The AUSTRALIAN MUSEUM MAGAZINE

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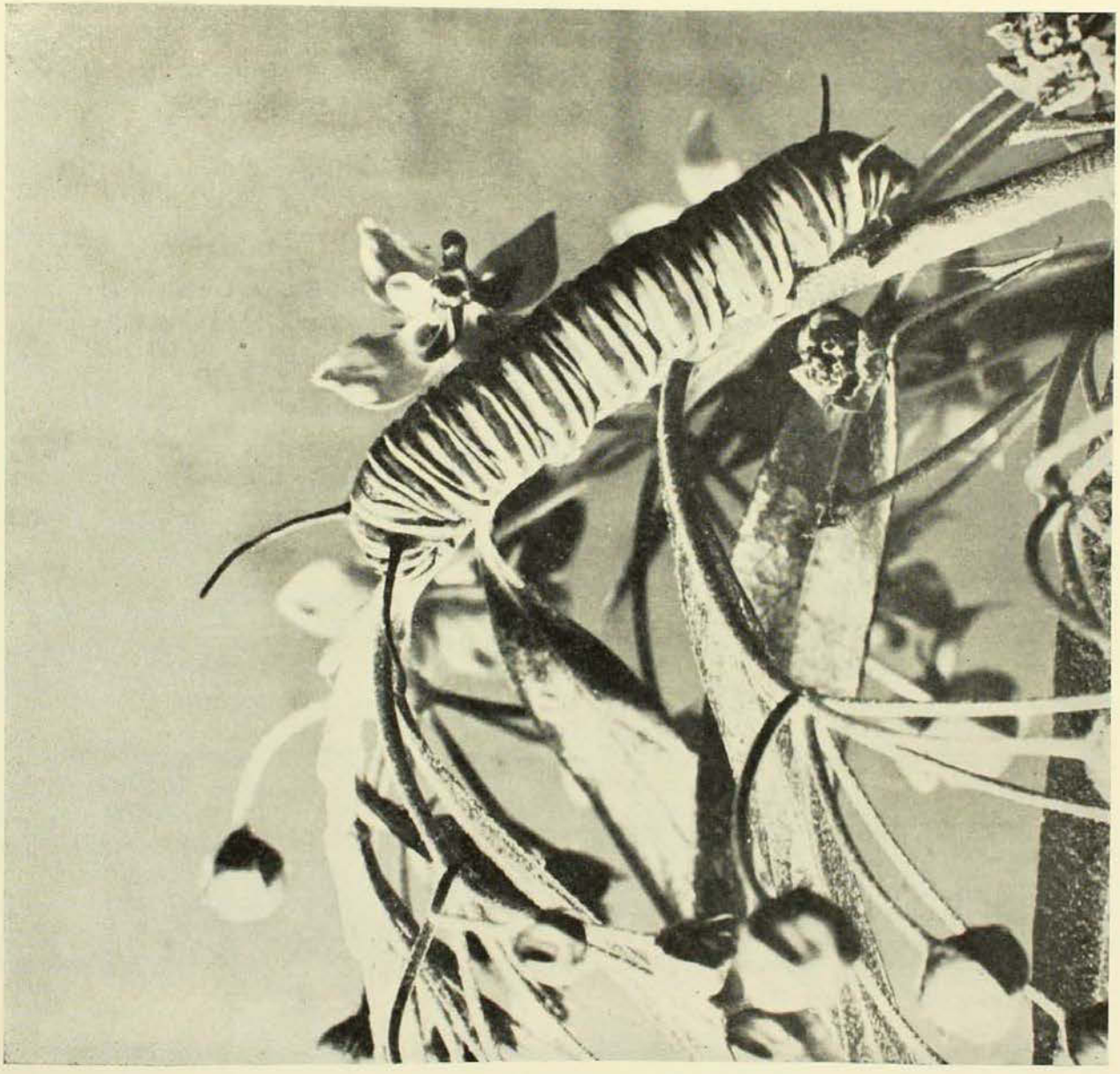

The Caterpillar of the Wanderer Butterfly.

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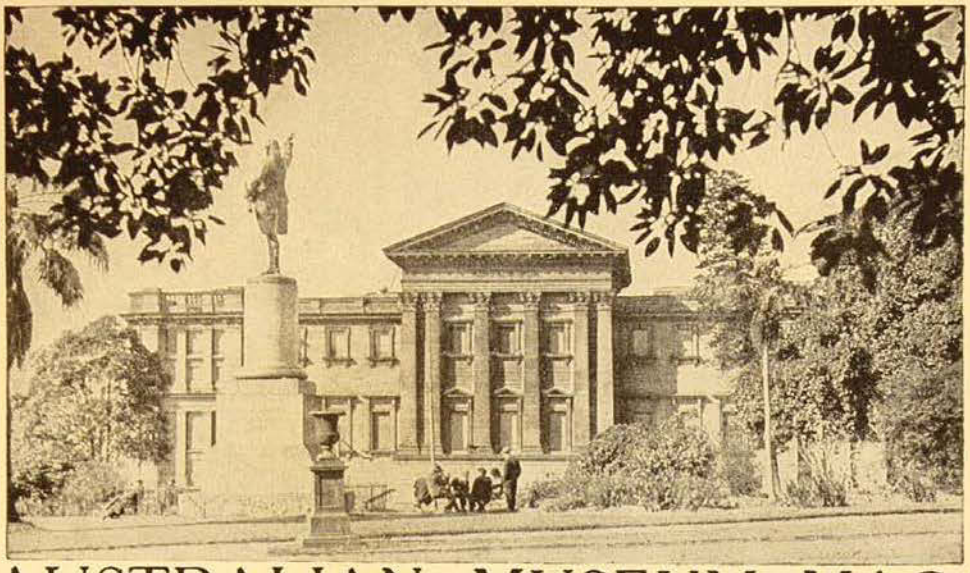

THE AUSTRALIAN MUSEUM MAGAZINE

● OUR FRONT COVER. The caterpillar of the Wanderer Butterfly, *Danaus menippe*, is here seen feeding upon one of the milk-weeds which are included in the family Asclepiadeae. The caterpillar is yellow and banded with black and has a pair of fleshy feelers at each end of the body. The Milk Weeds or Cotton Plants upon which the caterpillar usually feeds are the introduced species, *Asclepias curassavica* and *Gomphocarpus fruticosus*, and it may feed upon plants of the same family native to Australia. The juice of these plants is usually milky.

Photo—A. Musgrave

VOLUME IX, NUMBER 8. JULY-SEPTEMBER, 1948.

A series of miniature figures, one-third natural size, is in course of preparation to illustrate the races of man in Oceania. The sturdy build of the Polynesians is well shewn in this figure of a Maori chief holding a greenstone mere club.

Photo—Howard Hughes.

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The Aims of UNESCO

In recent issues of this Magazine reference has been made to the association of the work of museums with the United Nations Educational Scientific and Cultural Organization (UNESCO).

UNESCO is a body linked with the United Nations Organization and now comprises forty-one Member States. The following extract from the report on its programme, published by the Preparatory Commission in 1946, will give readers an idea of the task which has been undertaken by Unesco.

"The general form and dimensions of the task before the United Nations Educational Scientific and Cultural Organisation were outlined by the London Conference of November, 1945, at which its Constitution was drafted. It was there laid down that the title of the Organisation should include Science as well as Education and Culture, and that Unesco (as it then became) should pay special attention to 'the means of mass communication'—of which the chief are the radio, the press and the film—to 'advance the mutual knowledge and understanding of peoples'. The two major purposes set forth for it were to contribute to peace and security, and to advance the common welfare of mankind—in both cases, of course, through education, science and culture. Further, in the Preamble, stress is laid on the need to dissipate 'ignorance of each other's way and lives' between peoples, to combat the false doctrines of 'the inequality of men and races', and to promote the democratic principles of the 'dignity, equality and mutual respect of men'.

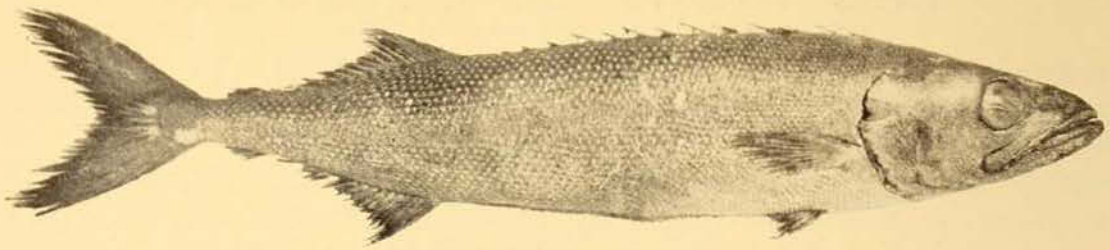
"The Preamble further asserts that 'the wide diffusion of culture, and the education of humanity for justice and liberty and peace . . . constitute a sacred duty which all the nations must fulfil'; and affirms that 'the peace must be founded, if it is not to fail, upon the intellectual and moral solidarity of mankind.' Accordingly the States members, 'believing in full and equal opportunities for education for all, in the unrestricted pursuit of objective truth, and in the free exchange of ideas and knowledge, are agreed and determined to develop and increase the means of communication between their peoples and to employ these means for the purposes of mutual understanding and a truer and more perfect knowledge of each other's lives.

"These are high aims and noble principles, many of them never previously affirmed in any international document. It will be for Unesco itself, working over a long period of years, to translate these aims and principles into concrete realities."

The Oil Fish in Australia

By GILBERT WHITLEY

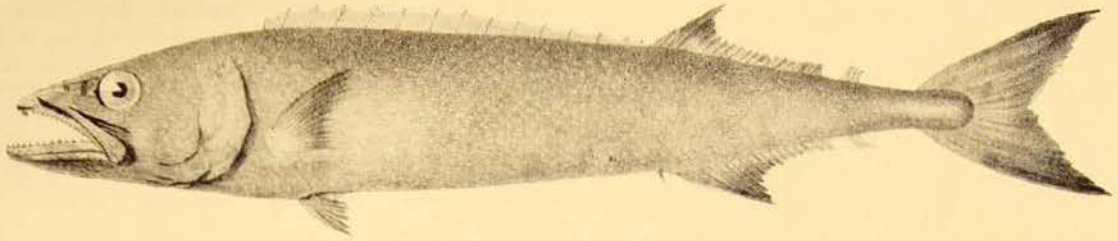
THE Red Funnel Trawlers Pty. Ltd. of Woolloomooloo, Sydney, have often presented rare or specially wanted fishes to The Australian Museum, yet no specimen, perhaps, was so surprising as the Oil Fish which came from the trawlers early in March, 1948. This remarkable fish had never been caught in Australia before but now came to light from 50 fathoms of water, about 100 miles south of Gabo Island, Victoria.



The Oil Fish (Ruvettus tydemani) trawled in Victorian waters.
Photo.—Howard Hughes.

The Oil Fish is rather like a Barracouta (*Thyrsites*) and the so-called "Hake" or Barraconda (*Rexea*) in form, having a large mouth, vicious-looking fangs, and somewhat similar fins, but the skin is studded with claw-like spines making it very rough to the touch. The general appearance may be inferred from the accompanying photograph. This Victorian specimen was 34¾ inches overall and weighed 8¼ lb. The general colour of the fresh fish was pale grey with the claw-like spines and a studded keel along the belly whiter. The front dorsal fin membranes were very dark grey and the other fins shaded to dark at their margins. The inside of the mouth was dark burgundy in hue and there were violet or vinous tinges on parts of the eye, and on the borders of the mouth-parts and the gill-openings. The huge eye was silvery above and darker below and had a glassy-looking pupil. When picked up, the fish sagged considerably as if lacking the support of a rigid skeleton. The dorsal fin had 15 spines, 17 rays and 2 separate rays forming a finlet, and the anal fin had 18 rays plus 2 in a finlet. There were about 90 spiny scales between head and tail and 34 shields or studs along the abdominal keel. Altogether a very peculiar, not very attractive-looking fish, yet one of considerable interest from several points of view.

The Oil Fish was first scientifically named from Messina, in the Mediterranean Sea in about 1833 as *Ruvettus pretiosus* by a zoologist named Anastasio Cocco, but several other species or races of it have since been discovered in other parts of the world. *Ruvettus* is derived from a Sicilian word meaning rough, with reference to the rasp-like skin, and *pretiosus* is Latin for precious, costly or rare, because this fish is said to have been in great demand in Italy as food for epicures. But, as its popular name implies, the fish is extremely oily, and though described as delicious to eat, has a severe aperient effect. Cocco's species has been caught from a broad sweep of the Atlantic, from the Canary Islands and Eire to the Grand Banks and the West Indies. At the latter place it has been named *scholaris*, from the native name Escolar, meaning not a scholar, but a scourer. From the East Indies and Hawaii, a second species, *Ruvettus tydemani*, has been distinguished, and it is with this that the Victorian Oil Fish seems to agree best, rather than with the



The "Rovetto" of Sicily (Ruvettus pretiosus).
After Cantraine.

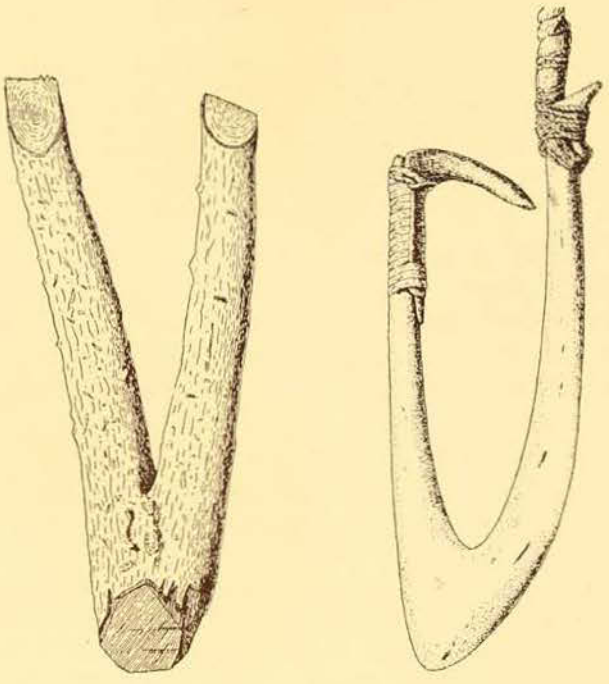
New Zealand *R. whakari* or the South African *delagoensis*. Oil Fish have also been caught in Japan and over a wide area of the South Seas where the native name is Palu.

The Oil Fish is said to grow to 6 ft. 10 in. in length and a weight of between 150 and 200 lb., but the average size caught is much smaller, nearer 3 or 4 feet long. It is said to be partly or wholly luminescent when first caught, when the spines of the skin are held erect and thus likely to scratch the captor very severely. It is a deep-water fish and great credit must be given to the old Polynesians who evolved means of catching it. Apart from man, the only known enemy of the Oil Fish is a kind of huge and savage brown eel.

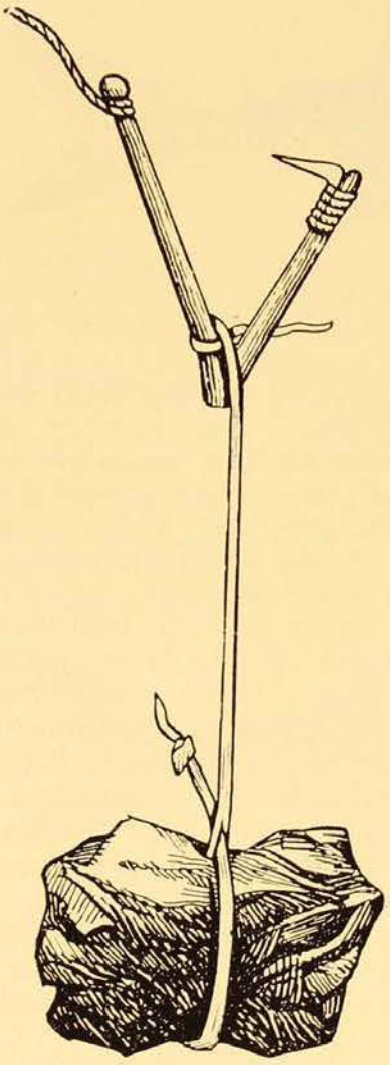
In many parts of Oceania, embracing an enormous range of South Sea islands, the Oil Fish or Palu is caught with a remarkable large wooden hook which Charles Hedley aptly described as being "as characteristic an ethnological feature of its especial region as the boomerang of Australia or the bolas of South America". Indeed the presence of these distinctive Palu hooks has been taken to indicate an even wider distribution for the Oil Fish than has been revealed by specimens. The hook is prepared from a wooden fork such as a boy might select for a catapult, and a barb is added from a right-angled piece of hard wood, lashed to the hook. The line is of sinnet and a sinker is attached in such a way that as soon as it touches the sea-bottom it is detached from the hook and left there. At Rarotonga, in the Cook Islands, I was shown a simple method of attaching the sinker to the hook by a slip-knot of hibiscus-fibre, and I was told that in olden times they used hooks almost as long as the forearm.

The peculiar Palu hook was known to scientists years before they saw or determined the type of Oil Fish it caught and, although Louis Becke and other authors had mentioned the Palu and its means of capture, it was not until 1899 that the late E. R. Waite of this Museum discovered that the Palu of Oceania was *Ruvettus*, on the basis of a Funafuti specimen which is still exhibited in our Fish Gallery.

The native fishing is done in from 70 to 200 fathoms with up to 400 fathoms of the line which must be gently sunk on a calm and moonless night. A fish-bait, generally flying fish, is used, tied to the hook near the barb. When first hooked, the fish is rather lively but becomes like



A wooden fork used for making the distinctive Palu hook (right), Funafuti, Ellice Islands.
After Hedley.



A Ruvettus hook from Atiu, Cook Islands, showing method of attaching sinker so that it is released from the hook when reaching the sea-bottom. The bait is lashed on the right arm of the hook just below the barb.
After Nordhoff.

a log as it is slowly hauled up. Towards the surface, it must be pulled up quickly or sharks may take it and the Oil Fish must be a prickly customer when it regains its energy and lashes about in the canoe of its captor.

From Atiu and other parts of the Cook Islands, the well-known author Charles B. Nordhoff* described the taking of the Oil Fish as follows:

"Now suppose it is a calm night in Atiu, with no moon, and, above all, no current. The fisherman goes out alone in his sixteen- or eighteen-foot outrigger canoe. He carries no lantern or torch for this work, only his line, sinkers, hook (and a spare one, perhaps), bait, fish-club of ironwood, and thread for lashing on bait. The line, more than 2,500 feet of it, is done up very neatly in what he calls *potaro*—a ball which allows the line to run out from the inside. When all is ready, he drags his canoe over the fringing-reef, waits for a favorable opportunity, and pushes out through the breakers. . . .

"The fisherman now paddles to a place some distance off the reef, where he knows the bottom may be reached at say four hundred fathoms. The bottom anywhere at the correct depth seems to be equally good; there are no particular fishing places (or 'holes' as the natives say) in the case of this fish. The fisherman first fastens the outer end of his big ball of line to the outrigger-pole (*kiato*) where it crosses the gunwales; he baits his hook, attaches the sinker, and allows the line to run out through the fingers of his right hand until he feels the sinker strike bottom. A little more slack, and a tentative slight pull tells him that the sinker is free. All is now ready.

". . . If he has no strikes at this depth, he . . . raises the hook about two yards. If nothing then strikes, he raises the hook three times and waits a little. After that he raises it four times, and so on up to six. At whatever level he catches his first fish he continues to fish the rest of the night. . . .

". . . It takes a young and strong man to pull up a big fish from a depth of nearly half a mile, and do it several times in a night. It is a soaking wet, back-breaking job and I do not wonder that *Ruvettus*-fishing has never become popular in the Society Group. If the *Ruvettus* is small, the fisherman seizes him by the gills and breaks his back over the gunwale before taking him aboard. If larger, he is seized and then clubbed to death; and if a giant, he is made fast to the boat, clubbed, and towed ashore. His teeth are not considered dangerous."

In the islands, where the flesh of most of the fishes is rather dry, the capture of an Oil Fish is a rich reward. Captain E. F. Allen, who spent much time in the Ellice Islands, noted that the flesh appears like a piece of very fat pork and its effect, when eaten fresh, especially if the skin were eaten, was to produce intense diarrhoea which does no harm otherwise. The natives of Fakalfo erect small platforms over the water's edge, upon which they lie and gorge themselves to sleep.

Whether the Oil Fish will ever be captured in payable commercial quantities in Victoria remains to be seen; it has yet to capture the Australian public's taste.

* Nordhoff: *Natural History* (New York), xxviii, 1928, p. 42.

Australian Shore Lice (Ligia australiensis), cockroach-like crustacean scavenger.
Photo.—
Howard Hughes.

Deserters from the Sea

By FRANK McNEILL

THE vague restlessness among living things is a characteristic that has not escaped the notice of observant people. Technically, this can be interpreted in terms of subtle changes of growth and behaviour. It is linked with the relentless struggle for survival and as such is part and parcel of the progress of evolution. A keen student of nature need not look very far for some marked evidence which gives a clue to an ultimate state or modification.

Outstanding examples of change are seen in the many kinds of migratory tropical land crabs. These creatures have actually left behind the mode of life of their numerous marine relatives. Their methods of breathing have become adapted to an entirely new existence, so much so that they will quickly drown if immersed in water. However, one inflexible law they must obey is to return at breeding time to the edge of the ocean, where the young from their eggs are freed in the shallows. Such behaviour is true breeding migration. But think of the many creatures which have totally deserted their former marine home—creatures like the slaters or woodlice of bushland, garden, and even sandy deserts.

Of all the crustaceans, slaters are the most completely adapted to a land existence, and there is every reason to believe they have been derived from marine ancestors. It is true that most kinds are found in damp places, but those which are desert dwellers must be content with a very slight degree of humidity. In no case is their dependence on moisture greater than that of numerous insects and spiders which are regarded as typically terrestrial animals. Turn over a garden slater some time and examine with a lens the location of the breathing apparatus. This takes the form of two tiny white spots directly behind the last of the creature's seven pairs of legs. The spots are tufts of

fine branching tubes radiating into the interior of two little appendages from slit-like openings on their outer edges. A remarkable fact is that this special modification for breathing is very like that found in the insects *et cetera*, and seems to have developed along parallel lines. With the insects, though, the breathing tubes branch everywhere inside the body, and their minute openings are found over most of the outside surface.

The transfer of the established land slaters from their former marine home is, perhaps, a comparatively recent change. Even this, however, would involve a very lengthy period by human standards for the creatures gradually to adjust themselves to a new and revolutionary mode of life. It would take ages and ages—thousands of years—for them to get right away from the sea and not have to return there any more. A fact of extraordinary interest is the striking contrast between the highly specialized types and the primitive forms living literally at the edge of the sea. Of the latter there are several kinds, and they are found along almost every shore. Some rove freely and conspicuously, while others live mostly hidden, burrowing in sand. All of them are considered to be the links between their innumerable true marine cousins and the highly developed land slaters—evidence of stages in transfer between the restless hordes of the seas and the dwellers of the land. They are totally dependent on the salt dampness of rocks, sand and spray. The reason is that their breathing apparatus has departed so little from that of their aquatic relatives. It provides little more than the taking of oxygen direct from water through the thin plates of small appendages on the underside of the body. Although so seemingly bound to the edge of the sea, these primitive land forms would, nevertheless, drown if immersed for long in water.

The most conspicuous shore louse of the Australian coast is the Sea Slater, rarely found further from the water than a narrow band of shoreline immediately adjacent to the high tide mark. It has a broad, flattened, greyish-black body and grows on occasions to an inch and a half in length. Being fleet of foot, it dodges and runs almost as speedily as a cockroach, creeping where possible into crevices between and under rocks. The long, often trailing, antennae give the creature quite an insect-like appearance.

Along the open coastline the Sea Slater seems to remain moderate both as to size and numbers. On the other hand, the shoreline population of the quieter inlets and estuaries at times assumes large dimensions and plague proportions. One such breeding storm, as it is technically known, occurred in the deeper reaches of Port Jackson, New South Wales, early in the year 1932. At that time several reports were received at the Museum about a strange cockroach-like "insect" swarming along the shore of Leichhardt Bay, near the mouth of the Parramatta River. When the tide was out there were literally millions of the Sea Slaters running over the damp rocks. We knew, as with all creatures reaching plague proportions, that the numbers would diminish just as quickly as they had increased. Not so the authorities at the nearby big dockyards on Cockatoo Island, who had soon after become alarmed at the spread of the lice plague to their waterfront. They sent specimens to the Museum, and stated that when water was pumped from their large ship dock the stone walls were black with the scurrying "pests". It was honestly thought the creatures were insects which would ultimately overrun the workshops and cause dire trouble. We learnt that the authorities had attempted to exterminate them by spraying the dock walls with steam. It was easy for us to allay any fears of the Slaters ever being able to leave, as a mass, the damp shore line around the limit of the highest tide. They could be left, as it were, to their own devices, being neither of the sea nor the land, but just a sort of betwixt and between.

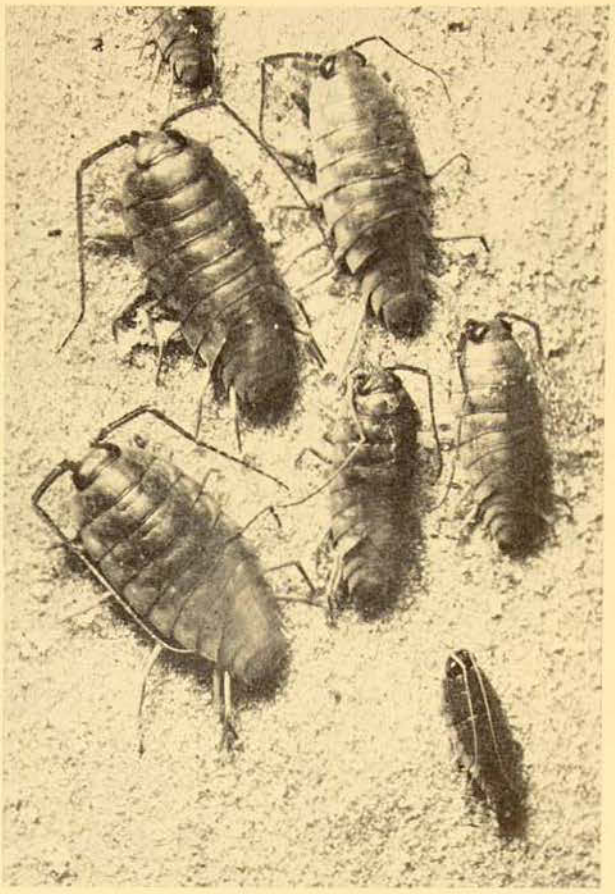
About the same time a resident of a waterfront home nearby reported large Sea Slaters running over his retaining wall and boat-slip. A few individuals

were actually making excursions up to seventy feet from the water along a shady side passage. It was understandable that this behaviour would cause some alarm. Shade, late afternoon and overcast skies will tempt the creatures to move further from the water line during the daylight hours, when their movements come more under notice than at night. During the darkness they are less hampered by the drying and suffocating effect of sunlight.

Along certain parts of the shorelines of South Australia and Kangaroo Island the same Sea Slaters occur at times in large numbers. In the places where there is a small tidal range, leaving only a narrow band of shore between high and low water mark, the creatures move swiftly away ahead of a walker like leaves before a wind.

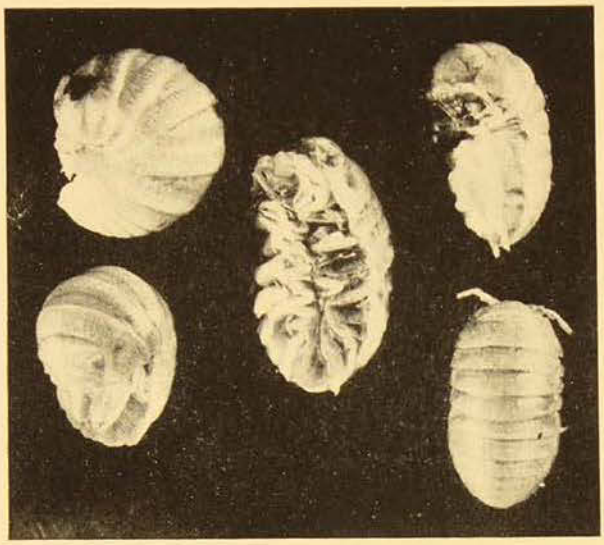
Not much is known of the feeding habits of the Sea Slater. While we believe that it is a scavenger, feeding on any kind of edible jetsam and dead shore life, it is probably also a predatory creature. Its fleetness of foot and strong jaws suggest an ability to run down and consume small living quarry like the crustacean sea fleas and sand hoppers living between tide marks.

The truly thorough scavengers of the beaches, both ocean and inlet, are the small shore lice which spend most of their lives hidden from view. They cannot face the rigours of full daylight exposure as do the better adapted Sea Slaters. Some beaches literally swarm with these Sand Lice. Mostly they pass unnoticed unless specially sought after. It is customary for them to come out in their numbers in the twilight and during the night. They crawl amongst seaweed that has been cast ashore by the waves and are found massed like a swarm of flies on the carcase of some dead fish or sea bird; few of them are more than a quarter of an inch in length. Convincing proof of their scavenging instincts was presented to us in February, 1931. A journalist arrived with eight or ten dried-up little specimens no bigger than a pin's head. These had been taken from holes gnawed in the legs of a bather who had been basking in the



Garden Woodlice (Porcellio scaber).
Photo.—G. C. Clutton.

sun on a beach at Narrabeen, just north of Sydney. The bather must have dozed off to sleep for conditions to have reached the stage they did. A sleepless night followed the experience, with the patient vainly trying to ease the pain of thousands of little wounds. He first discovered the lice when he tried to brush what looked like sand off his legs. The "sand" could not be moved; in fact, it was alive, and well on its way into the skin. A scarcely perceptible itch rapidly became more intense, until it was almost unbearable. Repeated applications of a disinfectant removed the Sand Lice, but the itching remained; not until medical treatment was sought did the condition of the patient improve. There is no doubt that, had that man been dead, he would ultimately have been consumed by the voracious hordes of Sand Lice. Such an incident as this could, of course, occur only in some extraordinary set of circumstances; it should not deter sun-bathers



Sand Lice of the ocean beach dunes; coast of New South Wales. A common habit is to curl the body up in the shape of a ball.
Photo.—Howard Hughes.

from continuing to enjoy the healthy relaxation of reclining on the sands.

Backing many of our coastal surf beaches are high sand dunes clothed with coarse creeping grass. These are well out of range of the waves, but close enough to the sea to absorb the damp from wind-driven and air-borne spray. Although dry on the surface under strong sunlight, the sand of the dunes is moist at a shallow depth; at least sufficiently moist to sustain in hiding a creamish-grey slater which appears to be advanced a stage further in the lengthy process of changing from a sea to a land existence. It grows to half an inch in length and curls itself up into a pill-like ball when handled. This slater is rarely seen in daylight, but a critical search of the dunes will disclose its presence in the way of fragments or whole remains. The creature stays in its semi-dry environment, which is too far from the sea for the practice of the same scavenging habits as its smaller neighbours. What it feeds upon is a question which as yet has not been investigated.

Whereas migratory land crabs obey an inexorable law by returning to the sea to release the larval young from their eggs, the Sand Lice and Slaters are not bound by this necessity. The young hatched from their carried eggs are miniatures of the parent in form and can almost immediately fend for themselves. Unlike other crustaceans they do not have to go through a free-swimming life and metamorphose from stage to stage until a form resembling the parent is attained.

In the present number of the MUSEUM MAGAZINE reference will be found to Dr. A. S. Corbet and some of the contributions he has made to the study of the Indo-Australian butterflies of the Family Danaidae. While the article was in the Press there arrived a copy of *Nature* for June 26, 1948, containing the sad news of his sudden death together with a biography by his colleague, N. D. Riley. The following facts are based chiefly upon this obituary. Dr. Alexander Steven Corbet was born on August 8, 1896, and died May 16, 1948. He was educated at Bournemouth and University College, Reading, Ph.D.; D.Sc. 1935 in biochemistry. He had a varied scientific career. He was first engaged as a bacteriologist to the School of Agriculture, Cambridge, and later as bacteriologist and entomologist to the Rubber Research Institute, Kuala Lumpur, F.M.S. While in Malaya he published, in collaboration with H. M. Pendlebury, a book entitled *The Butterflies of the Malay Peninsula* (1934). In May, 1939, he joined the staff of the British Museum (Natural History), where he was employed at the time of his death. In addition to his systematic papers upon the Rhopalocera, he also wrote, in association with his colleague, W. H. T. Tams, a series of papers on Lepidoptera which infest stored products, which includes some species of interest to Australian economic entomologists. His death deprives entomology of one of its best-known workers in the Order Lepidoptera.

A. MUSGRAVE.

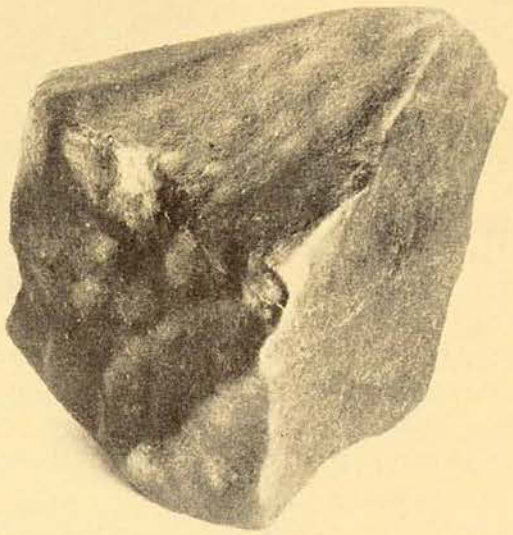
New Meteorites from New South Wales

By R. O. CHALMERS

THE NARDOO AEROLITES.

WHEN Mr. L. S. Brown, of Nardoo Station, near Wanaaring, in the far north-west of New South Wales, set out with his brother one morning in March, 1944, to muster sheep, just a routine matter on any of our big inland stations, he little thought that before the day was out he would have discovered two new meteorites. The circumstances are very interesting. During the morning as he was riding through the mulga scrub he noticed a tree that had been struck as though by lightning. Nearby was a stone, about 2¾ lb. in weight, which, to quote Mr. Brown, "did not look natural", and was unlike what few stones were lying around. This was placed in a fork of a tree that could be easily located later, and the two brothers proceeded with the day's work. Returning with the sheep in the afternoon, within about two miles of the station homestead, Mr. Brown saw another stone, that again did not look quite natural, and resembled the one picked up earlier in the day. This second stone, weighing about 4¼ lb., was brought to Sydney by Mr. Walter Brown, father of the finder of the two stones, and was identified as a stony meteorite, or aerolite, by the late T. Hodge-Smith, then the Museum Mineralogist, and is now called Nardoo No. 2. Some months later the smaller stone that had been left in the tree was recovered and also sent down. It proved to be an aerolite also and has been named Nardoo No. 1.

Mr. Brown's generosity in presenting these two fine specimens is greatly appreciated. The finding of a meteorite is an event of considerable scientific interest, because of the comparative rarity of these objects. To find two meteorites in the one day seven miles apart in sparsely populated country is a very noteworthy



The Nardoo No. 2 aerolite, weighing 4¼ lb.
Photo—Howard Hughes.

event, and this distinction is well earned by Mr. L. S. Brown, on account of his acute powers of observation.

Although most meteorites fall singly, showers have been known, particularly showers of aerolites. Aerolites, or meteoric stones, consist principally of stony material with varying amounts of metallic iron, containing a percentage of nickel. Very often the stony material is somewhat friable. The explanation of meteorite showers is simple. A single large mass enters the atmosphere from somewhere else in the solar system and falls under the influence of gravity. The friction with the air rapidly heats the aerolite to the point of incandescence. Complete fusion of the surface layers invariably occurs. If friable, further down during its passage through the air, the pressure of the denser atmospheric layers is often sufficient to shatter the

single mass into a number of fragments, each of which pursues its separate course to the ground. If the shattering does not occur until the aerolite is comparatively close to the earth, the speed is usually so reduced that insufficient heat is developed, fusion of the surface does not occur and the fragments, when found, show freshly fractured surfaces as well as portions of the original "crust" or "skin" caused by fusion of the outer layer of the original single mass when it first entered the atmosphere. The Forest Vale shower[1] is an example of this. Incidentally, the complete stone found together with the fragments of the Forest Vale indicates that there must have been a previous explosion of the mass at a much greater height in the atmosphere, for the following reason. If the shattering takes place at a sufficient distance from the ground each separate fragment may still be heated sufficiently to cause complete fusion of the freshly fractured surface as well as the original surface. Stones of this type are completely covered by a "crust" and show no fresh fractures.

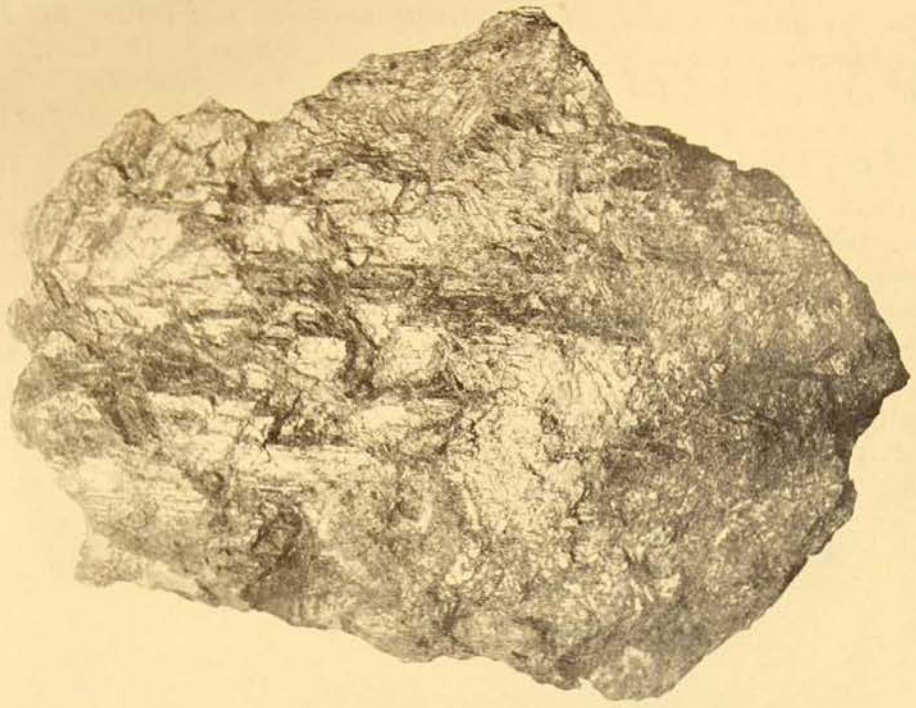
The fact that these Nardoo stones bear a striking outward resemblance to each other, and were found at no great distance apart, immediately suggests that they both belong to the one fall. If so, they are a product of this latter type of explosion of a single mass in the upper layers of the atmosphere. Furthermore, a third complete stone is known to have occurred in this same area. At a point some 25 miles to the north-west of where the Nardoo No. 1 was discovered, an aerolite, known as the Elsinora, came to light in 1922. This stone, which weighs about 1¼ lb., is now in the Museum collection. It bears a superficial resemblance to both the Nardoo stones, although more weathered. However, superficial resemblances do not afford sufficient evidence of identity. No definite pronouncement on the subject can be made until the two Nardoo stones have been chemically analysed, and their chemical composition compared with that of the Elsinora. Microscopic examination has been carried out, and Elsinora and Nardoo No. 1 are so similar in their mineral constituents and structures that one would be almost justified in saying without further examination that they belong to the one fall. The curious fact is that the two Nardoo stones, although closest together, and superficially most alike, differ more in their microscopic characters than do Elsinora and Nardoo No. 1. Even allowing for these differences, it must be remembered that all these belong to the most common group of aerolites and, on that account, the possibility that they are three quite separate falls must be considered. It is a nice little problem, and one on which the final word can't be said until a chemical examination of the Nardoo stones is carried out, which it is hoped to do soon.

[1] Hodge-Smith, T.: "A Fall of Meteorites at Forest Vale, N.S.W.", THE AUSTRALIAN MUSEUM MAGAZINE, Vol. VIII, No. 2, 1942, pp. 45-48.

THE DORRIGO SIDERITE.

Siderite is the name applied to the metallic meteorites which consist of a nickel-iron alloy. In the commonest types of siderite the alloy is by no means homogeneous. Due to the rather severe heat treatment received during their passage through the atmosphere, the nickel-iron alloys form in bands containing different amounts of nickel and arranged in a regular triangular pattern. This pattern shows quite visibly to the naked eye when a polished surface of a siderite is etched with acid, and is known as Widmanstätten figures. These nickel-iron alloys have the properties of high-grade steel and consequently do not corrode easily, although in time they become oxidized by the atmosphere and will rust away completely. Occasionally the process is hastened by the presence, both in aerolites and siderites, of a mineral known as lawrencite, which is the bane of the museum curator's existence. It is a chloride of iron, which fortunately is found only in meteorites, and oxidizes immediately it comes in contact with the air. It causes rapid decomposition of siderites, especially in humid salt atmospheres.

The Dorrigo siderite is of interest because it was apparently generously endowed with lawrencite when formed, and at the present it is in an interesting stage of decomposition, due to the com-

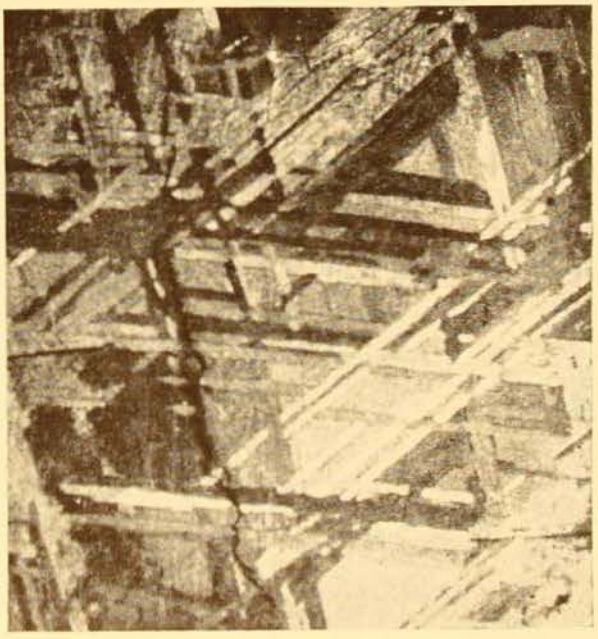


Portion of the Dorrigo siderite showing white triangular patches of unaltered taenite. The regular pattern is produced because the nickel-iron alloys are affected differently by oxidation and thus the Widmanstätten figures show up clearly. Note the completely oxidized outside crust of the meteorite along the top of the specimen.

Photo.—
Howard Hughes.

bined action of the lawrencite and long exposure to the atmosphere. The only alloy that has withstood decomposition is taenite, because it contains the most nickel of all the meteoritic alloys. It stands out in the photograph as white patches, wholly or partly triangular in shape. In the hand specimen the taenite is the only fresh looking material and is tin-white with a metallic lustre. The rest of the material is brown and dull and is a magnetic oxide of nickel and iron. On the top of the specimen a border of iron oxide showing no structure can be seen. This is the outside crust. Elsewhere the regular triangular pattern of the Widmanstätten figures has been accentuated by decomposition, the taenite areas standing out in marked relief.

The specimen was found by Mr. J. A. McGuire in the town of Dorrigo, and was only recognized as being something out of the ordinary after it was cracked with a hammer. Outwardly it resembled the weathered basalt boulders which are common in and around the town, and had Mr. McGuire not been cracking the boulders to fill in a hole in the road, it might never have been discovered. Furthermore, it might still have been unrecognized had not a small specimen found its way into the hands of Mr. J. J. Johnston, an enthusiastic Sydney mineral collector, who, suspecting it to be of meteoric origin, brought it to the Museum for identification.



Widmanstätten figures produced by the action of weak acid on the polished surface of an undecomposed siderite.

Photo.—G. C. Clutton.

A visit was made to Dorrigo and the largest remaining mass, weighing some 16 lb., together with a couple of fragments weighing a pound or so, and a lot of small fragments were acquired for the Museum collection. No information regarding the circumstances under which it fell could be obtained, which, together with the weathered appearance, indicates that it fell a considerable time ago, although it would be impossible even to hazard a guess as to its exact age. On arriving in Sydney the specimens began to decompose at an alarming rate. Apparently the moisture-laden sea air of Sydney did not agree with them. The lawrencite began to behave more objectionably than usual and in a few days they were covered with a mass of tiny drops of green and brown liquid decomposition products. To preserve the specimens it was necessary to place them in sealed glass containers containing silica gel as a drying agent. Small fragments which were purposely left exposed to the air, within a few weeks could be flaked to pieces in the fingers.

Review

BEETLES AHOY! Being a Series of Nature Studies specially written for Children. By Ada Jackson. (Paterson's Press Ltd., Perth.) 160 pp., 8s. 6d.

IT is a pleasure to review this series of Nature Studies for School Children by Ada Jackson ("Ajax"). It is brightly written, and although in dialogue form it does not descend to the bare and stilted question and answer of "Little Arthur", whom many of us met within our youth. Anyone who has attempted this style of nature study writing will realize the difficulties that the authoress has successfully overcome. But, above all, the book is notable for a feature, unfortunately lacking in many recent nature books for children, that is accuracy.

The title, "Beetles Ahoy!" is misleading, for its pages deal with far more than merely beetles, the subjects of the various chapters ranging from beetles to kangaroos, from marine life to grass-trees. No youngster reading the book can fail to learn much about the strange and often unique living things which share our land with us, and discover a new interest in their lives.

Criticism is perhaps called for in a few instances only; and in a book of this type they are of relatively minor importance. On page 17 reference is made to the larva of the longicorn beetle feeding in the hardest wood; on page 27 it is stated that "termites are the only living things that can eat wood—and thrive on it". Actually, like the longicorn beetle and the termite, wood-boring insects and other animals eat wood—and "thrive on it". On page 149 it is stated that the ant-lion is "the larva of a fly that belongs to the dragon-fly family". The ant-lions belong to the order Neuroptera, family Myrmelionidae; dragonflies to the order Odonata, and are divided up into a number of families. Dragonflies and ant-lions are only distantly related.

It is to be regretted that illustrations are lacking; the chapter-headings are inadequate for the purpose. They show, however, that the artist is quite capable of preparing the necessary drawings for illustration.

One last point remains: why are "professors" always endowed with long white beards?

The book is heartily recommended for children, and for use in the primary classes in our schools. Authoress and publishers are to be commended on the production.

K.C.McK.

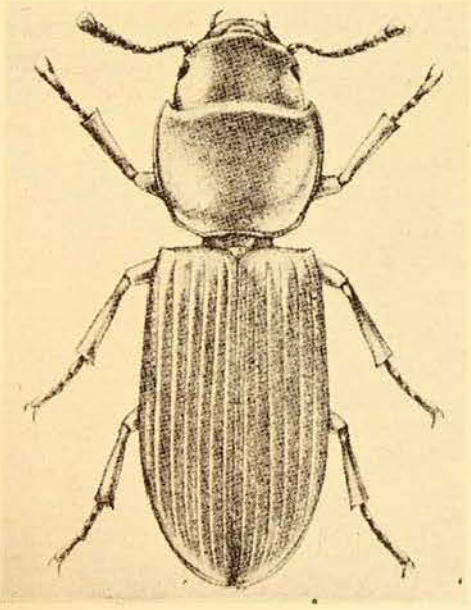
Australian Insects. XXXIII

Coleoptera 10—The Trogositidae

By KEITH C. McKEOWN.

THE Trogositidae (sometimes called Temnochilidae or Ostomidae) is another of those small families of beetles about which, apart from descriptions of species, little is known. As a result of this they lack a popular name. Of native species, only about forty have been described from Australia, although some species are widely distributed and fairly numerous. The commonest and best known of these insects—*Tenebrioides mauritanicus* Linn.—is cosmopolitan in its distribution, and has been introduced here. Since this insect is of economic importance, its life-history is adequately known, in marked contrast to our native forms, of which we do not even know with certainty upon what they feed, either as larvae or adults.

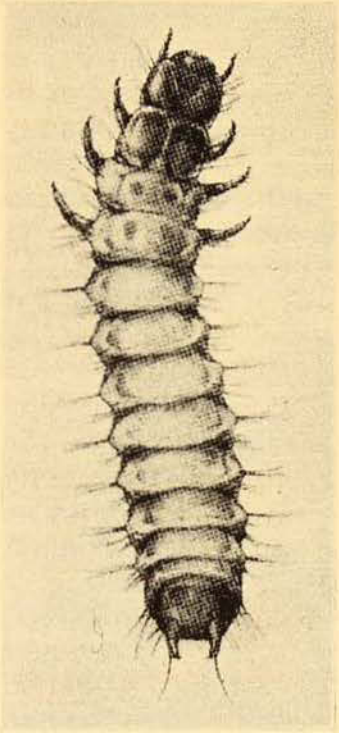
The chief distinguishing characters of the adult Trogositidae lie in their tarsi, or feet, and the antennae. The joints of the foot are five throughout, with the basal joint very small, the second somewhat longer, the third and fourth similar in length to the first, and the fifth markedly long. The antennae are clubbed, but the club is not symmetrical, as the three joints which make up the swollen portion are enlarged on the inner side only. The first or basal joints of the hind legs—the coxae—are situated so close together as almost to touch. The majority of our species are placed in the genus *Leperina*, and these insects are moderately broad in form, with only the largest individuals attaining to a quarter of an inch in length, the majority, even in the same species, falling below this. Despite their small size and retiring ways, they are very curious and beautiful in appearance, being decked with patches of hairs and scales, producing a striking mottled effect. The Australian insects are usually grouped in four subfamilies, the Nemosomatinae, the Leperininae, and the Ostominae. The fourth, the Temnochilinae, also accommodates the introduced species referred to above. The larvae are usually cylindrical, with short legs.



The Cadelle (Tenebrioides mauritanicus), an introduced grain pest.
After Back and Cotton.

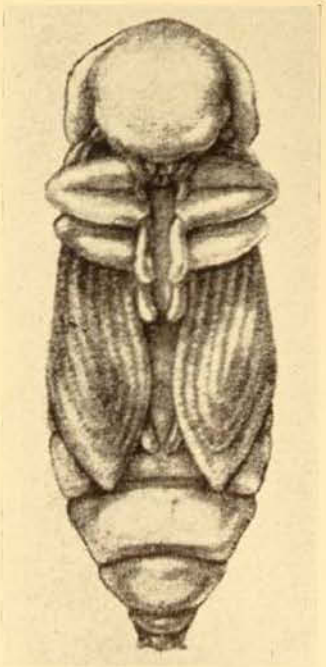
The adult beetles are to be found, as a rule, hiding by day under bark flaking from the trunks of trees; the larvae frequent decaying wood. In both stages they are usually considered to be "predaceous", but this statement is largely unsupported by direct evidence. This question of the food of Trogositidae had better await confirmation; this can only be secured when the lives of the insects have been intensively studied—a study which should not present any particular difficulties where the larvae are found.

The subfamily Nemosomatinae includes only one Australian species, *Egolia variegata* Er., a slender, elongate beetle, densely black in colour with the elytra thickly spotted with bright yellow. It occurs in Tasmania, but appears to be uncommon. It has also been recorded from Tahiti, but whether native or an introduction to that island does not seem to be known.

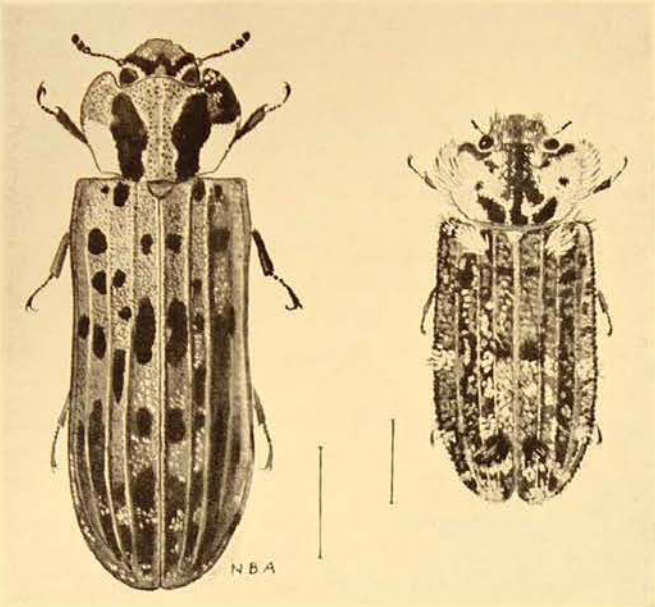


Larva of the Cadelle.
After Back and Cotton.

One species only, *Tenebrioides australis* Boisd., in the subfamily Temnochilinae, has been recorded from Australia, but the genus also includes the cosmopolitan Cadelle (*T. mauritanicus* Linn.). This beetle and its larva infest grain and grain products, such as breakfast foods, flour, biscuits and bread, but may also frequently be found in nuts, seeds, and various dried fruits. Despite the intensive studies that have been made of this insect, and although the details of its life-history are well known, opinions differ as to the food of the larvae. Some workers contend that they are predaceous, feeding upon the grubs of other types of grain insects; E. A. Back and R. T. Cotton, however, consider that any injury to other larvae has been caused as a result of the restricted space in which the insects have been confined. They conclude that they are essentially vegetarian in their diet. The adult beetles, on the other hand, are "both predaceous and granivorous", and if animal food is available tend to produce more eggs. In wheat the beetles seem largely to confine their activities to destroying the "germ" of the grain. Tillyard considered that the insects devoured "codling-moth larvae and other pests"—but this is extremely unlikely. The larvae are extremely resistant to starvation, even under normal conditions; it has been found that when kept without food at an average temperature of 68° F., they lived for fifty-two days. The adult beetle, as shown in the illustration, is a narrow oblong in shape, and of a dark reddish-brown or black in colour. It measures up to 10 mm. in length. The full-grown larva may be a clear or muddy white in colour, cylindrical, with the head and thorax dark brown, and a similarly coloured horny plate armed with two distinct projections upon its posterior. It may grow up to three-quarters of an inch in length. The white pupa is usually



Pupa of the Cadelle.
After Back and Cotton.



Australian Trogositid Beetles (Leperina decorata and L. cirrosa).
N. B. Adams, del.

hidden from sight in a cell gnawed in wood adjacent to its former food supply, or in some other situation, the more inaccessible the better.

Among the members of the subfamily Leperininae, *Leperina cirrosa* Pascoe and *L. decorata* Er. may be selected as possibly the most striking of the numerous species of this genus. Most of the species are very similar in form, but duller and less conspicuously decorated. *L. cirrosa* occurs in Queensland, and is a general blackish-brown colour with patches of buffy scales and tufts of white hairs dispersed over its surface, giving it a very ornate appearance; the expanded sides of the prothorax are densely clothed with large patches of long, shining white hairs. *L. decorata* is not so hairy; the pattern being produced by patches of vari-coloured scales, black and reddish-buff predominating, on a general background of dark brown. Each of the expanded sides of the prothorax is adorned with an irregular patch or spot of bright yellow. But such a description is inadequate; when viewed in a bright light the appearance of this insect is surprisingly beautiful. The accompanying illustrations of both species give a good general idea of these beetles, although, of necessity, they lose much by their lack of colour.

Members of the fourth, and last, subfamily, the Ostominae, are mostly insects, broad, flattened, and of oval contour, with the margins of the prothorax and elytra flattened to form a distinct flange almost surrounding the animal. Most of them are small and brownish, but some have the elytra varied, though inconspicuously, with minute patches of yellowish hairs. These insects are included in the genera *Peltonyxa, Neaspis, Ancyrona*, and *Soronia*. Insects of the genus *Phycosecis* are minute, less rounded in outline but fuller in profile, and clothed densely with pale grey scales.

Some Butterflies of Australia and the Pacific

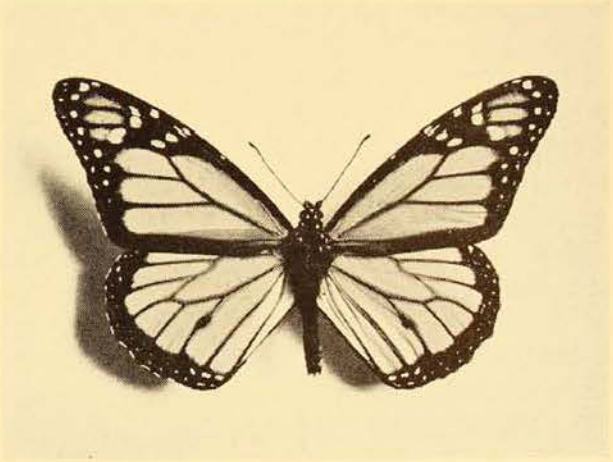
Family Danaidae—Danaids I

By A. MUSGRAVE

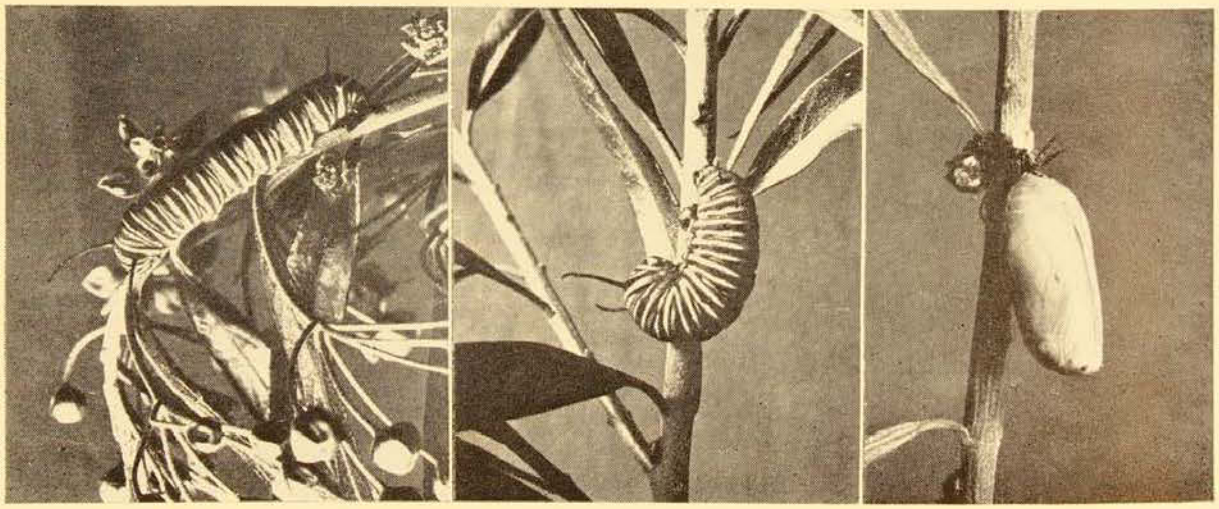
THE members of the family Danaidae are usually large butterflies with the wings rounded and never tailed. The adults have the first pair of legs imperfectly developed in both sexes. In the fore and hindwings the cells are closed. The submedian vein in the forewing is forked near the base. Many of the males have raised scent pouches or patches of specialized sex scales on the fore or hindwing and the veins thickened. These insects are noted for their tough qualities and tenacity of life. In addition they possess distasteful body fluids which make them unpalatable to enemies. They fly slowly as a rule. Many species are gregarious. This family occurs most abundantly in the tropical parts of the Indo-Australian region.

The egg is conical, broad at the base, higher than broad, with vertical ribs and cross-lines. The larva is smooth, banded, with two to four pairs of fleshy tentacles and a small head. The foodplants are those with a milky sap. The pupa is short, stout, smooth, often metallic, and

* Photographs, unless otherwise stated, are by the author.



The Wanderer, Danaus menippe Hübner, widely distributed in Australia and the Pacific, whose original home was America. The wing expanse is about three and three-quarter inches.



Life history of the Wanderer, Danaus menippe Hübner.

is suspended by means of the hooked cremaster in the tail so that it hangs head downwards.

GENUS DANAUS.

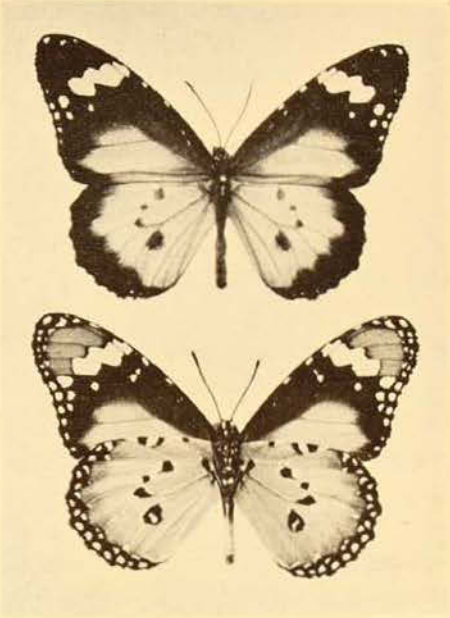
In the genus *Danaus* we have some showy forms, including The Wanderer, *Danaus menippe* (Hubner, 1816), which has been known under many different names. In my "Classification of the Australian Butterflies"[1] I referred to it as *Danaida archippus*, overlooking the fact that Talbot (1941)[2] has shown that *menippe* should be used for this American species which has spread over the world, and *D. plexippus* (Linn., 1758) for the Indo-Australian butterfly which it somewhat resembles.

The Wanderer is also referred to in Dr. G. A. Waterhouse's *What Butterfly Is That?* as *Danaida plexippus* Linn. 1764. The *male* is orange-red with black margins to the wings on which white spots are present; the veins are black. The sex mark is very close to vein 2 in the hindwing. The underside resembles the upper surface but the hindwing is paler. The *female* resembles the male, but lacks the sex mark and the veins are more suffused with black. The pale yellow eggs are laid singly on young leaves of the food plants. The larva and pupa were figured in a previous article. The larvae feed on plants with a milky sap such as the Milk or Cotton Weeds, *Asclepias curassavica* and *Gomphocarpus fruticosus*. The butterfly is very common in eastern Australia, and occurs in the islands to the north of Australia ranging from New Guinea to the Solomons and other Pacific islands. The smooth pale-green pupa has golden spots. It is usually to be found suspended on some plant, such as a bracken fern, near the food plant. When it pupates on the food plant it is almost invariably parasitized by flies. About a fortnight is spent in the pupal stage during the summer.

[1] Musgrave, A. The Classification of Australian Butterflies. *Austr. Mus. Mag.*, viii (9), Sept.-Nov., 1944, 317-322, illustr.

[2] Talbot, G. Revisional Notes on the Genus *Danaus* Kluk (Lep. Rhop. Danaidae). *Trans. R. Ent. Soc. Lond.*, 93 (1), August, 1943, 115-148.

The Lesser Wanderer, *Danaus chrysippus* (Linn., 1758), and its many forms and subspecies, forming the *chrysippus* group, have been recorded from Ceylon, India, Burma, Andamans, China, Formosa, Hainan, Indo-China, Malaya, Java, Palawan, Philippines, Celebes and Sula Islands, Moluccas, Key and Aru Islands,



The Lesser Wanderer, Danaus chrysippus petilia Stoll, showing upper and underside of male. Wing expanse about two and a half inches.

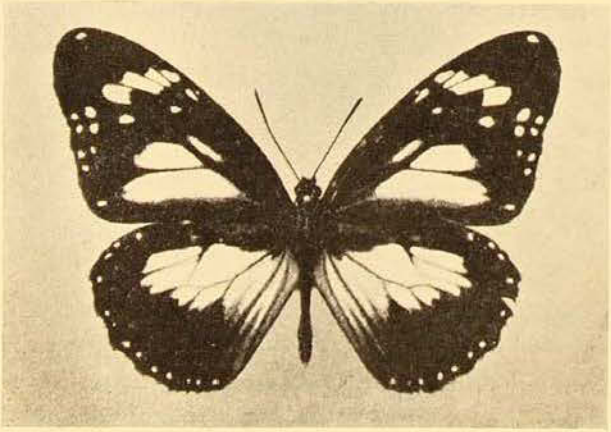
New Guinea, Australia, New Hebrides, New Caledonia and Fiji. The subspecies *petilia* (Stoll, 1790) occurs in Australia, New Guinea, New Hebrides, and other Pacific Islands. In Australia it is widely distributed, and I have taken it on the Hamilton River in Central Australia. The upper surface of the male butterfly is tawny-orange or yellowish with the black apex of the forewing crossed by a band of white spots; the margins of the wings are black. The underside approximates to the upper side, but the black margins are narrower and there are white dots on the hindwing and, near the cell, a white area with black spots and white stripes along the veins. The female, apart from the absence of a sex-mark, resembles the male in colour.

The life-history has been described by Dr. Waterhouse. The larva on hatching

from the pale-cream egg is smooth with broad black and yellow transverse bands and three pairs of reddish tentacles. Its food plants are cotton plants. The pupa is smooth, greenish with golden spots near the head. The pupal stage lasts about a fortnight in the summer.

Danaus plexippus occurs in a variety of local forms to constitute the *plexippus* group. These range over a wide area, including Ceylon, India, China, Malaya, Philippines, Celebes, Sula Island, Lesser Sunda Island to Tenimber, Key and Aru Islands, and Australia. The form or subspecies, *D. plexippus alexis* Waterhouse and Lyell, 1914, popularly termed "the Orange Tiger", occurs in northern Australia at Port Darwin and Derby. This is a small form with the band of the forewing compact and narrow and a minute submarginal spot in area 2.

Danaus affinis (Fabricius, 1775), "the Black and White Tiger", consists, as Talbot points out, of two forms, which may occur together but one always in greater numbers than the other. He says, "The lighter or *affinis* forms range from the Nicobars and Malaya to Australia and the Bismarck Islands. The darker or *philene* forms have a more restricted range from Celebes and Moluccas to Australia and Solomons". To the last-named form belongs "The Brown Tiger", *D. affinis* subsp. *ferruginea* Butler, 1876, which is one of the many colour varieties found in New Guinea. Waterhouse and Lyell have named a geographical race, which occurs on Darnley Island, Torres Strait, as *gelanor*. The upper side of this insect is brown with white marginal spots and a band of subapical spots; the hindwing bears two rows of faint subterminal white spots. On the underside the pattern resembles the upper surface, but the white dots are more pronounced on the hindwing. The male has a brown-black sex mark in area 1a.



The Black and White Tiger, Danaus affinis affinis Fabricius. The wing expanse is about two and a half inches.

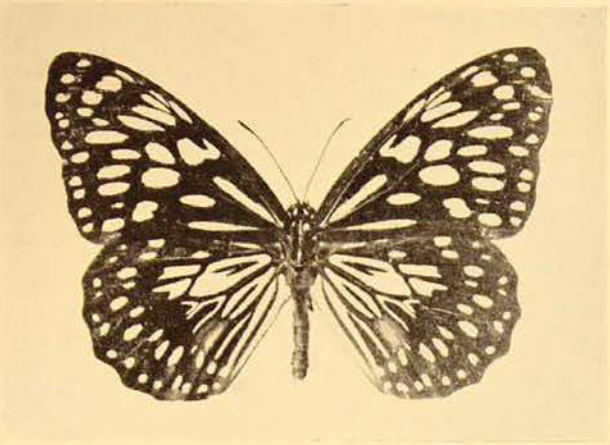
In the typical *affinis* the white markings are fully developed and the brown colouring is absent. This insect occurs commonly along the coast from north Queensland to the Richmond River. Odd specimens have been taken as far south as Sydney. Mr. H. Hacker[3] has described and photographed the early stages. The larva feeds on a trailing plant, *Vincetoxium carnosum* Benth., which grows on the edges of salt creeks and swamps always among reeds, to which it clings for support. Many colour varieties occur throughout the range of the species in the islands north of Australia.

Danaus hamata (Macleay, 1826), or "The Blue Tiger", is shown by Talbot to be closely allied to *D. limniace* (Cramer), "the wings of both species being similarly striped and spotted. In *limniace* the spots and stripes are larger and broader". This last-named ranges from West Africa to Timor, occurring under different forms. The different colour forms of *D. hamata*, on the other hand, range from Ceylon, India and China through the Malayan region to the Moluccas, New Guinea and adjacent islands, Australia, and the Pacific islands to Tonga and Samoa. The typical subspecies, *hamata*, occurs in Australia. It is black with blue streaks and blue spots near the wing margins. The underside is similar, but the markings are fainter. In the *male* the sex mark is seen as a silky spot near vein 2 on the upper side of the forewing and forms a grey pouch below.

When at Cleveland Bay, on 16 June, 1819, Captain Phillip Parker King

[3] Hacker, H. The Early Stages of *Danaida affinis* Fabr. *Mem. Q'land Mus.*, viii (1), Jan., 1924, 43-44, pl. ix.

records in his *Narrative of the Survey of the Intertropical and Western Coasts of Australia*, 1826, an interesting occurrence,



The Blue Tiger, Danaus hamata Macleay, has a wing expanse of about three and a quarter inches.

> Here, as well as at every other place we had landed within the tropic, the air is "crowded" with a species of butterfly, a great many of which were taken. It is doubtless the same species as that which Captain Cook remarks as so plentiful in Thirsty Sound; he says, "we found also an incredible number of butterflies, so that for the space of three or four acres the air was so crowded with them that millions were to be seen in every direction, at the same time that every branch and twig were covered with others that were not upon the wing". The numbers seen by us were indeed "incredible"; the stem of every grass-tree, xanthorrhœa, which plant grows abundantly upon the hills, was covered with them, and in their taking wing the air appeared, as it were, in perfect motion. It is a new species and is described by my friend, Mr. W. S. Macleay, in the Appendix, under the name of *Euploea hamata*.

Banks, in his *Journal*, has much the same to say about this butterfly as that appearing in the official account of the voyage of the *Endeavour*. This butterfly occurs in swarms in the Whitsunday Islands off the east coast of Queensland, as my friend Mr. F. A. McNeill[4] has pointed out, and where, on Hayman Island in particular, he noted that towards evening they assembled in a camp, resting in millions on the trees. He informs me that as a result of several subsequent trips, he is confident this swarming habit is normal in any year during, at least, the month of September.

Genus Euploea.

The tropical genus *Euploea* constitutes a group of Danaids popularly termed the "Crows" and found chiefly in the Indo-Malayan, Australian, and South Pacific regions. In Australia, the genus extends as far south as Victoria in the east, and to Derby in the west.

The butterflies of this genus have been recently revised by A. Steven Corbet (1942,[5] 1943[6]) and by G. Talbot (1943[7]). Corbet points out that although Fruhstorfer[8] "has recognized over 140 different species of *Euploea*, it is doubtful, in fact, if more than 40 species exist".

These Danaids are all black or dark-brown with white spots or markings and, in some species, a bluish or purplish sheen is present on the upper surface of the wings. The males have characters which enable them to be more easily separated into species than the females, but, as Talbot points out, "the problem of associating the geographical races of the same species is more involved". In the males of *Euploea* the hind-margin of the fore-wing (dorsum) is frequently convex or outwardly bowed, particularly, as Dr. Waterhouse has indicated, in those forms recorded from Australia. The silky sex-stripes or "brands" vary in the positions they occupy in the spaces 1a and 1b of the forewing of the different species; these relative positions, important for classification, have been dealt with by Corbet (1942). In the males of many forms sex-brands are absent on the forewing, but on the hindwing is a lightish area, the *speculum*, upon which may be a raised patch of androconial

[4] McNeill, F. A. Notes on the Gregarious Resting Habit of the Danaine Butterfly, *Danaus melissa hamata* W. S. Macleay, in the Whitsunday Islands off the East Coast of Queensland. *Proc. R. Ent. Soc.* Lond., (A) 12 (8-9), Sept., 1937, 108.

[5] Corbet, A. S. Revisional Notes on the Genus *Euploea* F. *Ann. Mag. Nat. Hist.*, (11), ix (52), April, 1942, 253-271.

[6] Corbet, A. S. A Key for the Separation of the Indo-Australian and African Species of the Genus *Euploea* F. (Lep. Danaidae). *Proc. R. Ent. Soc. Lond.*, (B) 12 (2), Feb. 1943, 17-22.

[7] Talbot, G. Notes on the Genus *Euploea* Fabr. (*Lepid. Danaidae*). *Proc. R. Ent. Soc. Lond.*, (B) 12 (1), 15 Jan., 1943, 6-16.

[8] Fruhstorfer, H. In A Seitz, *The Macrolepidoptera of the World*, Fauna Indo-Australica, ix, 1911, 275-278.

scales. In some of the *Climena* species-group both sex-brands and speculum are absent. In the females the dorsum of the forewing is straight. Talbot (1943) has stated that,

> Generally speaking, in the female the wing-pattern, particularly on the underside, partakes much of the male, and is often quite similar. In the females of most species the forewing underside, in area 1b, has a pale stripe. The length, thickness, and definition of this stripe, and its distance from the pale area in lower part of 1b is not always constant. In females of the following species there is no stripe in 1b, or it is vestigial, or it is represented by a normal pattern-spot: *Eleusina* group, *Tulliolus* group, *Phaenareta* group, *klugii* Moore, *leucostictos* (Gmelin), *usipetes* Hew., *diocletianus* (F.).

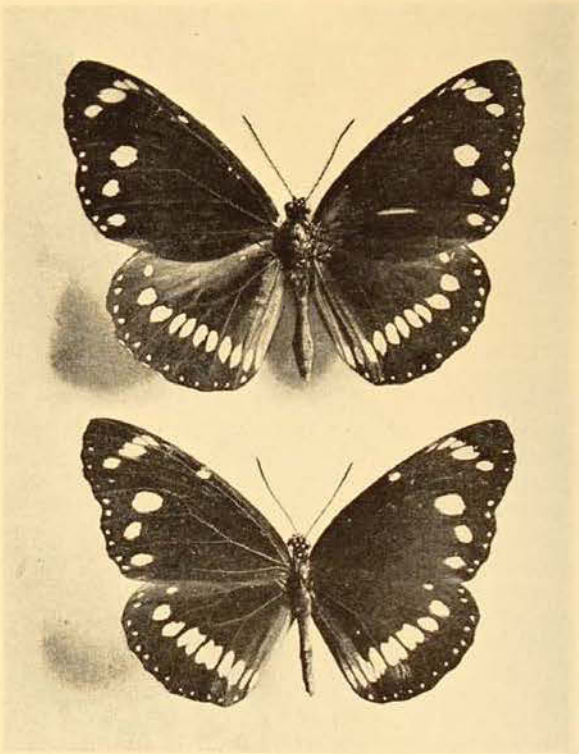
The butterflies of the genus *Euploea*, as in other genera of Danaidae, resolve themselves into certain "species-complexes" or "groups". Some of these species-groups in the past were raised to the rank of subgenera, but here I follow Corbet, who regards them as species-groups. Eleven groups are recognized by him for the Indo-Australian and African species, but for the purpose of this article, only the eight which include Australian, New Guinea, or Pacific Island forms are mentioned.

Corbet (1942) has shown that the different species of this genus are remarkable for their similarity in general appearance when they fly in the same area. He points out,

> Moluccan races are darker, with reduced or obsolete markings, and representatives from New Guinea are rather similar. Forms from islands of the Timor group are remarkable for the rather falcate forewing and the greatly increased white spotting; representatives from Australia are similar to the corresponding forms from New Guinea or Timor and, in the case of *E. tulliolus*, it is evident that Australia has been colonized by forms from both Timor and New Guinea, which now fly together in some districts and apparently do not interbreed. The occurrence of two "species" of the same species-complex in the same habitat makes the question of nomenclature somewhat involved, and particularly so in the case of the *E. tulliolus*-complex where two distinct forms occur together, and apparently behave as distinct species, in the Sula Islands, New Guinea and Australia.

In an earlier paper Talbot (1921[9]) has dealt with Euploeines from various island groups including Australia and he shows that *Euploea core corinna* and *E. sylvester*

> are variable in the north and are nearly constant in the southern part of their range. Typical *sylvester* is mimicked by *eichhorni*, which occurs in the area, and is rarer than either *corinna* or *sylvester*. Typical *corinna* is mimicked by *sylvester pelor* and *sylvester dardanus*. It looks as though the *sylvester* f. *crithon* acquired markings in association with *corinna*, and that these markings were intensified by association with *eichhorni*.



The Common Australian Crow or Oleander Butterfly, Euploea core corinna Macleay, showing the male (above) with rounded hind margin to forewing; female (below) with hind margin of forewing straight. Wing expanse from about 2½-3 inches.

A Queensland naturalist, M. J. Manski, writing on "The Euploeas (Rhopalocera) of the Cairns District" in *The North Queensland Naturalist*, Cairns, vol. viii (59), Sept., 1939, pp. 3-4, advances the opinion

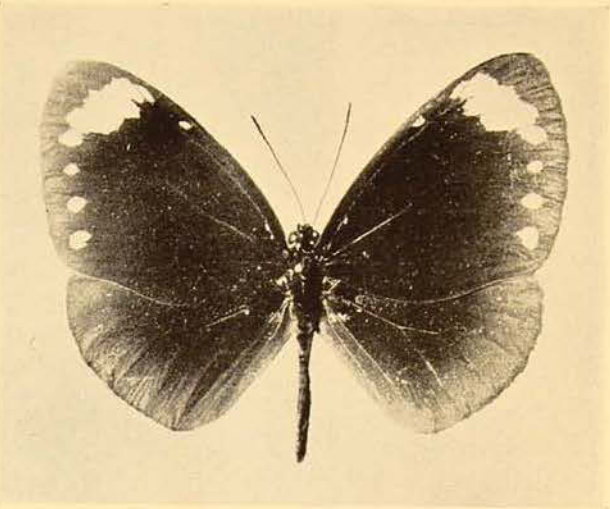
> that *E. corinna*, *E. eichhorni*, *E. sylvester* inter-breed with one another as their habits are the same, food plants, as far as known,

[9] Talbot, G. Euploeines Forming Mimetic Groups in the Islands of Key, Aru, Tenimber, Australia and Fiji &c. *Bull. Hill Mus.*, i (1), October 17, 1921, 16-31, pls. i-iv.

are the same, the adults are on the wing in the same locality, and I have even obtained caterpillars which I suspected were *E. sylvester*, owing to marked differences, but they always emerged *E. corinna* or *E. eichhorni*.

If, however, we accept, with Corbet, the presence or absence of the sex-brands of the males as furnishing characters for the separation of species-groups we find that these three species are included in three distinct species-groups.

Similarly with *E. tulliolus tulliolus* and *E. darchia* [= *hyems*] *niveata*, which are placed by Corbet in the *tulliolus*-group, Manski suggests, for the same reasons that he gives above, that they inter-breed. The larvae of these two species have only three pairs of tentacles not four as in other Euploeas.



The Eastern Brown Crow, Euploea tulliolus tulliolus Fabricius. A male specimen from Mackay, Queensland. Wing expanse about two and a half inches.
Photo.—H. Hughes.

(To be concluded.)

By the death of Mr. E. C. Andrews on July 1 the Australian Museum suffered the loss of a trustee who had been associated with it since 1924.

Mr. Andrews had had a distinguished career in the service of this State, retiring from the position of Government Geologist in 1931. Whilst with the Department of Mines his duties took him throughout New South Wales, and it is doubtful if there is a mining field which he had not visited for he had reported on most metalliferous mines. An immense amount of his work on the different fields is contained in official publications, probably the finest being his memoir on Broken Hill.[1] Apart from this he had, in his earlier years, carried out extended geographical field work for Alexander Agassiz of Harvard, and had attended many conferences abroad in connection with mining, geographical and scientific work. He was an eminent physiographer and had published many papers. In 1915 he was awarded the David Syme Medal and Prize by the Melbourne University, in 1928 the Clarke Memorial Medal by the Royal Society in New South Wales, in 1931 the Lyell Medal of the Geological Society of London and in 1946 the Mueller Medal by the Australian and New Zealand Association for the Advancement of Science.

As a trustee of this Museum he took a keen interest in its various activities, and it may be truly said that he regarded the various scientific officers, no matter how junior, as colleagues, frequently discussing with them the researches upon which they were engaged.

[1] New South Wales Geological Survey, Memoirs, Geology, No. 8, Geology of the Broken Hill District, by E. C. Andrews, 1922. Supplementary note by author, 1923.

Marine Cave Wonderland

By ELIZABETH C. POPE

THE coast near Bermagui was almost the first part of Australia to be described by Captain James Cook, and his journal has this entry for Saturday, 21 April, 1770: "At six, we were abreast of a pretty high Mountain laying near the Shore, which, on account of its figure I named Mount Dromedary". Earlier on that day Cook had noted the smoke of fires in several places—"a certain sign that the country is inhabited" and he also commented most favourably on the aspect of the country itself which he rightly judged to be "agreeable and promising". This comment is still very much to the point and as he goes on, "I did not think it safe to send a boat from the Ship, as we had a large hollow Sea from the S.E. rowling in upon the land, which beat every where very high upon the Shore; and this we have had ever since we came upon the coast", we wondered what opportunities such a wild coast would offer to zoologists interested in shore collecting.

Our first trip to this region (Narooma to Bermagui) was made in January, 1946, and as it coincided with stormy seas, we felt that such an exposed coast was not as promising a collecting place for the observer between tide marks as some of the central, more sheltered parts of New South Wales. However, enough of interest was recorded on this first occasion, from what was snatched from the rocks between successive waves, to make us feel that, somewhere in the latitude of Bermagui, stragglers from a more southerly coastal fauna would be found and that some of the creatures from warmer waters would be found to be fading out, if only calm conditions would prevail for a short time—sufficient to allow us to search in safety. We determined therefore to come back to Narooma and Bermagui at a time when the seas should be suitable and so chose the autumn month of May.

Luck was with us, in that prolonged westerlies blowing from the shore kept the seas almost flat throughout our working time, and enabled us to venture into the most productive collecting areas of the rocks, right down near low-water mark.

Among the peculiarly shaped stacks in the Bermagui-Narooma district none is more picturesque than Camel Rocks, and round its base are many nooks and crannies for sea creatures to hide in.

* Photographs, unless otherwise stated, are by the author.

Near the mouth of Corunna Inlet are numerous stacks, arches and caves which form an intriguing hunting-ground for the zoologist.

The rocks of this part of the coast are of Ordovician age and are much older than those of the more central areas of the coast of New South Wales. In the course of their long existence they have been very much folded and crumpled and most of them have been metamorphosed to some extent. The sea, working on these rocks, has weathered them in the most peculiar way and has led to the formation of some grotesquely shaped stacks, arches, caves and rock pools which remind one of boiling devil's cauldrons. The well-known Camel Rocks, just to the north of Bermagui, and the arches and tunnels near the mouth of Corunna Inlet, are outstanding examples of the action of the pounding seas on these old rocks.

Smooth seas enabled us to poke around these places and even to enter and explore some of the caves and tunnels, where we found an abundance of the nooks and crannies so beloved by shore invertebrates. As we had suspected, the fauna was quite rich in species; it had merely been inaccessible during our first visit.

A large cave at Narooma provided the most interesting experience of our trip, for in it flourished many of the creatures which seek shade and shelter and therefore usually hide themselves from view under boulders. In the cave, they were out in the open for all to see, attached to the rock floor and walls or in the two fine pools towards the back of the cavern. Several feet in from the mouth, few creatures seemed to favour attaching themselves to the side walls and none to the roof, if we except a couple of nesting swallows in the back of the cavern. The floor was the popular spot.

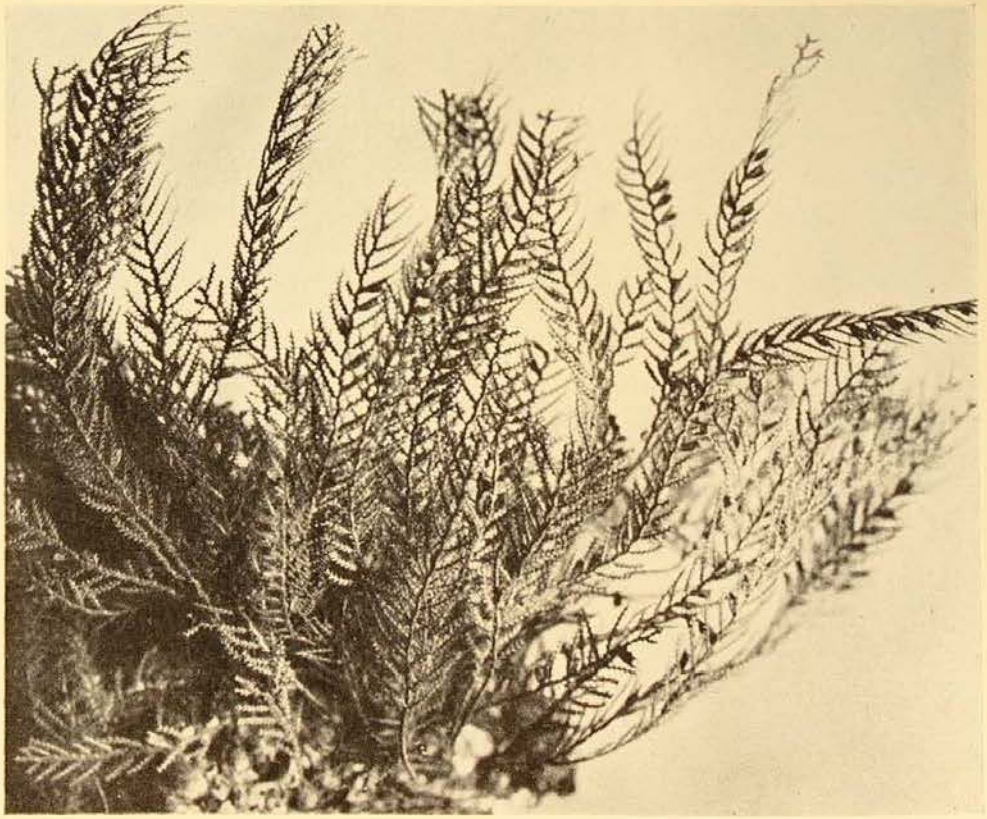
At its mouth the floor level was near low-water mark and from this point it sloped up gradually for about fifty feet to the inner end of the cave where it was approximately two to three feet higher. The only interruptions in its surface, apart from small crevices and cracks, were two impressive pools three to four feet deep. The mouth of the cave, which was about twenty-five feet across, framed a most delightful view of the tree-clad and grassy hills which slope to the ocean at the mouth of the river at Narooma.

The almost complete absence of seaweeds in the cavern was only to be expected because of the lack of light, and only one small, brown-coloured species was seen, growing like a fur on the rock of the cave floor, but the animal life made up for it. The higher, back areas of the floor were carpeted with a closely-packed growth of the barnacle, *Tetraclita pur-*

Mouth of the cave at Narooma which proved such a delightful collecting place. Note the extremely calm sea.

purascens. There was literally not room to put a shilling down between them.

On the middle levels of the floor a tightly packed and inter-twined mass of the tubes of the peculiar worm, *Idanthyrsus pennatus*, showing all the little heads, each with its array of horny bristles, completely covered the rocks and filled the crevices. Hitherto we have taken this creature from beneath rocks, where it was scattered in ones and twos, or have found it cementing boulders firmly to the substratum, as at Angourie, near the mouth of the Clarence River. In this position it is very hard to capture the whole worm with its tube, so tangled are they and so intimately attached to the boulders. In our cave, however, it



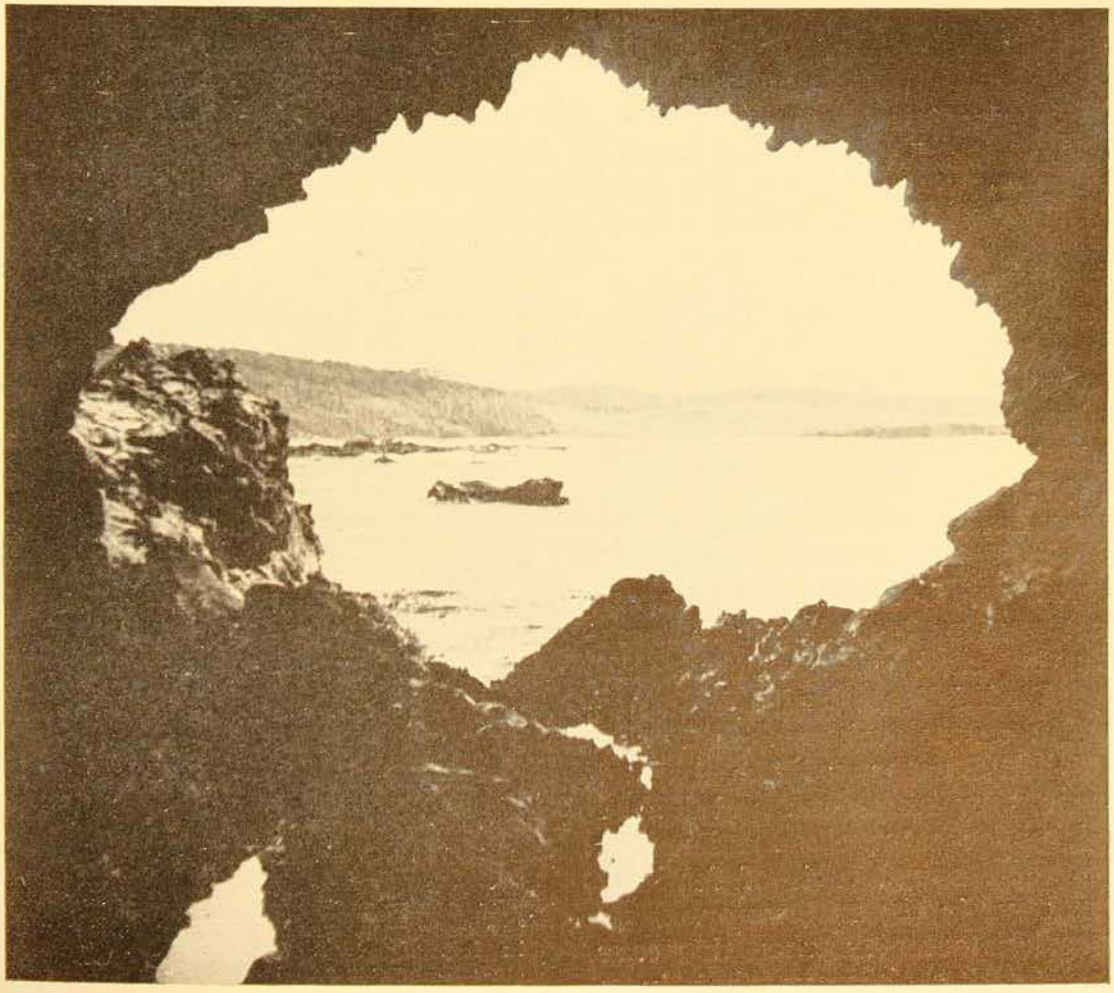
The delicate hydroid zoophytes are more reminiscent of plants in their body-shape than animals, but each 'frond' is portion of a colony, housing hundreds of tiny polyps. This species is Sertularia elongata. Slightly larger than natural size.
Photo.—
H. D. Hughes.

was easy to break off great clumps of the tubes. Each is cunningly fashioned from sand grains and pieces of shell grit and has a bore, 4 cm. in diameter near the mouth. The inner wall of the tube is perfectly smooth, while the outer one is rough and irregular and is produced above the tube into an over-hanging lip.

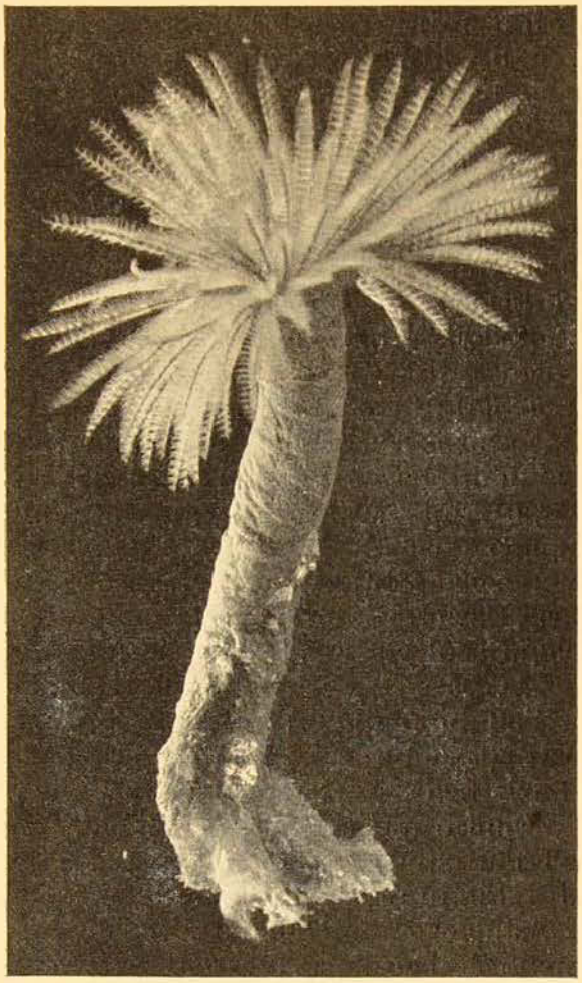
The lowest areas of the cave floor, and to some extent the side walls near the mouth of the cavern, were covered by a fine growth of Cunjevoi (*Pyura praeputialis*) which squirted as we walked over it. Each sea-filled crevice housed fine anemones which were fully expanded and very beautifully coloured in shades of olive green, with their rather short tentacles of light greenish-white flecked with brown. Very often when this species (*Anthopleura muscosa*) is encountered in shallow pools and crevices during low tides, it is so contracted as to look like a mere bag of tissues, with fragments of shells and sand all over the surface by way of camouflage.

One crevice, far back in the cave, was jammed full of cartrut Shells (*Dicathais orbita*), all of which (and there were forty or more) had the sculpturing on their shells perfect and uneroded. Moreover they were not overgrown by encrusting creatures such as *Galeolaria* worms, as they sometimes are when found out in the open. In fact, the "cleanness" of the shells and perfection of sculpturing was a feature common to nearly every shell-bearing animal in the cave. Even the chiton, *Sypharochiton septentriones*, which often has its valves so badly eroded that one can only distinguish it by its girdle, was perfect, and several of the rather rare red variety of this species were seen, well back in the darker parts.

The chief delights of the cave were, however, to be found in the two quite extensive pools, for in them flourished



View through the main entrance of the cave at Narooma at low water.



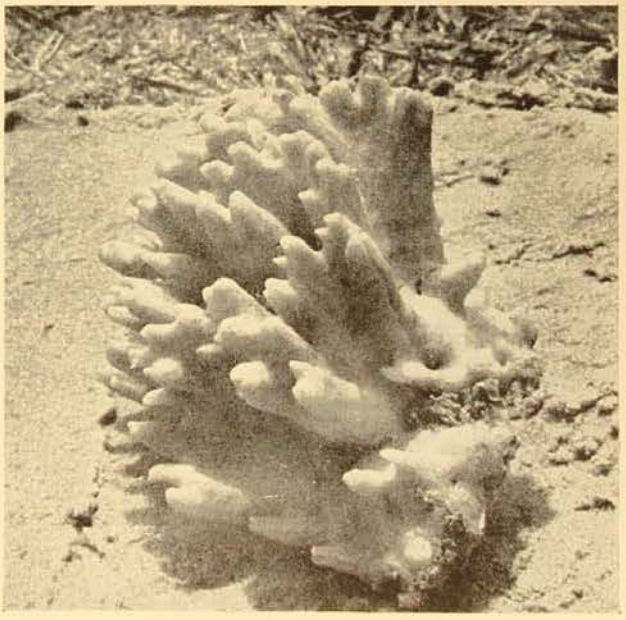
Larger of the two sabellid worms, Sabellastarte indica, with its crown of gills projecting from its tube home. Actual size.
Photo.—Miss G. Burns.

the most pleasing growths of sponges, worms and fine, large sea urchins, especially the long-spined variety (*Centrostephanus rodgersii*) which were clinging to the ledges and hollows, and these were only the more obvious of the inhabitants.

The absence of seaweeds from the pools (other than encrusting Corallines which were "splashed" like pink paint over the rock surface) was actually an advantage since there were no long fronds to interrupt one's view of the side walls with all their wealth of delicate hydroids, growing like a fur on the rock surface. Tube-building sabellid worms of two distinct species were very numerous and looked like small, under-water chrysanthemums because of their spiral tufts of feathery gills, spread out in the still water.

On a previous occasion when this cave was investigated each wave shot in a mass of swirling, foamy water which surged far up into the back of the cave and we did not judge it wise to collect there for fear of one of those larger waves which occur periodically and which might have trapped us. But in spite of this, animals growing in the cave are not subjected to the high degree of battering that some of their kin suffer on the rock platforms, for the waves are broken before they enter the cave or at least only surge in and out. The gentler movements of the water are reflected in the delicate shapes assumed by some of the sponges which grow luxuriantly rather than close-pressed to the rocks. In addition to their beautiful shapes, the sponges of the pools ranged in colour from a rich, creamy white, through bright yellows to oranges and purples.

Huge masses of a brilliant yellow sponge coated almost the whole of one side of the pool. Poking out through it at odd intervals were the leathery tubes and feathery heads of a small sabellid worm which we have not seen on any other occasion. Their heads were retracted instantaneously when an exploring hand was extended towards them.



The comparative calmness of the water in the cave rock pools enabled sponges to grow in luxuriant, delicate shapes, rather than pressed close to the rocks.
Photo.—W. J. Dakin.

As our eyes became fully adapted to the twilight gloom, we began to see more and more in the pool—the head of a quite large reef eel which, however, for once did not venture from its lair to attack us, the baleful eye of an octopus glaring at us from its crevice, and finally the tiny bryozoan Sea Mats and other similar minutiae which require microscopic examination to reveal their full beauty.

We should have liked to spend hours and even days more investigating those pools, but the clammy cold and rising tide soon forced us back into the region of the sunlit rocky reefs of our normal inter-tidal hunting ground where we were able to thaw out. Such a field day will remain a highlight in our collecting experiences and though we may never again be lucky enough to strike a calm sea and a low tide and be in Narooma at the same time, we will always be able to imagine ourselves back in that dim wonderland under the rocks.

It was one of those rare occasions when marine zoologists have the desire to immortalize the scene in the form of a reconstructed museum group, so that others, less fortunate, can feast their eyes and share in some of the pleasures of the field observer.

Readers are advised that the Council for Scientific and Industrial Research information service has changed its address and is now located at the Council's Head Office, 314 Albert Street, East Melbourne, C.2.

On August 26 Miss E. C. Pope, Assistant Curator (Invertebrates) on the Museum Staff, left by the flying boat service for a three-weeks' vacation on Lord Howe Island, about 300 miles east of Port Stephens, New South Wales. She was accompanied by Miss I. Bennett, Research Assistant to Professor Dakin, University of Sydney.

Both have been intimately associated for more than two years in a very searching survey of the marine shore fauna and general ecology of the whole of the New South Wales coast. On Lord Howe Island they will familiarize themselves with all the conspicuous forms of marine life and later compare results with their comprehensive New South Wales lists. The material knowledge gained will be of great value to zoologists as a whole and to the Museum in particular.

Recent acquisitions include a complete set of King George VI coronation coins from the estate of the late David Batey. The gold coins are £5, £2, £1 and 10s. Silver coins, 5s., 2s. 6d., 2s., 1s., 6d., 4d., 3d., 2d., 1d. Copper coins, 1d., ½d., ¼d., and the twelve-sided 3d. now in use in Britain.

Professor A. N. Burkitt, who has been a trustee of this Museum since 1928, recently completed twenty-one years as Head of the Department of Anatomy in the University of Sydney. A group of his distinguished former students took advantage of the occasion to present him with a bound volume, *Essays in Biology*, as a mark of their appreciation of his work. Among the essays in the volume are: "Genetic Types in Teeth", by A. C. Gabriel; "Prosencephalization of Motor Control, a Preliminary Note", by A. A. Abbie; "Radiographic Studies of the Sella Turcica", by G. Phillips; "Suppressor Activity in the Human Brain", by B. D. White; "Experimental Studies on the Internal Vertebral Venus Plexus", by W. F. Herlihy.

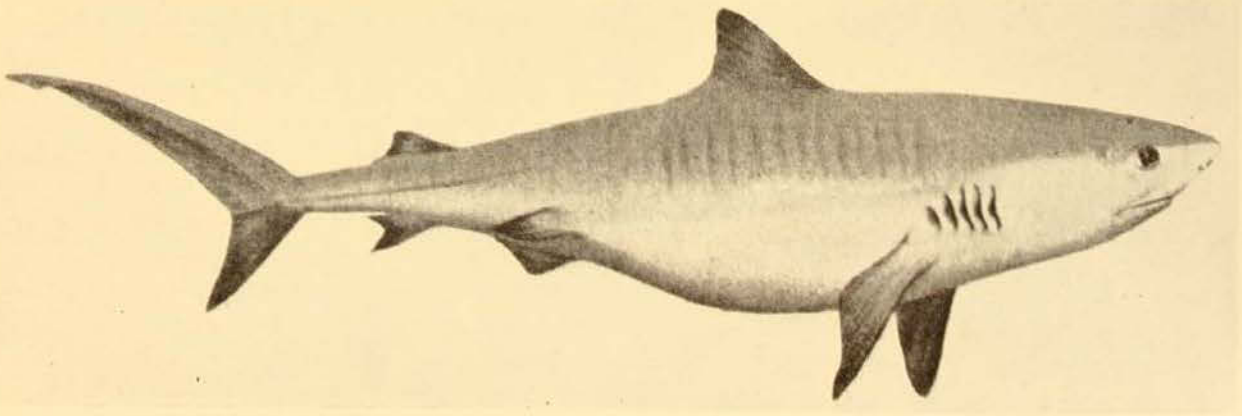
Stomach Contents of Tiger Sharks, Galeocerdo, reported from the Pacific and Indian Oceans

By E. W. GUDGER,
American Museum of Natural History, New York City

THIS is the third of a series of articles* dealing with the food and feeding habits of the tiger shark, *Galeocerdo*. The first dealt with the food of this shark in Gulf of Mexico waters at Key West, Florida, U.S.A. Here six of the seven specimens studied had been taken at or near Slaughterhouse Point on the southwest part of Key West Island. The food of the tigers here was quite miscellaneous and heterogeneous, but turtle scutes were found in the majority and in nearly all were mammalian remains—particularly the head of a cow in one stomach and of a horse in another, and in two stomachs three horses' hooves—two with leg bones.

In the second article are described the stomach contents of tiger sharks caught on the coast of North Carolina, U.S.A., and mainly in the Bight of Cape Lookout. The tigers, along with other sharks, various bony fishes and the large sea turtles, are summer migrants northward from Florida waters, and Cape Lookout is a natural fish trap for such migrants. Furthermore, in 1919-1923, the Ocean Leather Company maintained a fishery for sharks at Cape Lookout and a skinning and reduction plant at Morehead City, some 25 miles away. From this fishery most of my data came. Tigers were the most abundant sharks taken. Trapped in the Bight of Cape Lookout in large numbers, the tigers were further concentrated in the large nets of the shark fishermen, along with other sharks, various rays, porpoises and great sea turtles. Thus crowded together, the fierce tigers fed voraciously on their own species, on other sharks, on sea turtles and on porpoises. Thus was made pos-

* The first and second articles of this series are being published in America.



An Australian Tiger Shark, about 8½ feet long, showing the heavy build of the front half and the tiger-like stripes.

After Macdonald and Barron.

sible the feeding by the tigers on animals which—other than the slow and clumsy sea turtles and the fishes which go in schools—they could hardly have caught in the open ocean.

From the semi-tropical and warm temperate western North Atlantic, this story takes us to the greatest of the oceans, the Pacific, in which, according to H. W. Fowler,[1] *Galeocerdo* is found in all the "tropical and temperate seas to 70° or more from the equator". Over this vast area in the greatest ocean, *Galeocerdo* is found. Everywhere its food and feeding habits must in general be like those already described, but so far as this search has shown, the feeding has been recorded from but two regions—in the tropical eastern Pacific, and in Australian waters. To these widely separated parts of this great ocean, our studies will now take us.

Stomach Contents of Galeocerdo arcticus Taken in the Tropical Eastern Pacific.

Beebe and Tee-Van, in an expedition ranging from Cedros Island, Lower California (Lat. 28° N.), to the Galapagos Islands (almost under the equator), found the tiger shark (*G. arcticus*, syn. *tigrinus*) fairly common. They made dissections and notes on eleven specimens taken with the hook from the decks of vessels, and from these dissections, in the matter of concern for this article, they make the following statement:[2]

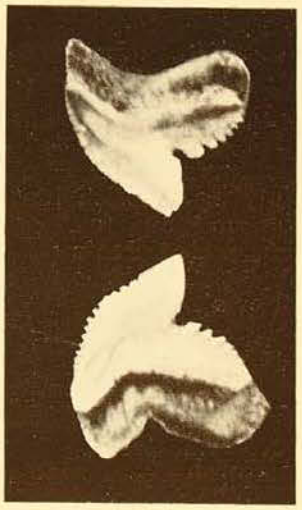
> FOOD: Almost any invertebrate or vertebrate of sufficient size may find a place in the diet of this shark. Our list is as follows: garbage (3 stomachs); octopus (400 mm.) [*c.* 16 in.]; *Heterodontus quoyi* (375 mm.) [*c.* 15 in.]; sting rays (7 in 3 stomachs, 4 of them *Urobatis halleri*); [of bony fishes, 4 specimens] *Gymnosarda alletterata* (400 mm.) [*c.* 16 in.] *Mycteroperca jordani* (600 mm.) [*c.* 24 in.], *Diodon holacanthus* (200 mm.) [*c.* 8 in.], *Ogcocephalus* sp. (150 mm.) [*c.* 6 in.]; *Iguana iguana* (1·371 mm.) [*c.* 57 in.]; *Chelone midas* [turtle] full of eggs (700 mm.) [28 in.]; feathers (3 stomachs); 2 Clarion shearwaters, *Puffinus auricularis*; and a Galapagos sea-lion pup, *Otaria jubata*.

I submit that this list fully justifies the statement with which the authors begin their account of the food of the tiger shark. Further, it shows that the Pacific tigers have dietetic tastes similar to those of the tigers taken in the Atlantic.

And finally we now go to that last and far distant Pacific region from which there are most interesting data on the food intake of the tiger shark.

Stomach Contents of Galeocerdo cuvier (syn. rayneri), The Australian Tiger Shark.

As the illustration shows, the Australian tiger, like its western Atlantic relative, is heavily built, especially in the forward half of the body. The head is large, much wider than deep, and capable of swallowing large objects. These pass easily through a large gullet into a capacious stomach. As shown in the accompanying photograph, the teeth are sickle-shaped. These have the lower part coarsely, the upper finely serrate, and the oblique tips always point right and left to the angles of the jaws. With these teeth, the tiger shark makes a shearing cut in its prey. In size, the large Australian tigers tabulated by Whitley[3] run from 11 feet 8 inches to 15 feet 6 inches



The curious sickle-shaped teeth typical of the Tiger Shark. After Waite.

[1] Fishes of Oceania, *Mem. Bishop Mus.*, Vol. 10, 1928, p. 19.

[2] Fishes from the Tropical Eastern Pacific, Part 2, Sharks. *Zoologica, Sci. Contribs. N.Y. Zool. Soc.*, Vol. 26, Pt. 2, 1941, *Galeocerdo*, pp. 113-114, fig. 23.

[3] The Fishes of Australia: Part 1, Sharks, Sydney, 1940, p. 113.

Like "a sinister grey shadow", a Tiger Shark approaching its food.
Photo.—Otho Webb.

(the largest tiger on record from any ocean and for which, unfortunately, no weight is recorded). The weight varies with the condition (probably with the stomach contents) of the shark from 710 lb. (12 feet) to 1395 lb. (13 feet 4 inches).

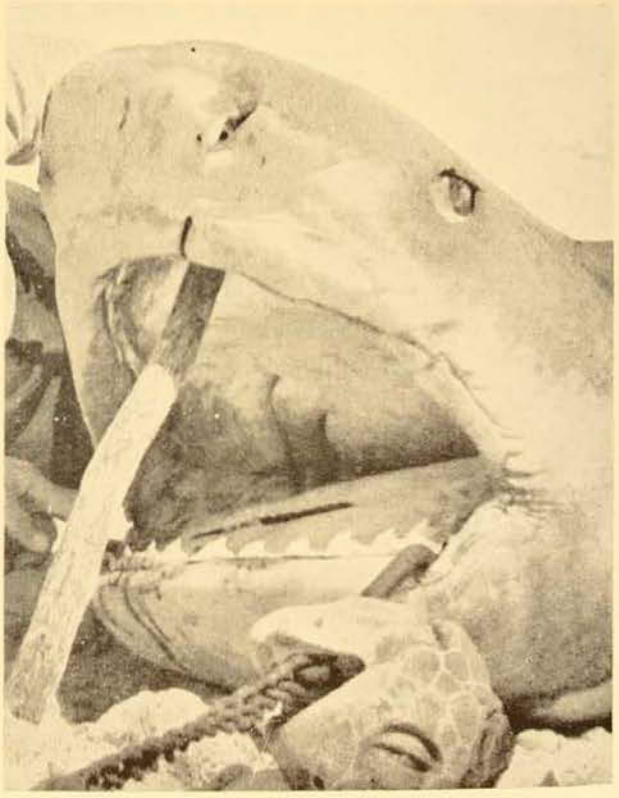
To turn now to the matter under study —the earliest indication of the feeding habits of the Australian tiger shark is from the pen of J. D. Ogilby.[4] He speaks of its size, fierceness and cunning, and then accounts for its abundance in Sydney Harbour in those days as follows:

> . . . the prevalence of these pests is undoubtedly due to the reprehensible system now in vogue [1888] of discharging the refuse of slaughterhouses and such like rubbish by means of lighters towed down the harbour, which, having been emptied of their load some distance outside the Heads, are immediately, while reeking with blood, brought back up the harbour and are followed by these keen-scented denizens of the ocean as naturally and as easily as hounds follow the trail of a fox.

Apart from some earlier references quoted by Whitley (see below), the oldest definite statement, found in this search, concerning the unexpected kind of food of the Australian tiger shark, is from D. G. Stead.[5] At a meeting of the Naturalists' Society of New South Wales, he stated ". . . that a large tiger had been caught off North Head [Sydney Harbour], the stomach of which contained a gannet and another sea-bird (possibly a gannet)". These must have been caught while floating on the surface of the water.

In the matter of the diversified food of the Australian tiger shark (or, perhaps better, the things swallowed by it), practically everything else known has been collected and published by my friend, G. P. Whitley, of the Australian Museum, Sydney, in various places, as called for by subjects, in his book on Australian Sharks (1940) previously referred to. Here follow these extensive and valuable data in the order of the pages on which they are found.

On his page 22, Whitley speaks of a tiger shark, 14 feet long, weighing 800 lb., which was caught off Bondi Beach (N.S.W.). "This tiger had been feeding on offal and matter from a nearby sewer outfall." Next (p. 34) Whitley records that a tiger captured and kept in an



Mouth of a Queensland Tiger Shark propped open to show the teeth. Note also the turtle-head bait still on the hook which caught the shark.
Photo.—Otho Webb.

[4] *Proc. Linn. Soc. N.S.W.*, Vol. 13, Pt. 2, 1888, *Galeocerdo*, pp. 1768-1769.
[5] *The Australian Naturalist*, Vol. 9, 1934, p. 95.

aquarium at Coogee "disgorged some pieces of shark and a number of bones and, strangest of all, a human arm almost unaffected by digestion". He kept this shark under observation and reports (p. 36) that "after having been in captivity for nearly a week, it vomited up . . . the bones of some non-mammal vertebrate and of a partly digested mutton bird". Next he states (p. 61) that:

> The scavenging Tiger Shark (*Galeocerdo rayneri*) is not finicky about its food. The stomach of a female caught in August, 1916, at Bondi, N.S.W., contained a full-grown Spaniel with the collar on, a porpoise's skull, remains of sea-birds, and a mass of more or less digested remains of fish, etc., including the spines of a porcupine fish. [This tiger shark was identified, and its stomach contents reported upon, by A. R. McCulloch, Sydney Sun newspaper, 15th August, 1916.]

Then with reference to tiger sharks in Queensland, Whitley (p. 61) quotes J. D. Ogilby[6] as follows:

> The most cunning and dangerous of all our sharks, lurking about wharves and similar places, where they pick up an easy living through the refuse thrown overboard from the vessels alongside, together with an occasional dog or other animal. When on board the "Endeavour" we were witnesses to a remarkable instance of gluttony and its fitting reward. While a brace of snapper was being hauled up, a large shark of this species was observed to be accompanying them from the bottom; instead, however, of tearing them from the hook, as is the usual practice in such cases, it contented itself with merely nosing them about, not even making any more vigorous protest when they were finally lifted intact out of the water.
>
> As it persisted in continuing this form of amusement with other captures, we threw out a shark hook nicely baited with fat pork, which it soon found. Even this tempting morsel it only nosed and mumbled for several minutes before taking it into its mouth so far as to enable us to effect its capture. When opened the secret of its extraordinary behaviour was revealed, for it was found to be full actually to the gullet with large leather-jackets (*Cantherines ayraudi*) of which it had already swallowed no less than 32, averaging fully fifteen inches apiece, all of which were perfectly fresh, unbitten, and undigested. This shark measured over 13 feet.

This intake of 480 inches (40 feet) of leather-jackets certainly constitutes a record. Nowhere else in this search has it been found that a tiger shark has taken in a whole school of bony fish of such size and volume.

Concerning the eating of birds, Whitley (p. 62) adds to his earlier remarks that "judging from the stomach contents of a number of tiger sharks, they frequently swallow mutton-birds (petrels) which they must snatch from the surface of the water". Then he quotes Griffin[7] that in the stomach of a New Zealand tiger was found a blue penguin, also a very large crayfish and a coarse-haired dog the size of a collie.

More extraordinary than any of these, Whitley (p. 63) notes the exhibition before the Linnean Society of New South Wales in May, 1888, of a gold watch taken from the interior of a tiger shark in Port Jackson. And he further states that in December, 1930, a shark fisherman in Sydney Harbour ". . . caught a *Galeocerdo* which had swallowed a purse containing three shillings, a powder puff and a wrist watch". However, Whitley thought that these did not indicate tragedies, but were simply things dropped overboard and retrieved by the sharks.

And last of all of the extraordinary things swallowed by an Australian *Galeocerdo* is the following, noted by Whitley (p. 129). "A 12-foot tiger shark, caught off Sydney on 7 April, 1940, had swallowed the 7-foot tail of a thresher shark [*Alopias caudatus* — the whip-tailed Alopias], and part of the tail was protruding from the shark's mouth when it was caught". If only a photograph of this could have been taken.

Finally, Whitley on page 113, sums up as to the contents of the stomach of the Australian *Galeocerdo* as follows:

> The tiger shark is a scavenger, eating almost anything which may come its way. Such objects as bags, lumps of coal, dead dogs, etc., have been found in the stomach contents of sharks caught in our harbours.
>
> As an example of the varied nature of its menu may be detailed the stomach contents of a tiger shark caught some years ago at Bondi, N.S.W. This shark had eaten a full grown spaniel, several sea-birds, and

[6] *Mem. Qld. Mus.*, v, 1916, p. 79.

[7] *Trans. N. Zeal. Inst.*, lviii, 1927, p. 138.

many fish. The stomach also contained a dolphin's head, bitten clean off the body, and some spines of a porcupine fish. Apparently the humble porcupine fish is not infrequently eaten by sharks, though from some accounts, it is an unpleasant victim, as, when it is swallowed, it raises its numerous sharp spines and sticks in the shark's throat or stomach, or else chews its way to freedom with its parrot-like beak.

This story of the porcupine fish biting its way out through stomach and body wall of its captor has been often repeated over the years and over much of Oceania, but I think that it is only a "tale". My own experience in handling objects from the stomach of tiger sharks has taught me that frequent washings of the hands are necessary to prevent the intensely corrosive stomach fluids from decomposing the skin of the hands. One man has spoken of the tiger's stomach fluids as "burning like fire". My judgment is that the porcupine fish would be very shortly killed and its flesh, spines and bones presently decomposed by these very powerful juices. In this connection see Beebe and Tee-Van, above, who found a dead *Diodon* in the maw of one of their tiger sharks in the eastern tropical Pacific.

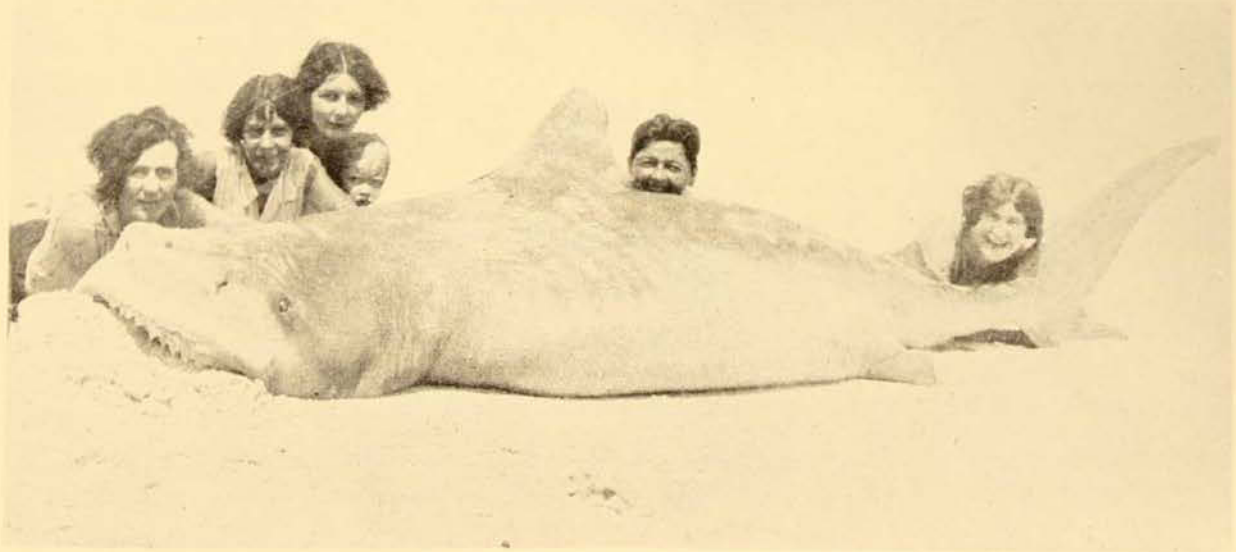
Mr. Max Nicholls, of Lord Howe Island, photographed a 12½ ft. tiger shark which was caught there on May 18, 1942, by Mr. Rowley Wilson. It contained one goat, one turtle, one big tomcat, three mutton birds, four big kingfish heads and two leg bones of bullock from the refuse of a freezing works, one dead shark about 6 ft. long, caught a few nights before and thrown back into the water, and a number of small fish.[8]

A female tiger shark, 4 feet 9 inches long, caught near Fraser Island, Queensland, in March, 1943, was dissected by Mr. G. P. Whitley, who found fish (*Pomadasys*) and elasmobranch remains as well as pieces of cuttle bones in the stomach.

Stomach Contents of Galeocerdo in the Indian Ocean.

On the other side of Australia, Mr. Whitley performed autopsies on 25 Western Australian (Indian Ocean) tiger sharks in which were such varied objects as shags, turtles, sea snakes, various sharks and rays, an assortment of fishes (stonefish, tailor, leather-jackets, cod, whiting, snapper, toadoes, porcupine and boxfishes, eels and fish offal thrown overboard by fishermen), cuttlefish, squid and octopus, bailer shells (*Melo*) and a large whelk-like mollusc, crabs (*Portunus*), a sheepshank and rib, pieces of

[8] *Walkabout* Magazine, October, 1947, p. 36 and figure.



A large Tiger Shark at North-West Islet, Queensland.
Photo.—Embury Bros.

seaweeds, and unidentifiable substances looking like pieces of bread, liver, and fat.

Otherwise the only published records of tiger sharks' food in the Indian Ocean are two accounts from India.[5]

I know of no paper dealing specifically with the food of *Galeocerdo* but the three on which I am at work. Of these one is based on my own dissections and observations of seven specimens of *G. tigrinus* at Key West and Tortugas, Florida. The second is from the writings of four men (two in collaboration) of *G. tigrinus* on the North Carolina coast. The third is the present article. Further, I know of no other paper bearing the specific title "The Food [or the Stomach Contents] of the Shark". So it has seemed well in these articles to bring together all the available data on the remarkable materials found in the stomach of *Galeocerdo*—of which it may be said that "All is grist that comes to its mill".

It is hoped that the publication of these reports on *Galeocerdo* may lead other observers, who have had the opportunity to study the stomach contents of this and other sharks, also to publish their observations under the name of the shark. Thus our knowledge of the food and feeding habits of sharks will in time be greatly extended.

Lastly, the inevitable question comes: "How does the tiger shark unload its stomach of the accumulation of indigestibles?" The answer is that these must come out as they went in—through the mouth. There is no other way. The shark relieves itself by the process of regurgitation as witnessed and recorded for three cases in the North Carolina, U.S.A., paper, and as recorded by Whitley on his page 34 (see this article, page 284).

[5] F. Day, *Fishes of India*, i, 1878, p. 718, and K. Chidembaram, *Journ. Bombay Nat. Hist. Soc.*, xlv, 1945, p. 247.

Mr. F. D. McCarthy, Curator of Anthropology at the Australian Museum, is gaining valuable experience as a member of the Australian-American Scientific Expedition at present in Arnhem Land. The expedition was on Groote Eylandt in the western part of the Gulf of Carpentaria from early April till about mid July, when it moved to Yirrkala in Arnhem Land. During the period spent on Groote Eylandt the wide range of Mr. McCarthy's activities included, apart from the collection of specimens, the recording of various craft techniques of the aborigines, recording of very numerous groups of cave paintings, examination of stone arrangements connected with totemism, excavation of Makassar graves, investigation of aboriginal bone-disposal caves and camp sites, study of genealogies of native families, study of the art of the people, observation of initiation ceremonies, and general observations on the physique and habits of the natives.

Mr. G. P. Whitley, Curator of Fishes, the Australian Museum, who has been seconded to the Division of Fisheries, Council for Scientific and Industrial Research for three months, left Sydney on 3rd September for New Guinea, where he will be acting as scientific officer associated with the fishery investigations being undertaken there.

The final lectures in the Museum's Popular Lecture Syllabus for 1948 will be:

October 7: "Spectacular Experiments in Zoology", A. N. Colefax, B.Sc.

October 28: "Some Aspects of Australian Fishery Research", H. Thompson, D.Sc.

These lectures will be delivered in the Museum's lecture theatre at 8 p.m. Admission is free.

Airborne Animals on the Tiger Route*

THE B.O.A.C. "Tiger" route between India, Pakistan, Egypt and Britain is appropriately named, for the first animal passengers on the recently opened Speedbird freight service between these countries were four tiger cubs to be followed by representatives of almost all the animal species which took ship in Noah's Ark—from pandas to red-faced stump-tailed monkeys and bulbuls to rosy-faced love-birds.

Pakistan and India abound in animal life and naturalists and collectors from many parts of the world are now busy in both countries collecting birds and animals for export.

Some of the Indian birds, for example the peacock, the racket-tailed drongo, the paradise flycatcher, the golden oriole, the minivet, the sunbird and the woodpecker, are beautiful and rare. They are protected by the game laws of the two Dominions and so are seldom exported. On the other hand, monkeys are unwanted in India because they destroy valuable crops, and many hundred have "emigrated" to Egypt and Britain in recent months by Speedbird Lancastrian.

Captain L. Arthur, pilot of one of the B.O.A.C. flying "Noah's Arks", described the reactions of his animal passengers: "Two mynahs were shouting 'Wacko' and 'Hullo' as we took off, but the animals soon settled down", he said. "A V.I.P., a Himalayan panda, refreshed himself on bamboo shoots, milk and fresh fruit. Some mice deer were confined to an exclusive diet of rice, but gibbons and wanderoos had milk and bread, peanuts and sweet potatoes, while the laughing thrushes ate minced-meat and boiled eggs. We were very careful with cabin temperature, maintaining it higher than would be the case for human beings.

"At Karachi, where we stopped overnight en route, the animals were accommodated in specially-prepared quarters. The monkeys needed warmth, whereas the panda had a cool room to himself."

Here is an extract from the "passenger list" of the Speedbird freight service over the "Tiger" route in recent months: Tigers 4, leopards 8, bears 54, fishing and civet cats 8, monkeys—several hundred, squirrels 34, pheasants 8, hyenas 4, jackals 4, panda 1, black swans 2, cranes 28, eastern rosella parakeets 2, rosy-faced love-birds 4, combed ducks 6, racoons 2, deers various 18, mongooses 5, peacocks and peahens 12, crocodiles 8, panthers 5, and unspecified numbers of tortoises, dogs, hornbills, parrots, bulbuls, golden-backed woodpeckers, sunbirds and scarlet minivets.

* Published by courtesy of British Overseas Airways Corporation

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From the Lord Mayor of Sydney, Alderman R. J. Bartley, a model of Captain James Cook's "Endeavour Bark" built by the late Commander Cecil Brooks, R.N., D.S.O., has been received. This was given by Mrs. Brooks to the Lord Mayor, with a request that it should ultimately be housed in the museum in Sydney, which already had the Cook relics. We hope in a later issue to publish a photograph and other information about the model.