Zebra Eel, Leihala polyzona.

variable and the morays are thus difficult to classify.

The Pettifogger (*Notorabula*) of Western Australia has a brown band each side of the snout and the Giraffe Eel (*Thaerodontis favagineus*) large blackish spots on a white ground, shaped rather like those on a Giraffe. Others (*Arndha* and *Leihala*) are banded like zebras; adults of *Siderea* are sprinkled with a galaxy of dark stars, whilst other Morays have clouded coloration or are adorned with pearl-like markings or yellow network. The Green Eel of New South Wales smears its colour (which may be due to symbiotic algae in its slime) on adjoining rocks and, after death, its skin turns a dingy brown.

There are many stories, some apocryphal, of giant eels of terrifying habits, on the Great Barrier Reef.

The longest Australian Eel, a veritable sea-serpent, is the specimen of *Evenchelys macrura* exhibited in the Queensland



The longest Australian Eel, Evenchelys macrurus, which grows to 13 feet.
After Weber and de Beaufort.

Museum, Brisbane; it is thirteen feet long and was hooked on a gut line by Mr. W. J. Butt at Maroochydore. Yet this svelte monster only weighed 24lbs. Can this be the man-eating eel of Barrier Reef legend, the modern counterpart of the ravenous Muraenae to which the Romans threw their slaves?

In Griffith's edition of Baron Cuvier's *Animal Kingdom* (1834, p. 547) it is related concerning the Morays or Muraenae that, "they were carefully reared in vivaria by the Romans. As early as the time of Caesar the multiplication of these domestic muraenae was so great, that on the occasion of one of his triumphs, that great general presented six thousand of them to his friends. Licinius Crassus reared them so as to be obedient to his voice, and to come and receive their food from his hands; while the celebrated orator Quintas Hortensius wept over the loss of those of which death had deprived him."

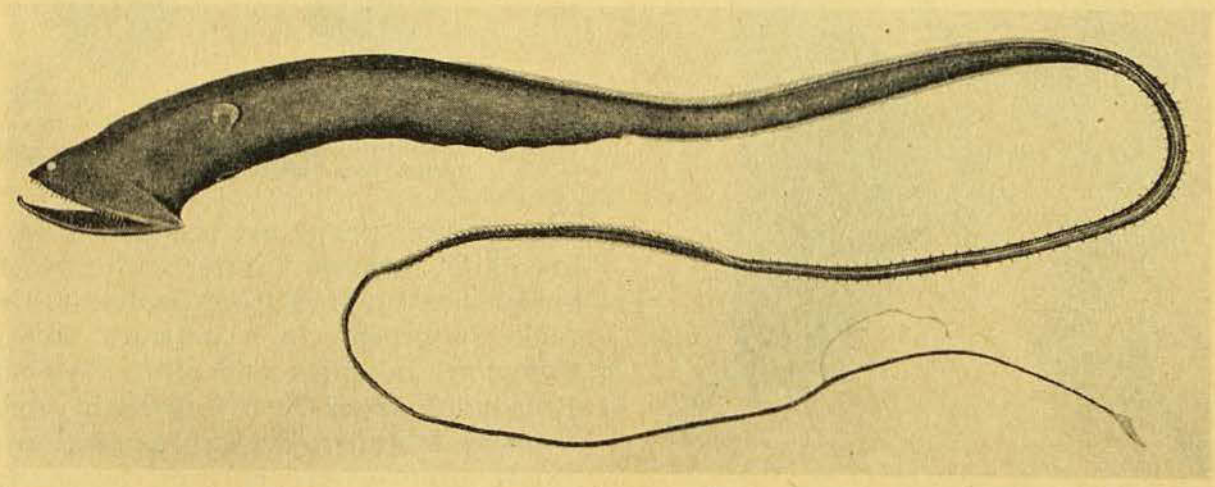
Some of the Romans even bedizened their favourite pets with rings and jewels like ear rings.

THE GULPER.

Strangest of all the Australian eels is probably the black Gulper or Pelican Eel (*Saccopharynx schmidti*), 4½ feet long, taken by the "*Dana*" in about 1,000 metres depth, in the Tasman Sea. The eye, brain and other vital parts of the head are insignificant in size compared with the enormous mouth with its pelican-like membranes. There is a luminous organ near the tip of the tail.

This, as Marston's *Scourge of Villany* has it, is surely one of those

> Eels that never will appear
> Till that tempestuous winds or thunder tear
> Their slimy beds.



Gulper or Pelican Eel (Saccopharynx schmidti) from the Tasman Sea.
After L. Bertin.

Mr. Wallace C. Wurth, C.M.G., LL.B., Chairman of the Public Service Board of New South Wales, has been elected a member of the Board of Trustees of the Australian Museum.

Mr. H. B. Mathews, B.A., President of the Board of Trustees of the Australian Museum, has been appointed Crown Crown Trustee.

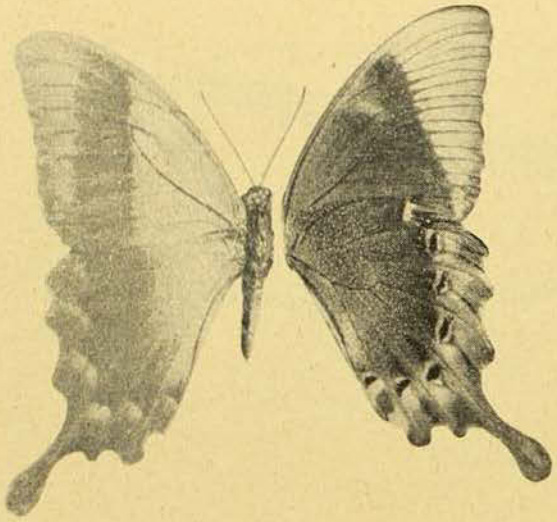
In the next issue of THE AUSTRALIAN MUSEUM MAGAZINE there will appear "Birds of a Tropic Isle", by Mr. F. A. McNeill, a continuation of his series dealing with the Great Barrier Reef.

Some Butterflies of Australia and the Pacific

The Swallowtails—IV.

By A. MUSGRAVE

IN the last article we commenced a description of the third division of the Fluted Papilios, the Gloss Papilios, and, in dealing with the *Peranthus*-group, we noted how the scaling, which is green in the western species of the group, changes to blue in the eastern forms. The representatives of this group in the Papuan region are *P. lorquinianus* Felder and *P. pericles* Wallace, which were then briefly described and which are here illustrated.

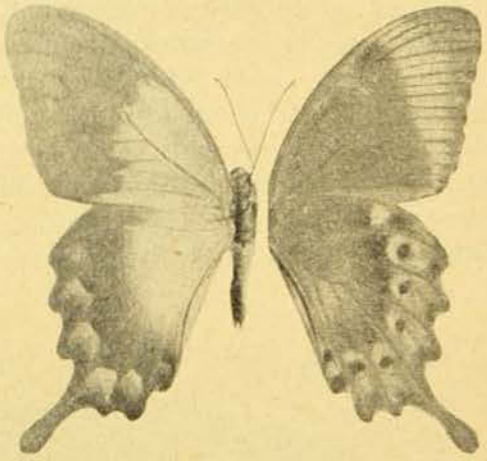


Papilio pericles. Male. Timor. Wing expanse 2¼ inches.

In the present contribution we continue with the second group of the Gloss Papilios, the *ulysses*-group, which includes the beautiful blue swallowtails of the north Queensland and Papuan tropics and certain Pacific Islands.

THE ULYSSES-GROUP.

In the *ulysses*-group the uppersurface of the wings is blue from the base for a third or more, and beyond this blue band the wings are black; the submarginal spots on the undersurface of the hindwing are tricoloured, blue, yellow and black, from before backwards.

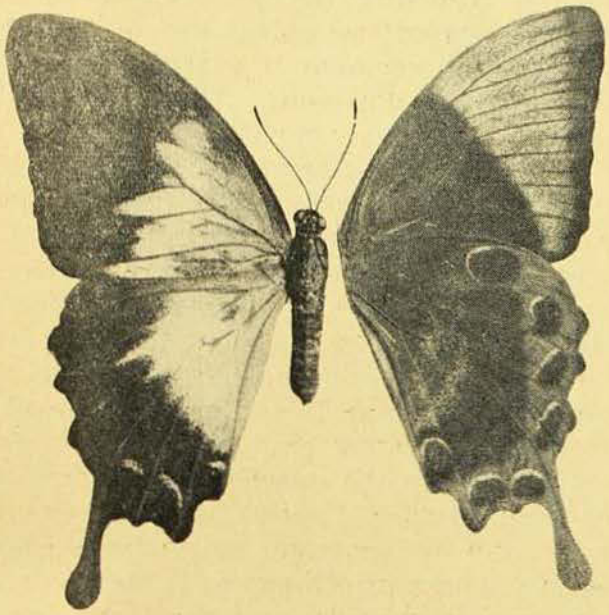


Papilio lorquinianus. Batjan. Wing expanse, across the forewings, 3¾ inches.

Only two species are recognized for this group, *P. ulysses* Linné, with its fifteen subspecies ranging from Amboina, Ceram and Saporoea, to Australia and the Solomon Islands, and *P. montrouzieri* Boisduval, from New Caledonia and the Loyalty Islands. These blue swallowtails excite admiration wherever they are seen, whether flying high over the Papuan jungles or as dead specimens in a museum collection.

In most forms of *P. ulysses* the male has the uppersurface black, while the metallic blue coloration extends on the forewing from the base to the apex of the cell and, in the hindwing, as far as the middle of the disc. Metallic scaling on the forewing, such as we may find in members of the *peranthus*-group, is wanting. Long pilose sex stripes, varying in the different subspecies, are present on the veins. The underside is black-brown

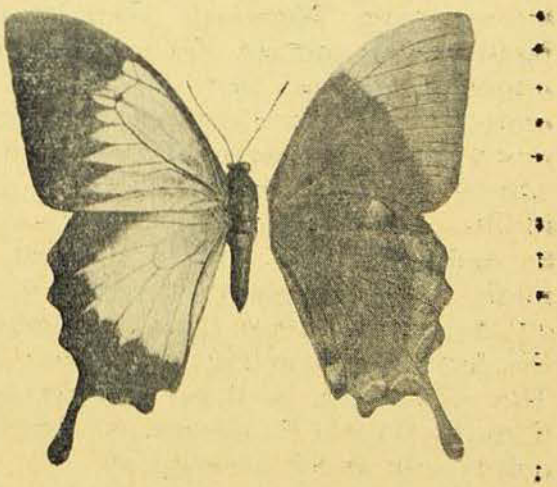
for the greater part of the basal area of the forewing to beyond the cell and, on the hindwing, to the middle; the outer part beyond the darker area is somewhat yellowish, the forewing with a light band broad towards the costal border and



Papilio ulysses oxyartes. Female. Aru Islands. Wing expanse 4 inches.

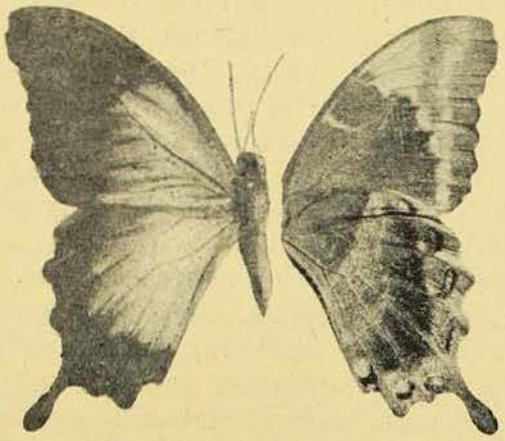
tapering towards the hind border; the hindwing has submarginal spots. The female is not so black, the blue areas of the wings are smaller and the blue scaling is not so dense; blue submarginal spots are present on the hindwing. The under side is similar to that in the male, but lighter.

The various subspecies are merely slight variations from this general description. To describe all of the fifteen varieties would be beyond the scope of this article, but a few are here touched upon. *P. ulysses oxyartes* Fruhstorfer, from the Aru Islands, is very similar to the New Guinea form *autolycus* Felder. This last-named occurs over the whole of New Guinea and on the islands of Salawatti, Waigeu, Jobi and Mafor, and to the Australian service men is known as "The Blue Emperor". In the male the black spot at the end of the cell on the forewing is prominent and in the hindwing the blue area is produced into two streaks behind veins 5 and 6. The long pilose sex marks are separated, but are broad (below) and narrow (above). The male measures about four inches across the outspread wings, the female about four and a quarter inches. Carl Ribbe has figured the larva and pupa from Finschhafen and records Citrus as the foodplant. In Australia the only representative of the Gloss Papilios is *P. ulysses joesa* Butler, which is also very similar to *autolycus*, but lacks the blue streaks on the hindwing behind veins 5 and 6. Sex marks are present on veins 1a to 6, with a faint indication of a sex mark on vein 7. Dr. Waterhouse has described the life history of the species which ranges from Cape York to Mackay. The foodplant of the larva is *Evodia accedens*, a rain-forest tree which belongs to the same family (Rutaceae) as *Citrus*. This tree, according to W. D. Francis, *Rain-Forest Trees*, occurs from Richmond



The Blue Emperor, Papilio ulysses autolycus. Male. New Guinea and nearby islands. Note the two streaks behind veins 5 and 6 of the hindwing (upper side). Wing expanse nearly 4 inches.

River, New South Wales, to North Queensland and in Papua. Another subspecies, *P. ulysses telemachus*, was first collected and described by the well-known Marist missionary and scientist, the Rev. Pere X. Montrouzier, from Woodlark Island, in 1857. It has also been recorded from the Trobriand Islands and Fergusson Island. In the Australian Museum are a series of four males and three females from Woodlark Island. In this subspecies there is a reduction of the blue area with a resulting increase in the



Papilio montrouzieri. Lifu, Loyalty Islands. Wing expanse 2¾ inches.

black outer area. In the male the blue of the forewing does not reach the end of the cell, while in the hindwing the blue extends only about half-way beyond the apex of the cell and the outer margin of the wing (termen). In the female (unknown from Woodlark Island to both Montrouzier and Dr. Jordan) the blue is much duller and the blue area is even more reduced than in the male, leaving a much broader brown-black outer area which is particularly noticeable in the hindwing, where the blue barely extends beyond the apical end of the cell. The male measures about three and three-quarter inches across the outspread wings, the female measuring about four inches. The subspecies is thus a little smaller than the typical *P. ulysses*, as Montrouzier points out in his description.

Much smaller than *P. ulysses*, but resembling it in general appearance, is *P. montrouzieri* Boisduval, a species restricted in its range to New Caledonia and the Loyalty Islands. In this Gloss Papilio both wings are more waved on their margins than in *ulysses*. In the forewing on the underside a small yellowish stripe is present in the cell and similiarly coloured marks border the grey triangular band. On the hindwing the submarginal spots are of a darker yellow than in *ulysses*. Three forms of the species are recorded, determined chiefly by the extent of the blue in the cell of the forewing and the nature of the male pilose stripes. In the form *ulyssellus* Westwood, the blue area in the forewing of the male reaches to beyond the apex of the cell, and in the female the blue extends to or near the apical end of the cell. The pilose stripes in the male are wanting or weakly defined. In the typical *montrouzieri* the blue area in the forewing of the male does not extend beyond the apical end of the cell, while in the female it extends to about the third median vein. In the male the pilose stripes are narrow. In the third form, *westwoodi* Oberthur, the blue in the cell is still more strongly reduced in both sexes and four or five broad pilose stripes are present in the male. The wing expanse is about two and three-quarter inches in the male, to about three inches in the female. Rothschild[3] has stated that the material from the Island of Lifu, Loyalty Islands, examined by him, "exhibit such a variation in the number and size of the cottony stripes [pilose stripes] in the *male*, and in the extent of the blue colour on the wings in either sex", that he was able to distinguish only the three forms mentioned above, which are also those later mentioned by Dr. Jordan[4] in his work.

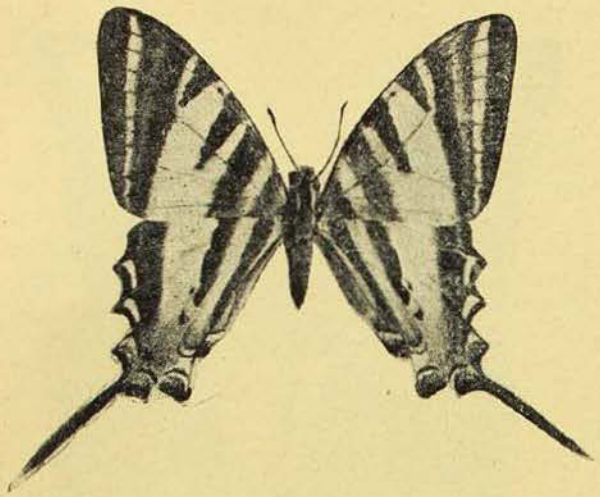
KITE-SWALLOWTAILS.

These Papilios constitute section C of Dr. Jordan's scheme of classification, and his account of the characters of the Section may be summarized as follows: The antennae are short and strongly clubbed. The wings are thinly scaled and almost transparent, particularly about the costal border of the forewing, while the green, bluish or purple spots on the upper surface, and sometimes those on the under surface, usually lack scales. The abdominal margin of the forewing in the male is folded upwards and the inside of this scent fold contains yellowish scent wool, while long hairs fringe the margin.

In the larval or caterpillar state young larva has forked hairs, but the fully-

[3] Rothschild, W.: "A Revision of the Papilios of the Eastern Hemisphere, Exclusive of Africa", *Novitates Zoologicae*, ii (3), August 17, 1895, pp. 167-463, Pl. vi.

[4] Jordan, K., in A. Seitz: "The Macrolepidoptera of the World, Fauna Indo-Australica", Vol. ix (1908-10).



The Fourbar Swordtail, Papilio leosthenes leosthenes. Bunya Mts., Queensland. Wing expanse 2 inches.
Photo.—A. Musgrave.

developed larva, in those Papuan and Pacific Island forms under consideration, has a pair of spines on each of the thoracic segments and the last segment, while the thorax is swollen. The pupa is smooth and swollen at the middle, though the wing-cases do not project; the thorax bears a horn from which keels (carinae) pass to the posterior end of the body.

Most of these Kite Swallowtails have long wings and long tails, though some mimetic forms have rounded hindwings, the tails being absent.

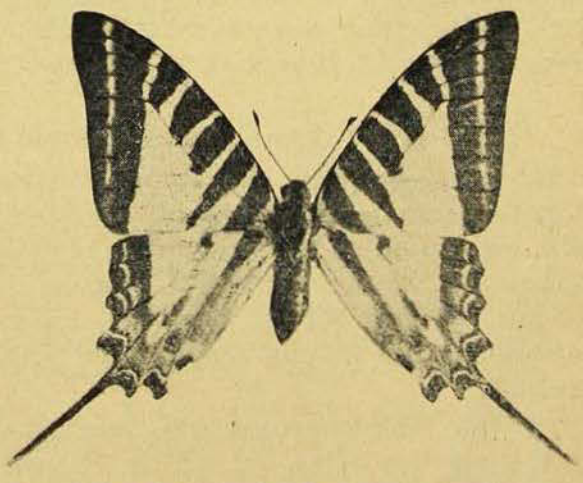
THE ANTIPHATES-GROUP.

Five species-groups are recognized by Jordan. The first, the *antiphates*-group, takes its name from *Papilio antiphates* Cramer from south-east China and Tonkin. In this species-group the whitish wings are black-banded, the bands on the forewing running perpendicularly to the veins, while on the underside of the hindwing a black band borders the abdominal margin to junction with a median band towards the hind border of the wing; these two bands sometimes show on the upper surface. The tail is long and tapering. The first subcostal vein of the forewing joins with the costal vein, except in the Australian *P. leosthenes*.

The Fourbar Swordtail, *Papilio leosthenes* Doubleday, though resembling in appearance the smaller Fivebar Swordtail, *P. aristeus*, is not, however, regarded as a true Kite Swallowtail like the last-named, and the pupae of the two species differ in shape. Veins 11 (subcostal) and 12 (costal) of the forewing in *leosthenes*, as in the Fluted Papilios, are *not* united. *P. leosthenes*, furthermore, is restricted in its range to Australia, though a larger and darker subspecies, *geimbia* Tindale, has been recorded from North Australia where it is rare.

The typical subspecies, *leosthenes*, has a range from Mackay, Queensland, to the Dorrigo, New South Wales, though specimens have been taken beyond these northern and southern limits. The adult insect resembles *P. aristeus* in coloration, but on the upper side only four brown-black bands extend on to the white basal two-thirds, and some yellow spots (absent in the Fivebar Swordtail) are present on the hindwing; on the undersurface the colour pattern resembles that of the upperside, but the yellow spots are better defined. The life-history has been described by Dr. Waterhouse in *What Butterfly is That?* and the foodplant of the larva is a creeper, *Melodorum Leichhardti*, which occurs in rain-forests.

The true long-tailed Kite Swallowtails are represented by *P. aristeus* Cramer, a species whose races or subspecies range from northern India to the Bismarck Archipelago. It is represented in Australia by the subspecies *parmatus* Gray, the Fivebar Swordtail, as Dr.



The Fivebar Swordtail. Papilio aristeus parmatus. Yeppoon, Queensland. Wing expanse 2¼ inches.
Photo.—A. Musgrave.

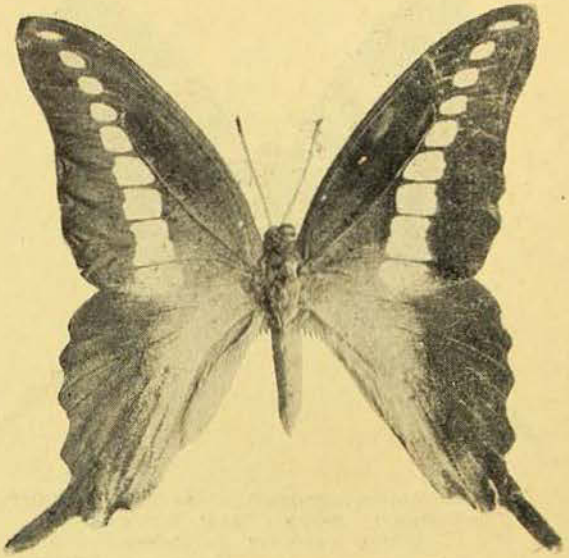
Waterhouse has popularly termed it, and it occurs also in New Guinea, Aru Island and Waigeu Island. In Australia, from where it was originally described, this subspecies ranges from Cape York to Rockhampton, Queensland, but it is not regarded as a common insect. The veins 11 and 12 of the forewing are joined together near their origin. The adult butterfly has the upperside of the forewing towards the base whitish for the greater part and from the costal border five brown-black bands extend back, the two inner ones longer than the outer ones (these bands give the insect its popular name); the outer part of the wing is also brown-black, while a central narrow band of white spots extends from the apex towards the hind margin. The hindwing is white with an outer brown-black band broken by white spots and a black median band sometimes dusted over with white; the long narrow tails are blackish. The underside resembles the upper surface, but, in addition, a series of red spots bordered with black extends across the hindwing. The complete life-history is not yet described, but the larva and pupa have been described by Dr. Waterhouse. The foodplant is said to be the same as that of *P. lycaon*.

Another race, *P. aristeus paron* Godman and Salvin, is found in New Britain and New Ireland. On the upper surface of the hindwing the black median band. which is so very marked in certain forms and sometimes in *parmatus*, is covered with white; on the underside the band is very broad with yellow (not red) spots.

THE PAYENI- AND CODRUS-GROUPS.

The *payeni*-group, based on *P. payeni* Boisduval from Java, is represented by two species only, the other being *P. gyas* Westwood from Sikkim, Bhutan and Assam. These forms, however, have no representative in the Papuan or Pacific regions.

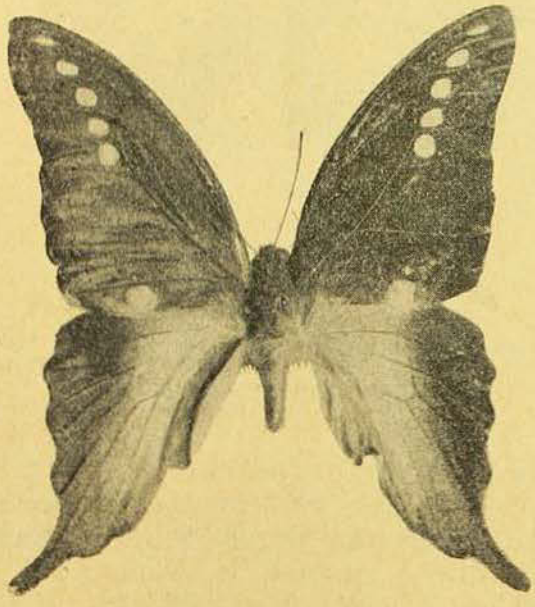
In the *codrus*-group are five species and their varieties, of which *P. codrus* Cramer, from the South Moluccas, typifies the group. With the exception of *P. empedocles* Fabricius from the Malayan region, all the remaining four species have subspecies in the area under consideration.



Papilio codurs tocalensis. Key Is. Male. Wing expanse about 3 inches.
Photo.—A. Musgrave.

In *P. codrus* the upper surface of the wings is shiny black-green in the male, but lighter in the female and without the silky sheen. A band of green or yellow scaleless spots extends from the middle of the hindmargin of the forewing to the apex, and decreasing in size, though in some forms certain spots are missing; on the under surface this band of spots is greenish-white and scaled. The long hindwing is triangular and ends in a broad tail; the inner half of the wing from the cell is greyish-white. On the underside the median band of spots of the forewing is often continued onto the hindwing as a costal spot. In *P. codrus* there are 13 subspecies widely ranging from the Philippines to the Solomons. Eight of these subspecies come within the geographical scope of this article and occur on certain islands from the Moluccas to the Bismarck and Solomon groups. One of these subspecies is *P. codrus medon* Felder, from Aru, New Guinea, Waigeu, Jobi, Mafor, Biak, d'Entrecasteaux, Woodlark and Rossel Islands. The life-history of this species has been described and figured by C. Ribbe from Astrolabe Bay, New Guinea, in the work previously cited in Number 2 of this series.

The spotted band of the forewing in *medon* is broad, in New Guinea forms broader even than in the subspecies *tocalensis* Rothschild, from the nearby Kei Islands, and the greyish-white area of the hindwing extends beyond the apex

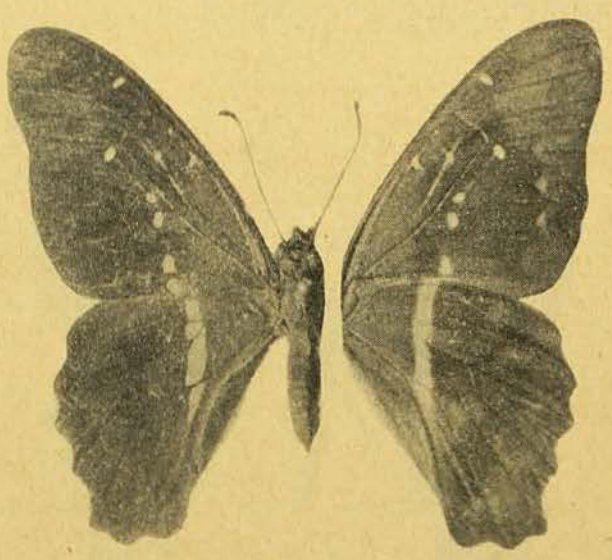


Papilio codrus segonax. Rabaul, New Britain. Wing expanse, 3 inches.
Photo.—A. Musgrave.

of the cell. The underside is pale and the white costal spot is so large as to form a band, whereas in *tocalensis* it is small. The life-history of *tocalensis* has been described and figured by L. de Niceville and H. Kuhn[5] from Little Kei Island (Kei Toeal). The smooth larva is yellowish-green with blue marks on the first thoracic segment and on the last two abdominal segments, while a pair of red fleshy processes are present on the sides of the thoracic segments and on the last abdominal segment. The pupa is greenish and the thorax produced into a high dorsal process, while three large round blue spots are present about the middle; the body ends in a sharp point. In *P. codrus segonax* Godman and Salvin from the Bismarck Archipelago (New Ireland and New Britain), the spotted band of the forewing is narrow and divided into an apical series of five or six spots and a posterior large spot on the hind border with sometimes a smaller spot before vein 1A (First anal).

In *P. codrus pisidice* Godman and Salvin from the Solomon Islands, Malaita, Guadalcanar, Alu and Bougainville, the spotted band of the forewing is complete, the spots more uniform in size but further apart than in *medon* and narrower than in that subspecies, the spot in space 1A is frequently narrowed or divided and the greyish-white area is more restricted than in the subspecies from New Guinea.

In another species, *P. gelon* Boisduval, from the Loyalty Islands and New Caledonia, the body is blackish, the legs green and the antennae yellowish-brown on the underside. The forewings on the upper surface are brownish-black with a row of four green spots near the middle of the hind margin, and three green spots, one in the cell and two outside it; the hindwing has a narrow band of green spots near the base and crossing the cell. The



Papilio gelon. Loyalty Islands. Wing expanse 2 inches.
Photo.—A. Musgrave.

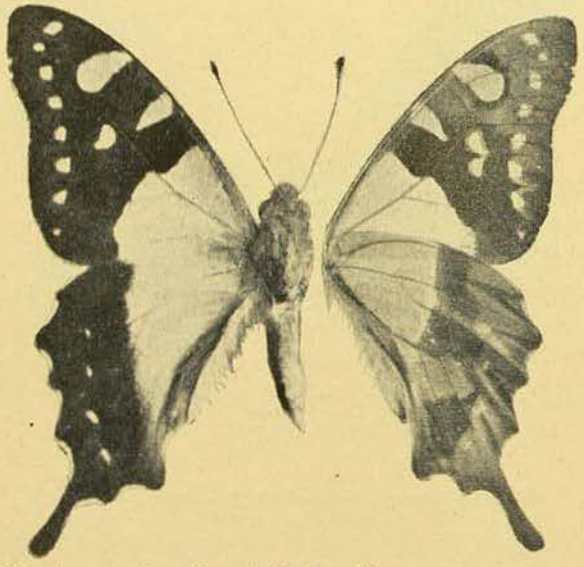
undersurface is greyish-yellow with the veins green basally and the band of the hindwing whitish. The female is lighter in colour than the male, and has a series of yellowish spots near the margin (termen) of the forewing and similar spots on the hindwing.

Macleay's Swallowtail, *P. macleayanus* Leach, from eastern Australia and Tasmania, is represented on Lord Howe Island by a variety *insulana* Waterhouse.

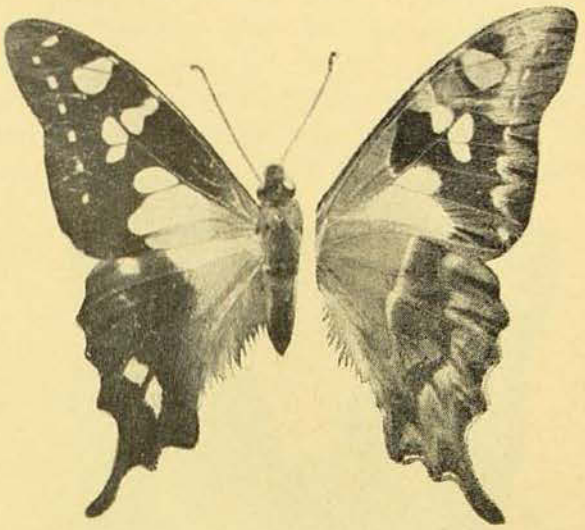
[5] Niceville, L. de and Kuhn, H.: An Annotated List of the Butterflies of the Ke Isles. *Journal of the Asiatic Society of Bengal* (n.s.), lxvii (2), No. 2, Sept. 15, 1898, 251-283, pl. i, col.

In Australia this butterfly occurs usually at an elevation of 1,000 feet and more, so it is common in such mountainous districts as the Blue Mountains, Barrington Tops and the Australian Alps. At the Barrington Tops I have seen the adults flying round the flowers of *Prostanthera lasianthos*.

The male, on the upper surface, is black with a whitish area tinged with green basally and green spots on the outer black areas of the fore- and hind-wings. The undersurface is subject to variation, but resembles the upper side though the outer area is brownish, particularly on the hindwing, and the spots are margined with white. The female is similar to the male. This is a tailed species. The life-history has been recorded by Dr. Waterhouse. The greenish larva feeds on a variety of food-plants including the Sassafras, *Geijera salicifolia*, *Drimys aromatica*, and on the introduced Camphor Laurel.



Macleay's Swallowtail, Papilio macleayanus. Barrington Tops, N. S. Wales. Wing expanse 2¼ inches.
Photo.—A. Musgrave.



Weiske's Swallowtail, Papilio weiskei. Edie Creek, New Guinea, about 7,000 feet. Wing expanse about 2¼ inches.
Photo.—A. Musgrave.

Even more beautiful than its Australian ally is Weiske's Swallowtail, *P. weiskei* Ribbe, from the Owen Stanley Range, New Guinea, named in honour of the Austrian collector, Emil Weiske.

In this species the body and wings are brown-black above and lighter beneath, the wings more produced than in *macleayanus*. The forewing has a large purple area beneath the cell and near the greenish base, the transverse band of spots at the apical end of the cell are green towards the outer margin of the wing and blue or purplish within, while the subcostal spot is green and the small submarginal spots bluish-green; the hind-wing has a green basal area and two blue spots beyond the cell. The under-side resembles that of *macleayanus*, but the green is more clearly defined and the purplish areas of the upper side replaced by white and a thin red streak occurs on the foreborder of the hindwing. The male and female are similar in colour pattern.