The AUSTRALIAN MUSEUM MAGAZINE

Vol. VI, No. 1. JANUARY-MARCH, 1936. Price—ONE SHILLING.

The Top-Knot Pigeon.

Registered at the General Post Office, Sydney, for transmission by post as a periodical.

THE AUSTRALIAN MUSEUM

HYDE PARK, SYDNEY

BOARD OF TRUSTEES

PRESIDENT:

F. S. MANCE.

CROWN TRUSTEE:

JAMES McKERN.

OFFICIAL TRUSTEES:

HIS HONOUR THE CHIEF JUSTICE.
THE HON. THE PRESIDENT OF THE LEGISLATIVE COUNCIL.
THE HON. THE COLONIAL SECRETARY.
THE HON. THE ATTORNEY-GENERAL.
THE HON. THE COLONIAL TREASURER.
THE HON. THE SECRETARY FOR PUBLIC WORKS.
THE HON. THE MINISTER OF PUBLIC INSTRUCTION.
THE AUDITOR-GENERAL.
THE PRESIDENT OF THE NEW SOUTH WALES MEDICAL BOARD.
THE SURVEYOR-GENERAL AND CHIEF SURVEYOR.
THE CROWN SOLICITOR.

ELECTIVE TRUSTEES:

G. H. ABBOTT, B.A., M.B., CH.M.
E. C. ANDREWS, B.A., F.G.S.
GORRIE M. BLAIR.
C. GORDON MACLEOD, M.A., M.D., CH.M.
G. A. WATERHOUSE, D.Sc., B.E., F.R.E.S.
F. S. MANCE.
THE HON. F. E. WALL, M.D., M.L.C.
PROF. A. N. ST. G. BURKITT, M.B., B.Sc.
THE HON. H. M. HAWKINS, M.L.C., F.R.E.I., F.I.L.V.
PROF. W. J. DAKIN, D.Sc., F.L.S., F.Z.S., F.R.Z.S.
FREDRICK W. MARKS, F.C.A. (AUSTR.).
MAJ.-GEN. SIR CHARLES ROSENTHAL, K.C.B., C.M.G., D.S.O., V.D.

DIRECTOR:

CHARLES ANDERSON, M.A., D.Sc., C.M.Z.S.

SECRETARY:

W. T. WELLS, A.I.A.V.

SCIENTIFIC STAFF:

Mineralogy and Petrology.
T. HODGE-SMITH.
R. O. CHALMERS, A.S.T.C.
Palæontology.
C. ANDERSON, M.A., D.Sc.
H. O. FLETCHER.
Lower Invertebrates.
F. A. McNEILL.
A. A. LIVINGSTONE.
W. BOARDMAN.
Conchology.
TOM IREDALE.
JOYCE K. ALLAN.
Entomology and Arachnology.
ANTHONY MUSGRAVE, F.R.E.S.
K. C. McKEOWN.
Ichthyology.
GILBERT P. WHITLEY.
Amphibia, Herpetology, and Ornithology.
J. R. KINGHORN, C.M.Z.S.
Mammalogy and Osteology.
ELLIS LE G. TROUGHTON.
Anthropology and Ethnology.
ELSIE BRAMELL, M.A., Dip.Ed.
F. D. McCARTHY, Dip. Anthr.

LIBRARIAN:

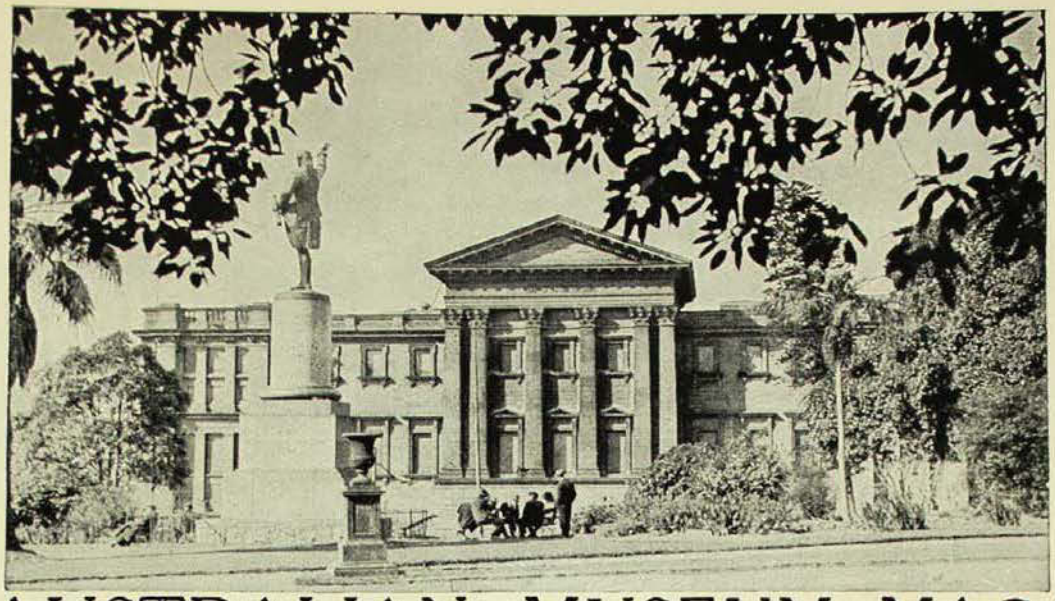
W. A. RAINBOW.

PREPARATORIAL STAFF:

G. C. CLUTTON, *Chief Articulator.*
H. S. GRANT, *Chief Taxidermist.*

HONORARY SCIENTIFIC STAFF:

Zoologists.
PROF. T. HARVEY JOHNSTON, M.A., D.Sc.
EDWARD F. HALLMANN, B.Sc.
PROF. E. A. BRIGGS, D.Sc.
H. LEIGHTON KESTEVEN, D.Sc., M.D.
MELBOURNE WARD.
Ornithologists.
A. F. BASSETT HULL, F.R.Z.S.
K. A. HINDWOOD.
A. J. MARSHALL.
Entomologists.
G. A. WATERHOUSE, D.Sc., B.E., F.R.Z.S.
H. J. CARTER, B.A., F.R.E.S.
T. H. GUTHRIE.
W. W. FROGGATT.
Archæologist.
GEORGE A. THOMAS.



THE AUSTRALIAN MUSEUM MAGAZINE

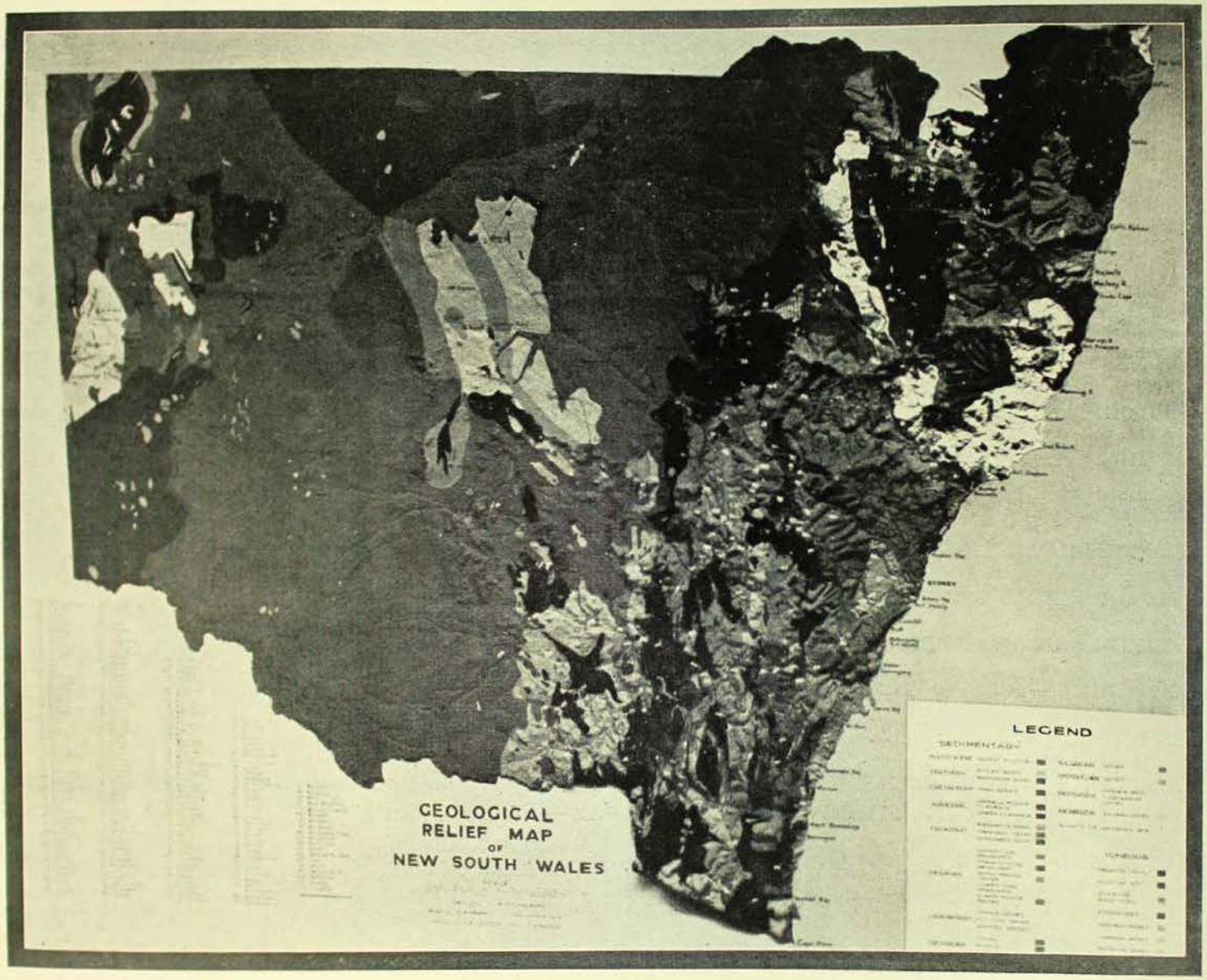
● OUR FRONT COVER. The Top-Knot Pigeon (*Lopholaimus antarcticus* Shaw) is by Lilian Medland. It is one of a series of post-cards issued by the Australian Museum.

Australia possesses a variety of beautiful pigeons, divided into two groups. The Ground Pigeons feed chiefly, as their name implies, upon the ground, and have legs and feet like a fowl. The Fruit Pigeons spend their time in the tree-tops, with legs and feet adapted for grasping branches, so that these have assumed a somewhat parrot-like form. The remarkable Top-Knot Pigeon, with its curious crest, is somewhat intermediate in structure, but resembles the Fruit Pigeon in its feeding habits, and in the fact that it lays but a single egg in place of the customary pair.

The Top-Knot is gregarious, and is on this account sometimes known as the Flock Pigeon. It ranges through the coastal scrubs of Queensland and New South Wales, where its present southern limit appears to lie in the National Park, though in time past it went much further south. It is a large handsome bird.

A third group of the pigeon tribe is constituted by the Doves, of which Australia possesses a number of species.

VOLUME VI, NUMBER 1. JANUARY-MARCH, 1936.



Geological Relief Map of New South Wales. Scale, eight miles to the inch.

This is a striking new exhibit in the Mineralogical Gallery. It measures nine feet by seven feet. To show the varying geological formations of the State, thirty-two colours had to be employed. The rugged nature of the coastal area and the vastness of the plains beyond are displayed at a glance. Railway lines are indicated, as also are various geographical points. Much time and care had to be expended to ensure the accuracy of the map.

Designed and modelled by Mr. C. A. Orwin, of the N.S.W. Department of Lands; geology by Mr. R. O. Chalmers, A.S.T.C., of the Australian Museum; cast by Messrs. G. C. Clutton and J. Kingsley, also of the Australian Museum.

[Photo.—*G. C. Clutton.*

See Article on page 13.

THE AUSTRALIAN MUSEUM MAGAZINE

Published by the Australian Museum - - - - - College Street, Sydney

Editor: C. ANDERSON, M.A., D.Sc., C.M.Z.S. Annual Subscription, Post Free, 4/4

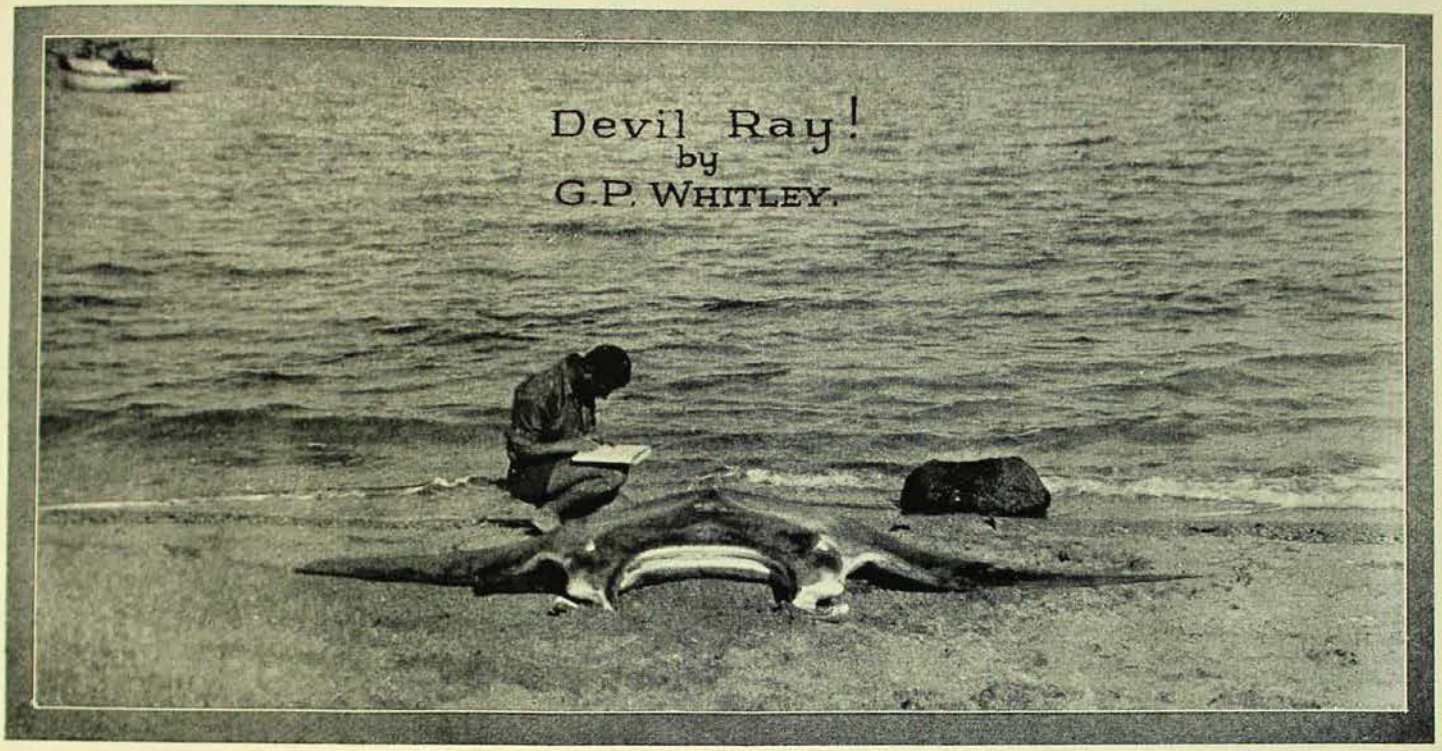
VOL. VI, No. 1. JANUARY-MARCH, 1936.

His Most Gracious Majesty

King George V

PASSED AWAY 20th JANUARY, 1936

Beloved and mourned by all his people after an exacting reign of a quarter of a century devoted to their welfare, to the advancement of the Empire, and to the betterment and peace of the nations.



A Devil Ray, 11 feet 8 inches wide, caught in the Cumberland Group, Queensland, July, 1935. Front view, showing the wide mouth with "horns" on either side.

[Photo.—*Melbourne Ward.*

WHEN H.R.H. Prince Alfred, Duke of Edinburgh, visited Australia in H.M.S. *Galatea* early in 1868, he was entertained at the Australian Museum by Gerard Krefft, the Curator, who staged fights between mongooses and snakes for his amusement. Shortly afterwards, Sydney was horrified at the attempt made by a Fenian on the Prince's life, but fortunately the Royal visitor recovered from his wounds, and thenceforward, as if in atonement, the greatest consideration was shown him. When, therefore, a marine monster in the form of a huge Devil Ray appeared in the harbour, Gerard Krefft hastened to name it in honour of his distinguished patron.

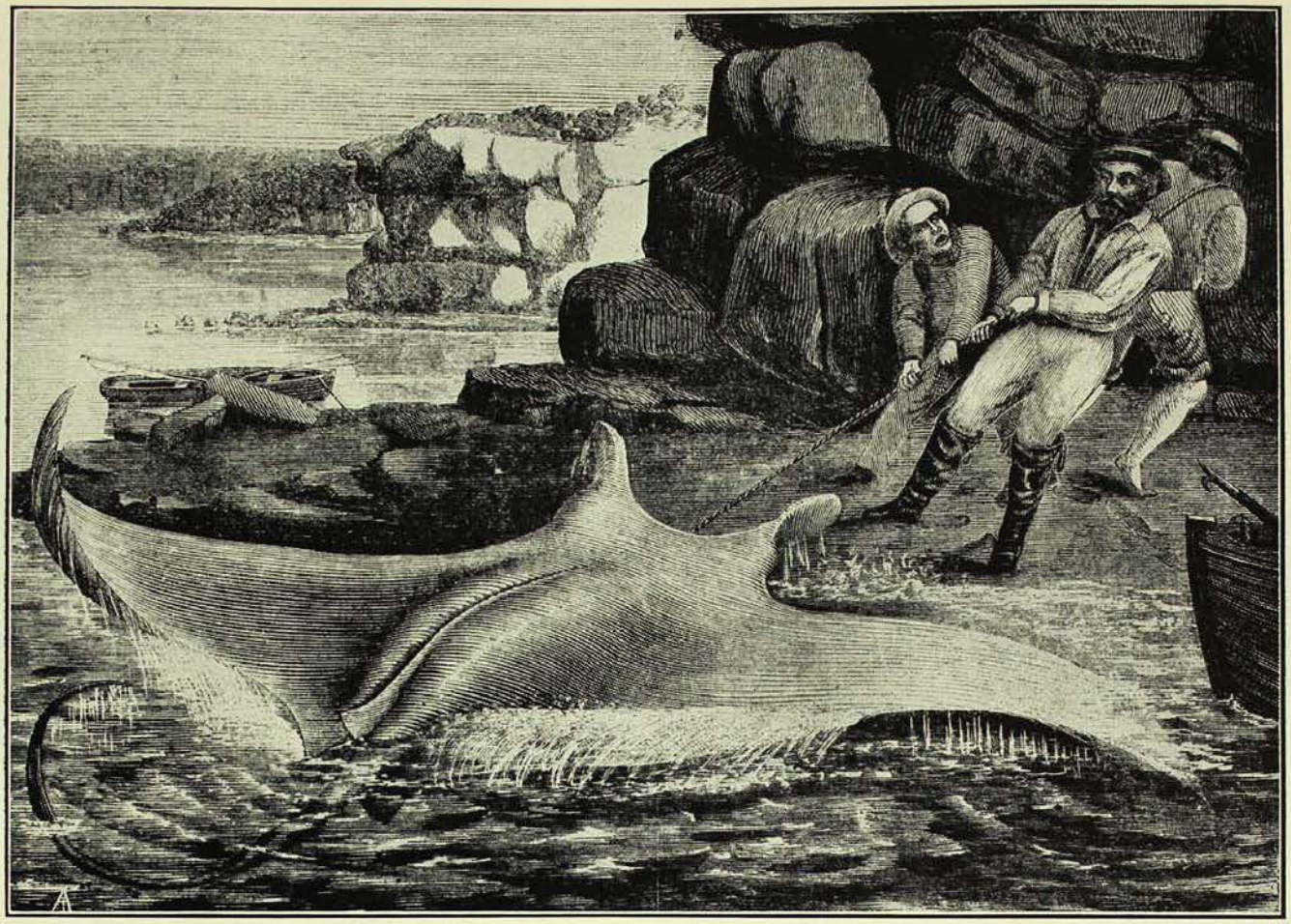
Here is the first notice of this Australian Devil Ray, a species which has remained almost unknown from that time to the present; it is taken from the *Sydney Morning Herald* of Tuesday, March 31, 1868, page 4, column 2:

Curious Fish.—On Sunday morning, at 11 o'clock, a curious fish was caught near the old Pier at Watson's Bay, being harpooned by a man named Wallace. It measures 14 feet 6 inches across, 20 inches through the thickest part. It very much resembles a tortoise, only on the back portion of the body it has two tails, one running out flat, and the other like a whip through. Its mouth measures 2 feet 6 inches from side to side, and when open it is about 9 inches all along. The liver weighs about one hundredweight, and when boiled it is expected it will yield about seven gallons of oil. There are two large flappers on each side of the mouth by which it forces its food in, and there are ten strainers on the belly, five on each side. We understand the name of this strange-looking animal is the devilfish.

On searching through newspaper files in the Mitchell Library, Sydney, I found, in the *Illustrated Sydney News* of July 11, 1868, the first picture of the Devil Ray, which is here reproduced by courtesy of the Librarian, with the following description, anonymous, but evidently by Gerard Krefft:

Deratoptera Alfredi (Prince Alfred's Ray).

It was a "royal fish" indeed those bold fellows battled with not long ago at Watson's Bay, and the "fool at one end and the worm at the other" could never have caught such a monster. Downright hard work, harpooning and hauling, secured the prize, which fetched a considerable number of sixpences from the curious, and a five pound note from the



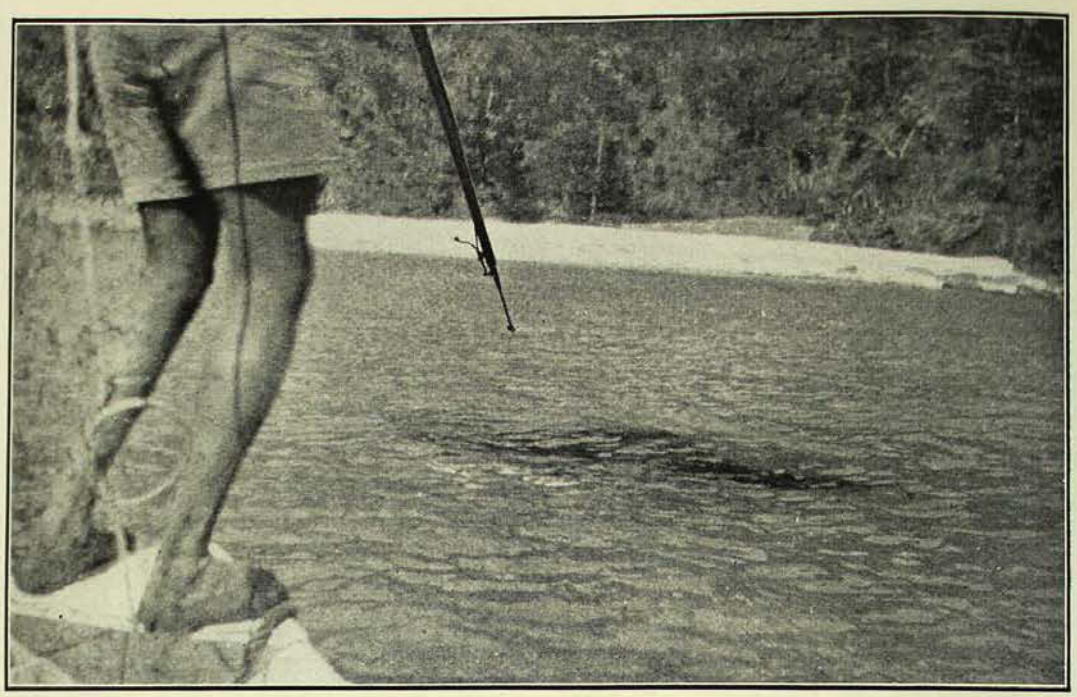
A spirited woodcut of the first Devil Ray caught in Australia. The huge Prince Alfred's Ray being hauled ashore in Sydney Harbour in March, 1868. Reproduced from the "Illustrated Sydney News", by courtesy of the Mitchell Library.

Museum trustees, who did well to secure this fine specimen. Few persons know the labor of successfully preserving so large a fish, and they will perhaps scarcely credit it, that it took Mr. Tost, the able taxidermist, fully three weeks to finish it. It is now exhibited (free of charge, of course) in the Museum, College-street. The fish is some fourteen feet broad, and, including the tail, about eight long. He, or rather she, (it is a female) has gills like a shark, and a curious pair of head-fins on each side, which are used for the purpose of feeding; in fact, the fishermen state that the fish shovels the prawns and other cray-fish down its capacious throat with these fins, which look exactly like a pair of gigantic ears. The mouth is very large, and, without exaggeration, reaches from "ear to ear". The teeth are very small, so diminutive that they can only be detected by close examination. Coloration—bluish above, white, with some darker markings, below. The Sea Devil is quite a harmless kind of fish, though of great strength, and wonderful tales are current of the pranks this playful giant frequently plays. De Kay, in his natural history of New York, mentions that one of them had hold of the cable of a good-sized schooner, and towed it forwards and backwards through the harbour for some time. The present specimen is the largest fish of this kind which has ever been preserved, and it is well worth a visit to the Museum to inspect it. The specific name of Alfredi was given to it, with the permission, and in honor of, His Royal Highness the Duke of Edinburgh, who accepted a number of photographs taken shortly after the fish was caught. The photographs are by Mr. Henry Barnes of the Museum.

From that day to this, Krefft's specimen of the Devil Ray has been exhibited in the Australian Museum, and you can still see it there (free of charge, of course). The exhibit, however, has been restored and rather altered in appearance, and a fresh specimen has long been desired for comparison and to enable some idea of the anatomy to be gained. But the Devil Ray is rare in New South Wales: a small one was caught in Middle Harbour in the 1880's, and a large one[1] off Cape Hawke in 1923, but neither was preserved for the Museum. Evidently it is a tropical

[1] Figured in THE AUSTRALIAN MUSEUM MAGAZINE, iv, 1931, p. 284.

species which only occasionally drifts so far south. McCulloch, in the *Illustrated Australian Encyclopædia*, wrote that these fish are not uncommon on the coast of Queensland (he had seen some near the reefs off Cairns some years previously), and T. C. Marshall, in the *Queensland Naturalist*, 1932, noted a Sea Devil, thirteen feet wide, which had been stranded at Cowan Cowan, Moreton Bay. These were all the Queensland records known to me until reports came from tourists accompanying the Embury Brothers' parties to North Queensland that Devil Rays could be caught at Hayman Island, and pictures of the monsters appeared in the press and in angling papers. I implored game fishermen to try to secure measurements, teeth, relics of any kind, but was generally informed that the rays sank to the bottom when killed, and were usually too heavy to remove from the water, even to photograph. I wanted a fresh specimen so badly that in July, 1935, I travelled to the Cumberland Group, North Queensland, to try to secure one. Thanks to the co-operation of Mr. Melbourne Ward, then Resident Naturalist at Lindeman Island, and Captain A. de S. Nicolson, who placed boats and other facilities at my disposal, the mission was a success, for, in addition to hundreds of coral reef and dredged fishes for the Australian Museum, a fine female Devil Ray was secured, and the first detailed description of *Dæmomanta alfredi* (Krefft) has now been drawn up for publication later in a scientific journal. The whole specimen was not preserved, but it is hoped that a scale-model of it will eventually be prepared for public exhibition. Meanwhile, an account of the field work may be acceptable, as this constitutes the first published record, in any detail, of a Devil Ray from Queensland. There are, it is true, Horned Rays, or Diamond-fish, figured in Saville-Kent's book *The Great Barrier Reef*, but they belong to a very different and smaller species, *Mobula diabolus* (Shaw), which has the mouth situated well below the head, not at the end of it as in the giant Devil Ray.

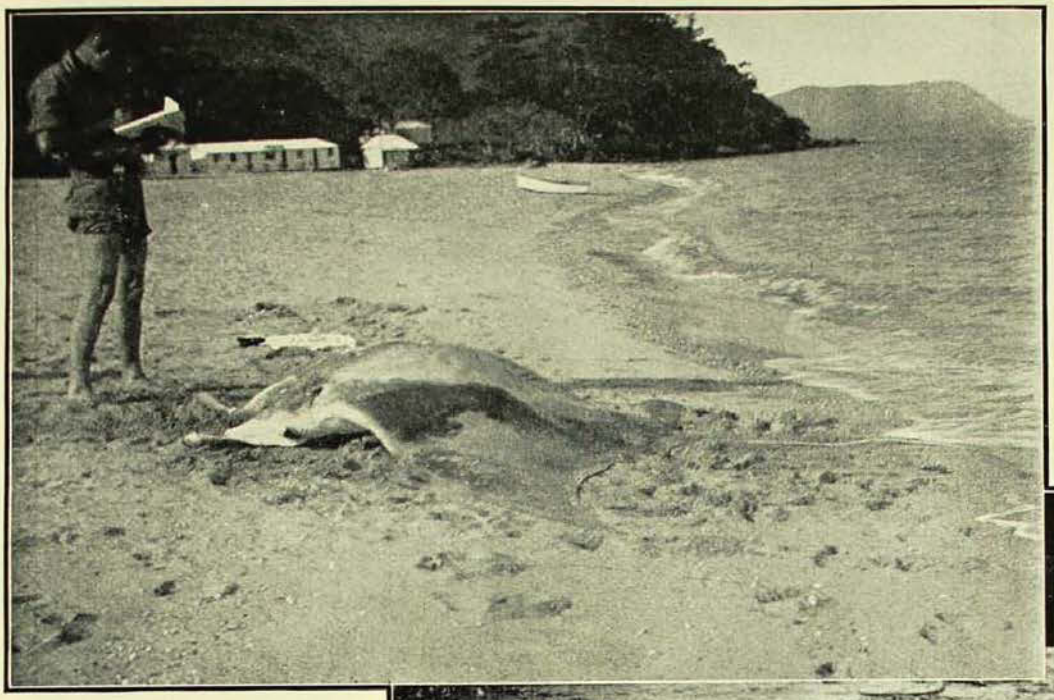


Devil Ray approaching the boat, where Dick poises his harpoon in readiness—an exciting moment just before its capture.

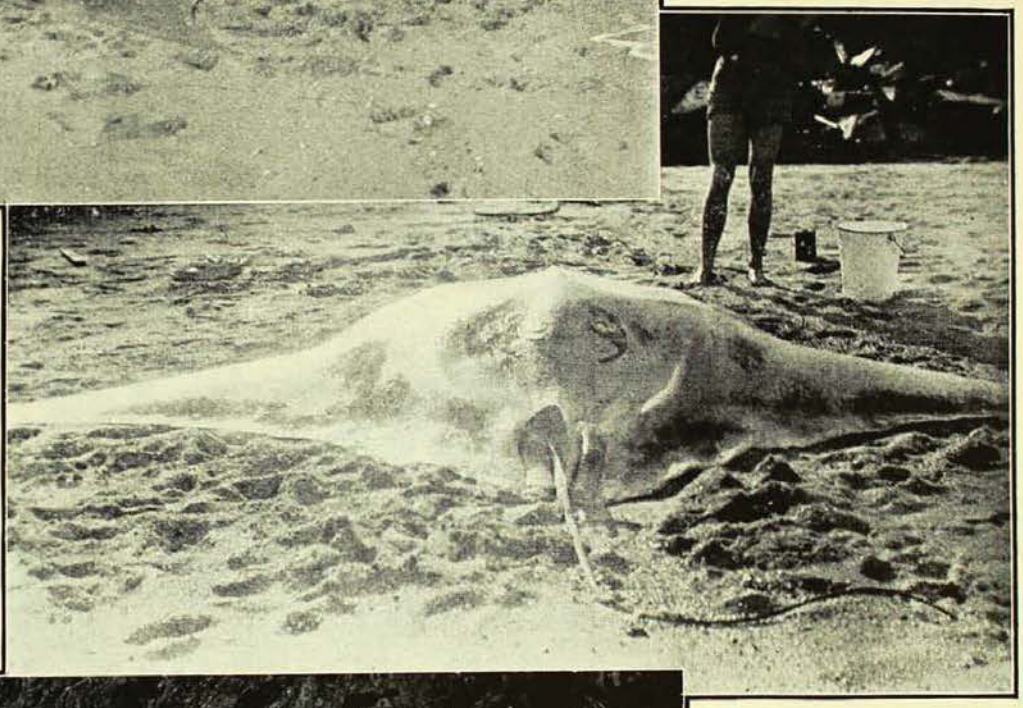
[Photo.—*Gilbert Whitley.*

THE CHASE.

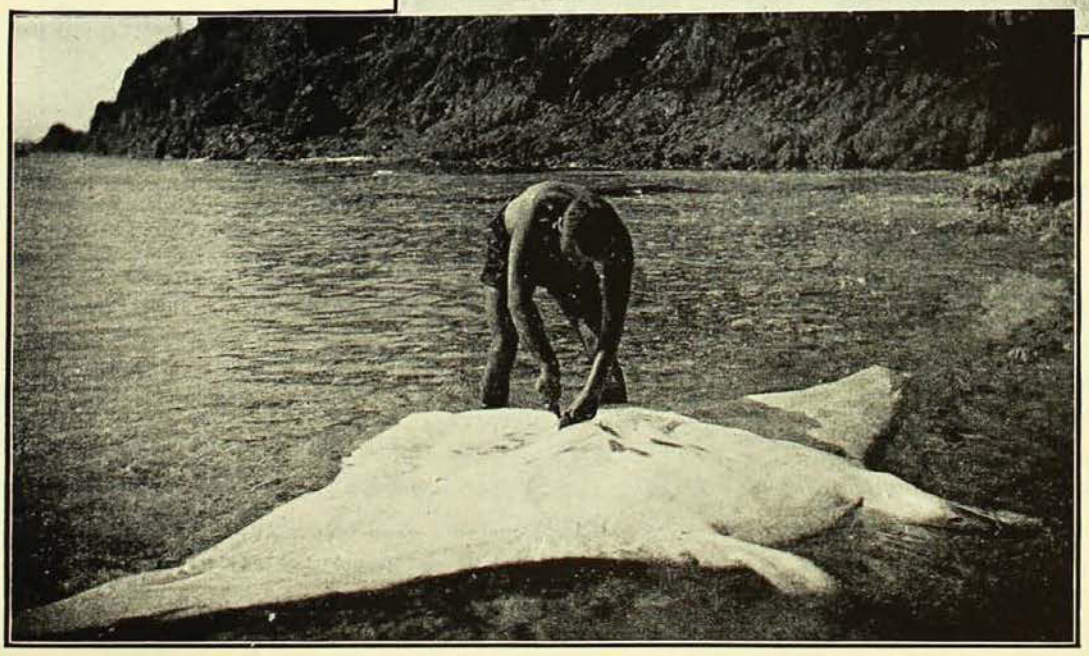
Saturday, July 20, 1935, was a fine, sunny, winter day, with a calm sparkling sea between Lindeman and Maher Island, our destination. Here Devil Rays were known to congregate at this time of the year until about November, and several were seen cruising in the vicinity of the inshore reefs. They swam rather slowly, apparently undulating the body, and with their mouths open and the cephalic fins ("ears", "horns", caropteres, or flippers) extended on either side; often one would break the surface, or they curled one or both tips of the wing-like pectoral fins right out of the water. At



Side, back, and ventral views of the Queensland Devil Ray which is being examined by the author of this article.



Note the curled "horns" on each side of the head, the broad diamond shape of the body, and the long tail.



Of these photos, the upper two were taken at Lindeman Island and the lower at Maher Island just after the ray's death.

[Photos.—
Melbourne Ward.

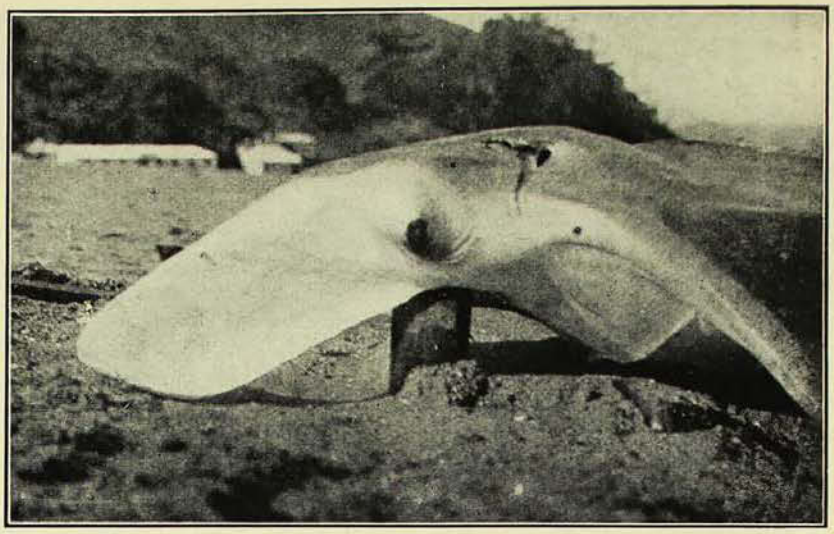
other times they swam well below the surface, or perhaps even sank to the bottom (especially when we wanted to get near them). The launch anchored, I embarked in a small dinghy with Messrs. Melbourne Ward, Loch Nicolson, and Dick Lahou, a Torres Strait islander. After a while a fine Devil Ray was seen approaching the bows of the dinghy, where Dick stood with harpoon poised and rope coiled ready; he also had a knife within reach to cut us loose in case of danger. Soon we were nearly on top of the monster, and, with a powerful plunge, Dick rammed the barb into the creature's skull. To our surprise the victim did not run away with the boat, as we had expected, neither did it flap or struggle; it simply subsided in the water and died. Dick was greatly excited; he had speared many turtles and dugong, but this was his first Devil Ray. "I kill him. I bin *kill* him!" he yelled, and then we set to work to prevent the prize from sinking. Its head was pulled to the surface, when it was found that the steel harpoon had bent under the great weight; a rope was passed through a hole cut in one cephalic fin, and the trophy borne in triumph to a beach nearby. Blood crimsoned the water for many yards around, and we tugged the ray ashore as quickly as possible for fear of sharks. After taking photographs I removed the stomach and intestines, as I was anxious to ascertain the food of such a monster (it was over eleven and a half feet wide). Only a little syrupy pulp was found in the alimentary canal, however, and this contained the remains of minute Crustacea. So, like some whales, the giant Devil Ray must feed on the smallest floating creatures, the plankton.

Diagram, drawn to scale, one-fortieth natural size, of the Queensland Devil Ray, showing "horns", eyes, and form of fins and tail. In the dorsal view (above) the slit-like spiracles are seen behind the eyes, also the small dorsal fin near the root of the spineless tail. The ventral surface (below) is white, with irregular dark blotches, and the five pairs of wide gill-slits are plainly seen.

[*Drawn by Gilbert Whitley.*

The launch towed the ray back to Lindeman Island, where I was able to

measure and sketch, photograph and dissect, the specimen, confirming in all detail its identification as a Prince Alfred's Ray. The specimen was so heavy that it was necessary to wait for the tide to help lift it at high water. No sharks were seen anywhere in the vicinity of the dead ray, but sea-eagles and gulls kept a watchful eye on my activities. I threw some scraps to them, and those eagles were as attracted to pieces of liver as if they had been torn from Prometheus himself.



Head from the left side showing caroptere or horn-like fin in front of the eye. Note also the first gill-slit below the side fin and the harpoon wound on top of the head.

[Photo.—*Melbourne Ward.*

DIMENSIONS.

From the tip of the "horns" to the end of the tail, the Maher Island Devil Ray was ten and a half feet long, and the width across the "wings" or pectoral fins was eleven feet eight inches. There was no means of determining the weight. Other measurements were as follows:

	Inches.
Distance between the eyes	36½
Diameter of eye	¾
Width of mouth	22
Length of "horns"	18
Length of tail, from behind dorsal fin ..	56¾

The upper surface, including the dorsal fin, was very dark slate grey in colour, tinged in places with bluish. Towards the upper lip the grey turned to powder blue, gradating to white on the lip itself, the powder blue being continued laterally along each cephalic fin, of which the outer surfaces were white. The large eye was surrounded by a suffused bluish area; the iris was very dark bluish-grey, and the pupil dark brown with a black vertical slit. The ventral (under) surface of the Devil Ray was white, except for some large irregular steel-blue blotches on chest and belly, some of them extending to the hinder parts of the fins. A very narrow fringe of dark blue was noticed near the tips of the "wings". The long tail was mostly bluish or very dark grey (almost black at the tip), but the lower surface was white near the root.

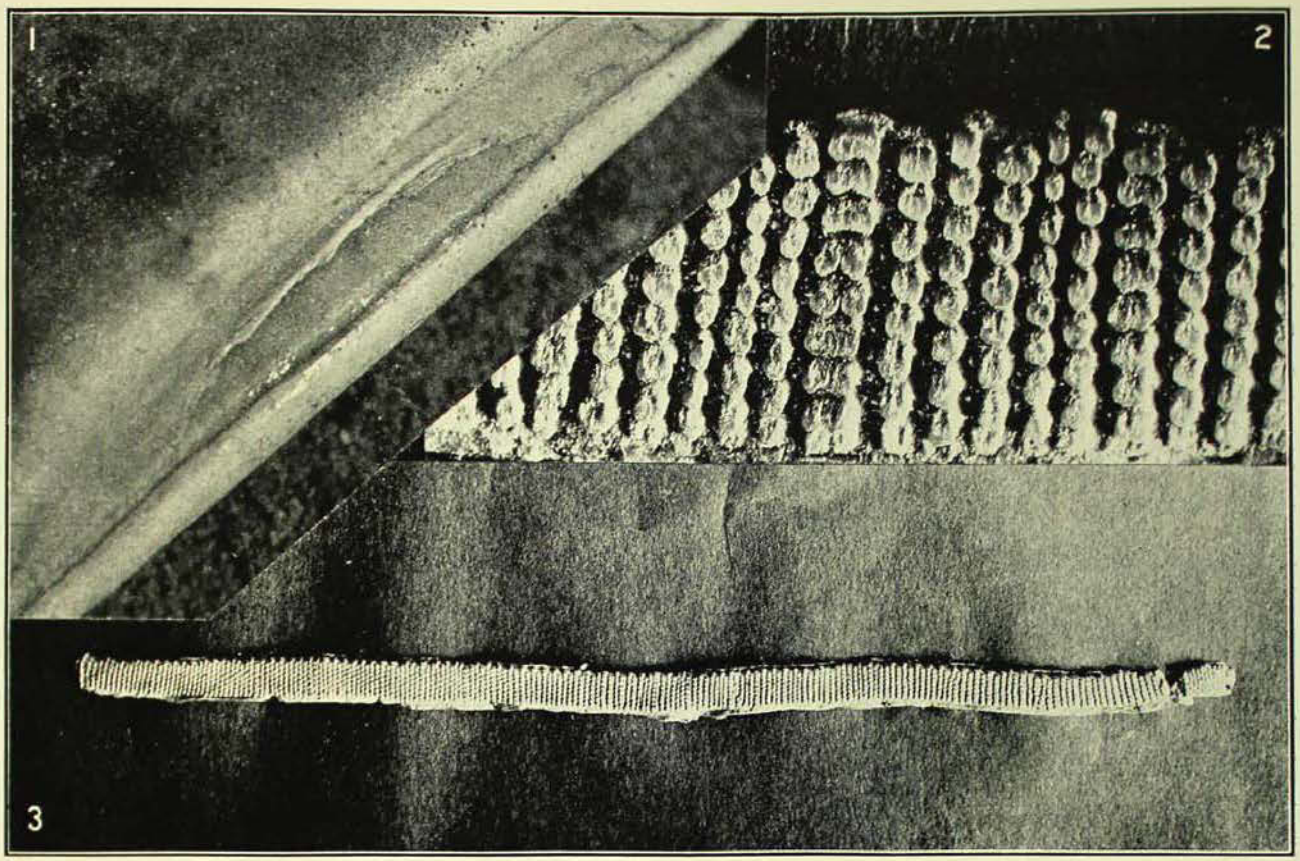
There was no trace of any spine on the tail as in true stingrays.

The horns could be curled, corkscrew-wise, and seemed quite flexible; probably they are used to guide water into the mouth, where the minute food therein would be strained by a very beautiful apparatus, found in no other fish, situated just in front of the five pairs of wide gills.

Some larval crustaceans (*Gnathia*) were found in the gill-cavities, but otherwise the integument and internal organs were quite free from parasites. No sucker-fishes accompanied the Devil Ray.

TEETH AND INTERNAL ANATOMY.

There has always been some doubt whether the Australian Devil Ray has teeth, Krefft's statement of their presence having been hitherto disregarded. On putting my hand into the mouth, the jaws felt perfectly smooth. However, in the lower jaw, I found that the skin lining the mouth could be peeled back, and there, underlying it, was a long band of tiny teeth which I removed with a scalpel. This band was fifteen inches long and half to three-quarters of an inch wide, and the teeth were in 212 rows, seven to



Unique photographs of the teeth of the Devil Ray: (1) Skin of the lower lip reflected to expose some of the teeth. (2) A few of the teeth, enlarged. (3) The entire dental ribbon, less than one-third life size, removed from the lower jaw. There are between 1,500 and 2,000 teeth in this band.

[Photos.—*M. Ward* (1) and *G. C. Clutton* (2-3).

nine deep. Thus there were between 1,500 and 2,000 teeth in all. There were no teeth whatever in the upper jaw.

The harpoon having pierced the one-and-a-quarter-inches-thick cranium, the skull and brain were too damaged for study. The details of the ray's internal anatomy will be reserved for future publication, but I may note that the spiral valve, a feature of all sharks and rays, made 44 coils in the large intestine, and that the heart was a purplish-red organ seven and a half inches long and five and a half inches wide. The specimen was a female, with two functional uteri, but no embryos.

The aboriginal name for the Devil Ray, in the language of the Whitsunday Passage natives, was Mungoona.

Now that game fishermen are paying more attention to our tropical waters, it is probable that more specimens of these giant rays may be caught. We have certainly much to learn concerning them; the male has yet to be described, an embryo specimen is much to be desired, and the structure of the brain and nervous system would repay study. These rays are apparently harmless creatures, though they sometimes fall foul of ropes or anchor-chains, but it is extremely doubtful whether they would attack man, notwithstanding the fearsome reports of ancient writers. I would, however, plead that they be not senselessly slaughtered, for they are unique animals and probably breed slowly. They are apparently the product of a very ancient line of evolution, as, although they outwardly resemble Eagle Rays and other Stingrays, but for the "horns", the terminal mouth, and other characters modified in accordance with their mode of existence, they are really not very closely related to those commoner creatures, as their skeletons and internal structure show. Once reduced in numbers by unsportsmanlike anglers, these curious

animals might well become extinct, instead of continuing to enjoy themselves harmlessly and afford amusement to sightseers in the future.

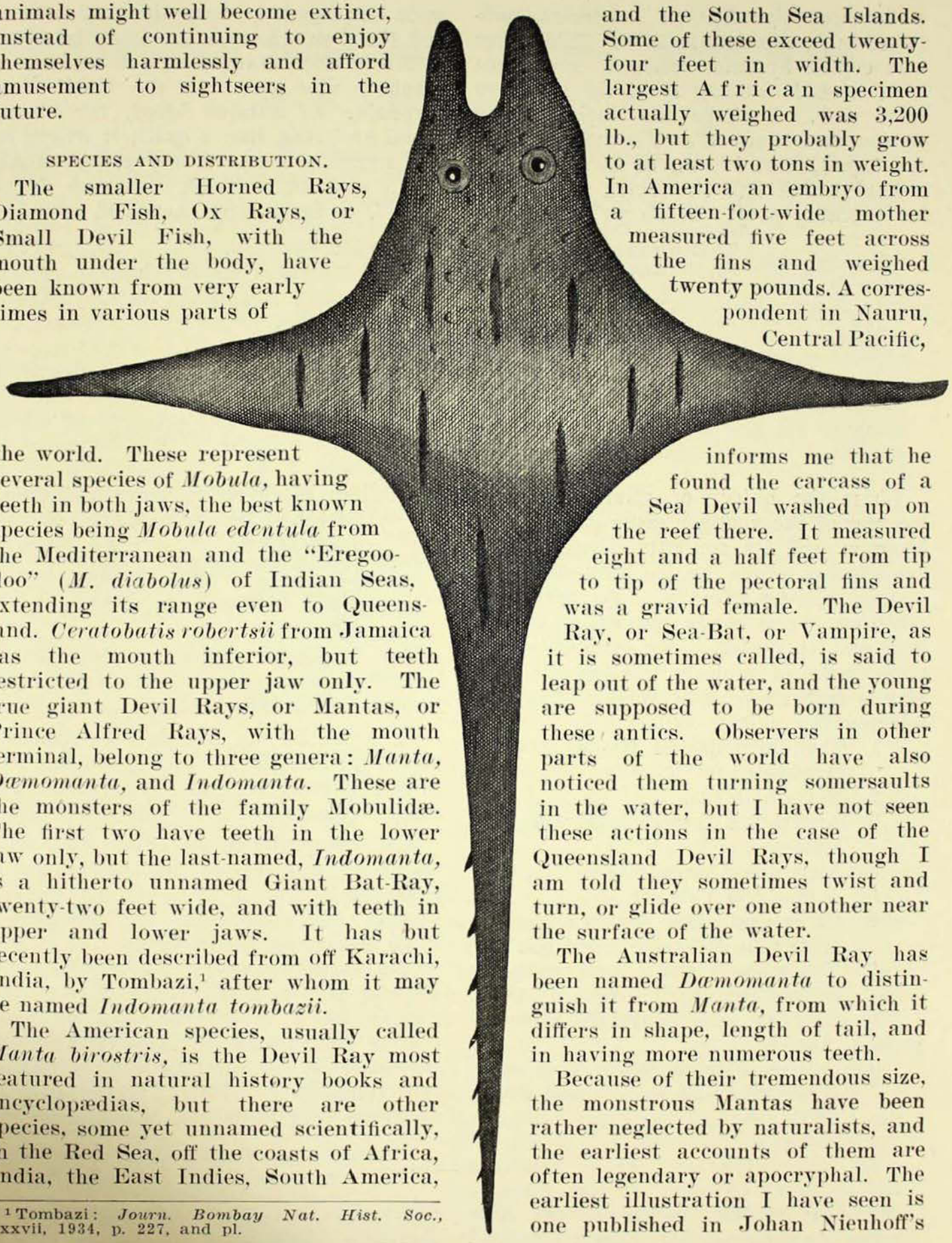
SPECIES AND DISTRIBUTION.

The smaller Horned Rays, Diamond Fish, Ox Rays, or Small Devil Fish, with the mouth under the body, have been known from very early times in various parts of the world. These represent several species of *Mobula*, having teeth in both jaws, the best known species being *Mobula edentula* from the Mediterranean and the "Eregoodoo" (*M. diabolus*) of Indian Seas, extending its range even to Queensland. *Ceratobatis robertsii* from Jamaica has the mouth inferior, but teeth restricted to the upper jaw only. The true giant Devil Rays, or Mantas, or Prince Alfred Rays, with the mouth terminal, belong to three genera: *Manta*, *Dæmomanta*, and *Indomanta*. These are the monsters of the family Mobulidæ. The first two have teeth in the lower jaw only, but the last-named, *Indomanta*, is a hitherto unnamed Giant Bat-Ray, twenty-two feet wide, and with teeth in upper and lower jaws. It has but recently been described from off Karachi, India, by Tombazi,[1] after whom it may be named *Indomanta tombazii*.

The American species, usually called *Manta birostris*, is the Devil Ray most featured in natural history books and encyclopædias, but there are other species, some yet unnamed scientifically, in the Red Sea, off the coasts of Africa, India, the East Indies, South America, and the South Sea Islands. Some of these exceed twenty-four feet in width. The largest African specimen actually weighed was 3,200 lb., but they probably grow to at least two tons in weight. In America an embryo from a fifteen-foot-wide mother measured five feet across the fins and weighed twenty pounds. A correspondent in Nauru, Central Pacific, informs me that he found the carcass of a Sea Devil washed up on the reef there. It measured eight and a half feet from tip to tip of the pectoral fins and was a gravid female. The Devil Ray, or Sea-Bat, or Vampire, as it is sometimes called, is said to leap out of the water, and the young are supposed to be born during these antics. Observers in other parts of the world have also noticed them turning somersaults in the water, but I have not seen these actions in the case of the Queensland Devil Rays, though I am told they sometimes twist and turn, or glide over one another near the surface of the water.

The Australian Devil Ray has been named *Dæmomanta* to distinguish it from *Manta*, from which it differs in shape, length of tail, and in having more numerous teeth.

Because of their tremendous size, the monstrous Mantas have been rather neglected by naturalists, and the earliest accounts of them are often legendary or apocryphal. The earliest illustration I have seen is one published in Johan Nieuhoff's



The earliest known picture of a Devil Ray. This apparition-like engraving of an East Indies example was originally published in a Dutch book of travel dated 1682.

[*After J. Nieuhoff.*

[1] Tombazi: *Journ. Bombay Nat. Hist. Soc.*, xxxvii, 1934, p. 227, and pl.

Gedenkwaerdige Zee en Lantreize, published in Amsterdam in 1682. This figure was copied by later authors, sometimes with tendrils issuing from the horns to catch fish. Perhaps the early artists confounded Nieuhoff's "Zee-duivel" with the Squid, also known as devil-fish, an animal which has two extra long arms for catching prey. Seven pairs of oxen were employed to drag this ray ashore, and the flesh was said to taste like game.

The name Manta, which means a blanket, was given to the Devil Ray, according to antique ideas, for "being broad and long like a quilt, it wraps its fins round a man, or any other animal . . . and immediately squeezes it to death", an error later turned to verse:

Thus proud of her success, the spreading Ray
By stratagem obtains the noblest prey.—Oppian, *Halieuticks.*

Essay Competition

WITH the object of stimulating the interest of the younger generation in the Museum and its contents, the Trustees are offering prizes for the best essays on certain of the exhibits. To permit a selection to be made according to the bent and aptitudes of the competitors, a wide choice of subjects is allowed. Any of the following seven subjects may be selected:

1. The daily life of the Australian aborigine.
2. Nests of birds.
3. Australian insects and their life histories.
4. Australian marsupials.
5. A study of fish life.
6. Coins and other articles used as money in different countries.
7. Venomous and non-venomous snakes, their structure and habits.

The essayists will be divided into age groups, namely:

Group I.—Fifteen years and over: First Prize, £3 3s.; Second Prize, £2 2s.

Group II.—Twelve years and under fifteen: First Prize, £2 2s.; Second Prize, £1 1s.

Group III.—Under twelve years: First Prize, £1 5s.; Second Prize, 15s.

For Group I the essays are to be limited to about 1,500 words; for Groups II and III to 1,000 words.

In addition to the money prizes, a medal presented by the President, Mr. F. S. Mance, will be awarded for the best essay submitted.

The competition is being conducted under the auspices of the Department of Education, and is open to all schools, public, private, and denominational. Each essay must be written in school under supervision, in the afternoon of Friday, May 1, 1936, and must be accompanied by a certificate that the competitor has visited the Museum and that the work is the unaided composition of the competitor. Entry forms can be obtained only from the Museum.

Amongst recent visitors to the Australian Museum was Mr. Edward Samuel of London. In chronicling this visit in our July-September issue our visitor was described as Sir Edward Samuel, Baronet. The error in description is regretted, but was certainly made in good faith.

A Geological Relief Map of New South Wales*

By R. O. CHALMERS, A.S.T.C.

FOR some time past it has been felt that a geological relief map of New South Wales would be an added attraction to the Mineral Gallery. The construction of a relief map of this State, however, presents great difficulties, due to the limited data available. This onerous task, however, had been undertaken some years ago by Mr. C. A. Orwin of the Lands Department, and he completed a remarkably fine and accurate piece of work, considering the attendant difficulties. It is to be hoped that the Lands Department will be able to carry to a successful conclusion their topographical surveys, and thus give us the basis for an intimate knowledge of the physiography of our State which will compare favourably with that of other countries. Accordingly, the original map constructed at the Lands Department was brought to the Museum workshops, and Messrs. Clutton and Kingsley of the preparatorial staff commenced to make moulds and casts, working with gallons of plaster and glue and other implements of their mysterious calling. The finished product, with the different geological formations carefully marked and distinctively coloured, will be seen occupying a place of honour in the Mineral Gallery probably by the time this issue of the Magazine is published. The map is drawn to a scale of eight miles to the inch, and will occupy about 63 square feet of wall space.

There is more to be said, however, about the story of New South Wales as told by the map than is conveyed by these few bald statements. It is fascinating merely to look at the map, with its bold sweeping bands of colour running mostly north and south, but who among us, unacquainted with geological interpretation, could guess that herein lies a clue to a profound and momentous drama, the duration of which has been the millions of years of geological time, the action having been brought about by the periodic unleashing of Nature's unmeasurable forces on the materials of the earth's crust, not always rigid and unbending.

"Now what does all this mean?" is the question usually asked by the layman, and unlike jesting Pilate, he usually stops for an answer. Geologists, and indeed all scientific workers, are usually accused of cloaking the meaning of natural phenomena with a mass of technical terms, so we will speak simply and try to make Nature's fascinating story somewhat clearer.

In regard to the building of a land mass, the principles of sedimentation, although treated with great scorn when first propounded, are now well established. Material is carried down by rivers from land masses and deposited in lakes or in the sea itself. The material is automatically graded once it reaches the water. Close in to the continental shelf we would fine coarse pebbly sediments, and from there all[1] gradations to the microscopic oozes of the ocean deep.

At intervals great earth movements may raise these sediments to form new land masses, and the fauna existing in the seas where they were laid down would be found as fossils in the rocks which form when consolidation takes place. The new land then forms the recruiting ground for further material, which is again laid down in the ocean or lake, forming a new sedimentary formation.

Since this basic principle has been studied and amplified for over a hundred years a very workable classification of formations has been evolved. The fossil evidence is of extreme importance in correlating strata, not only in the same continent, but in different parts of the world. Seventeen main divisions of all the

* See Frontispiece.

[1] An article describing deposition and other geological processes in the Sydney district appeared in this MAGAZINE, Vol. V, No. 12, Oct.-Dec., 1935, pp. 403–413.

sedimentary rocks of the earth have been made. These have been grouped into five eras: the Eozoic, which is the oldest and in which with a few doubtful exceptions no life has yet been found. Then come the Palæozoic, Mesozoic, Tertiary and Quaternary eras, the latter continuing at the present time. Each of the seventeen divisions has also been named, usually somewhat arbitrarily. For instance the six divisions of the Palæozoic era are, in ascending order, Cambrian, so called because the formation was first studied in Wales (Latin *Cambria*); then we have Ordovician and Silurian, named after two ancient British tribes; Devonian after Devon; Carboniferous because it was the age of the great coal measures of Europe; and Permian, after a district in Russia where Sir Roderick Murchison first observed the formation. These and the rest of the names have world-wide significance, although it has been argued that there is no sure way of correlating, say, the Permian sediments of Australia and Europe. The fossil evidence and the resemblances of the rocks themselves are not regarded as infallible criteria.

The main difficulty of course is to assign an absolute age to any of these formations, and most attempts proved very unsatisfactory until use was made of the manner in which radio-active minerals disintegrated.[2] These minerals occur in coarse-grained igneous (granitic) rocks which are intruded into sedimentary strata at great depth in the earth's crust. The great thrusts and stresses which on occasions close a period of sedimentation have been usually accompanied by great intrusions or extrusions of molten material which consolidate to form an igneous rock.

When we enquire how the oldest land masses originated a difficulty immediately arises in the mind of the discerning reader, for the Archæozoic or very oldest rocks, which are found very widely distributed over the earth's surface, consist partly of sedimentary strata which have been highly altered by heat and pressure to form metamorphic rocks. This immediately implies that Archæozoic sediments must have come from still older land masses, no traces of which now remain as far as is known. Also, it implies that there must have been a solid floor on which they were laid down, no trace of which has yet been found. The whole matter is very difficult to interpret, for it must be remembered that we are harking back some 1,600,000,000 years, and also the duration of the Archæozoic age may have been longer than all the subsequent ages put together. The clue may lie in the fact that, associated with all Archæozoic shields, or massifs as they are sometimes called, are huge and widespread granitic intrusions which are thought to have been of world-wide occurrence in those far-off times. These may have entirely assimilated the ancient basement, which may have been the very original crust of the earth.

These Archæozoic massifs are, as it were, great landmarks on the earth's surface. They are and always have been areas of great stability throughout geological time. They have acted as nuclei or rallying points round which younger sediments were laid down. Terrific thrusts then drove them against the unyielding shields forming extensions of the shore line. Thus it went on. New strips were continually welded on, and a continent was built. No very high mountains are ever found composed of Archæozoic rocks. The massifs are so stable that no great upheavals occur in their immediate vicinity. In fact, as above mentioned, they act as a strong barrier against which more yielding sediments are crumpled and elevated. Thus the Himalayas were formed by being forced against the Indian peninsula, which is largely an Archæozoic complex.

North-West Canada, Northern Scotland, Northern Scandinavia, and a large portion of Australia are Archæozoic massifs. Practically the whole of South-West Australia is composed of granites intruded in Archæozoic times; they continue almost right through to the Broken Hill district, although here and in Central Australia the ancient altered sediments or schists make an appearance. Of course in many parts the granites and schists do not outcrop

[2] T. Hodge-Smith: "Radium and the Age of the Earth", AUST. MUS. MAG., II, 4, 1924, pp. 136–7.

at the surface, being covered by younger sediments or by a veneer of recent desert formation, but it is safe to infer their presence at no great depth below the surface. This huge area was the nucleus to which Eastern Australia attached itself in successive stages, and nowhere is the progression more clearly shown than in New South Wales.

Unfortunately the desert formations and widespread recent alluvial deposits mask the succession in western New South Wales until we come to a meridian drawn in the vicinity of Cobar. From here, going east, we see the great Ordovician and Silurian strips running north and south, because they were consolidated by great thrusts coming from the Pacific Ocean on the west. When they first suffered orogenic uplift, due to these mountain building forces, possibly ranges of Himalayan proportions were formed, but these have long since worn away. The present valleys and hills are the products of a much later and gentler upheaval. As we travel to the east the formations become less and less altered, giving evidence of less and less distorting influences. Of course, the older the formation the more it is likely to be altered, for not only has it been subjected to the original force to which it owed its origin, but also to every subsequent one. Also, every formation in New South Wales does not necessarily run in a well-marked north and south band. For instance, shallow Upper Devonian seas extended far westward, and its sediments were laid down on the upturned edges of the Silurian and the Ordovician rocks, so that at the present, although considerable erosion of the Devonian must have taken place, yet it is found much further to the west than the Ordovician. Also, the Carboniferous sediments do not extend further south than the Hunter River, simply because the old Carboniferous sea did not extend much further south than this point. Incidentally, the majority of the granites which are such a striking feature of the map were intruded at the close of the Devonian.

When we come right to the coast of New South Wales, in the Sydney district and in the Clarence River district the rocks are level bedded. They are supposed to have been deposited for the most part in large fresh-water lakes and have suffered no great deformation. The basin structure of the Sydney area can well be seen on the map. The Permian and Triassic sediments make up a conformable succession of great thickness. Although some of the Permian sediments were of marine origin, fresh-water conditions prevailed on two occasions, and in these lakes accumulated great quantities of vegetable material which is now found in the form of coal and kerosene shale.

An old established fallacy is that Australia is the oldest country in the world. It is certainly very stable and conservative, geologically speaking. When the Alps, Pyrenees, Caucasus, Himalayas, and even the great ranges of New Guinea and New Zealand were being formed in Tertiary times, that is anything from one to fifty-four million years ago, Australia remained stable except for a comparatively gentle differential crustal movement during the Kosciusko Epoch, as it is called, which commenced at the end of Tertiary times about a million years ago. Part of eastern Australia was thus elevated to an average maximum of three or four thousand feet, forming the present main divide and initiating the present cycle of erosion.

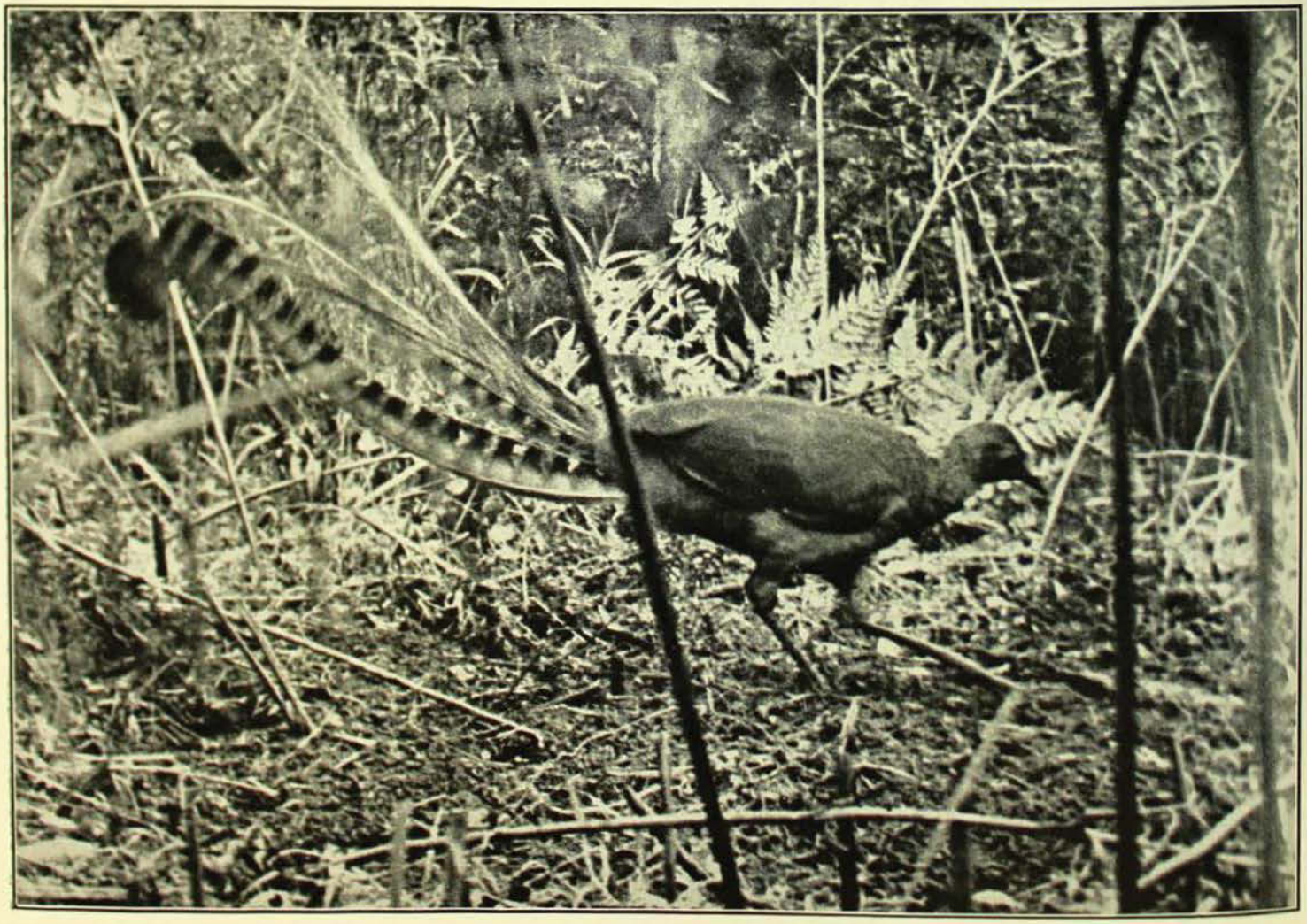
Since then minor downward movements have occurred, drowning a number of valleys and forming such harbours as Port Hacking, Port Jackson, and Broken Bay, or it may be that the sea-level rose partly as a result of the melting of the great ice-sheets of the Pleistocene glacial period. The Kosciusko epoch still continues, for the slight earthquake shocks that occur at intervals in eastern Australia, sometimes even in Sydney, suggest that our main divide is rising, while on the other hand parts of the coast may be sinking, but both movements take place with such extreme slowness that any rise or fall will not be appreciated until far into the future.

The Lyrebird Display for the Screen*

By R. T. LITTLEJOHNS, R.A.O.U.

AFTER having spent seven years, 1925 to 1931, in an endeavour to make a motion picture of the life story of the lyrebird, the writer decided that, in view of the difficulties, improvement of the result obtained in that period was only remotely possible. Three seasons were devoted, then, to "still" photography. But the interest attached to making motion pictures is such that the quest for "stills" was not entirely satisfying. Neither, in fact, was it very successful. The whole of the ten years was spent in the Sherbrooke Forest area, twenty-five miles from Melbourne, where the birds have attracted considerable attention. Late in the winter of 1934 it became apparent that the chances of successful photography had been considerably enhanced by the fact that the lyrebird population of the area had increased. As a result of the increase, a strip of dense growth extending some three hundred yards along the forest edge was adopted for the first time by a male bird as his "territory". But, whilst this portion of the forest formed an

* Photographs copyright.



Male Lyrebird preparing a new mound by vigorous scratching. The tail is shown in the folded position.

[Photo.—*R. T. Littlejohns.*

efficient feeding ground, it contained no screen of ferns amongst which the bird could make his "mounds". For his relaxation, or whatever the display means to him, therefore, he left the forest and cleared playing places amongst the bracken in well-lit situations. These changed conditions, together with the improvement effected in cinematograph and photographic film, caused a renewed anxiety to record the dancing ceremony.

Before the beginning of the present winter, therefore, arrangements were made with the Commonwealth Department of Commerce to make a new film on its behalf. The Department already was in possession of a remarkable sound film record of the song made during the direct broadcast from Sherbrooke through the national stations on June 24, 1934. Conditions on that occasion were ideal, so that the recording, which covers twenty minutes of song, is as close to perfection, probably, as a recording ever will be.

When the display season commenced in April a small cinema camera, using standard film and operated by clockwork motor, was fitted into a padded box and arranged so that the motor could be operated from a distance by means of a line. Each week-end the apparatus was fastened to the ground fifteen feet from a mound and covered with ferns and *débris*. But week after week this particular mound was passed by, though it was apparent that it was used during the period that the camera was not in position. It became obvious that the neglect of the mound was something more than coincidence, and the shining lens, although small and recessed far into the box, was strongly suspected of being responsible.

Male Lyrebird on one of the mounds in the bracken at the forest edge. The dense growth of the forest may be seen in the right-hand corner of the picture.

[Photo.—*R. T. Littlejohns.*

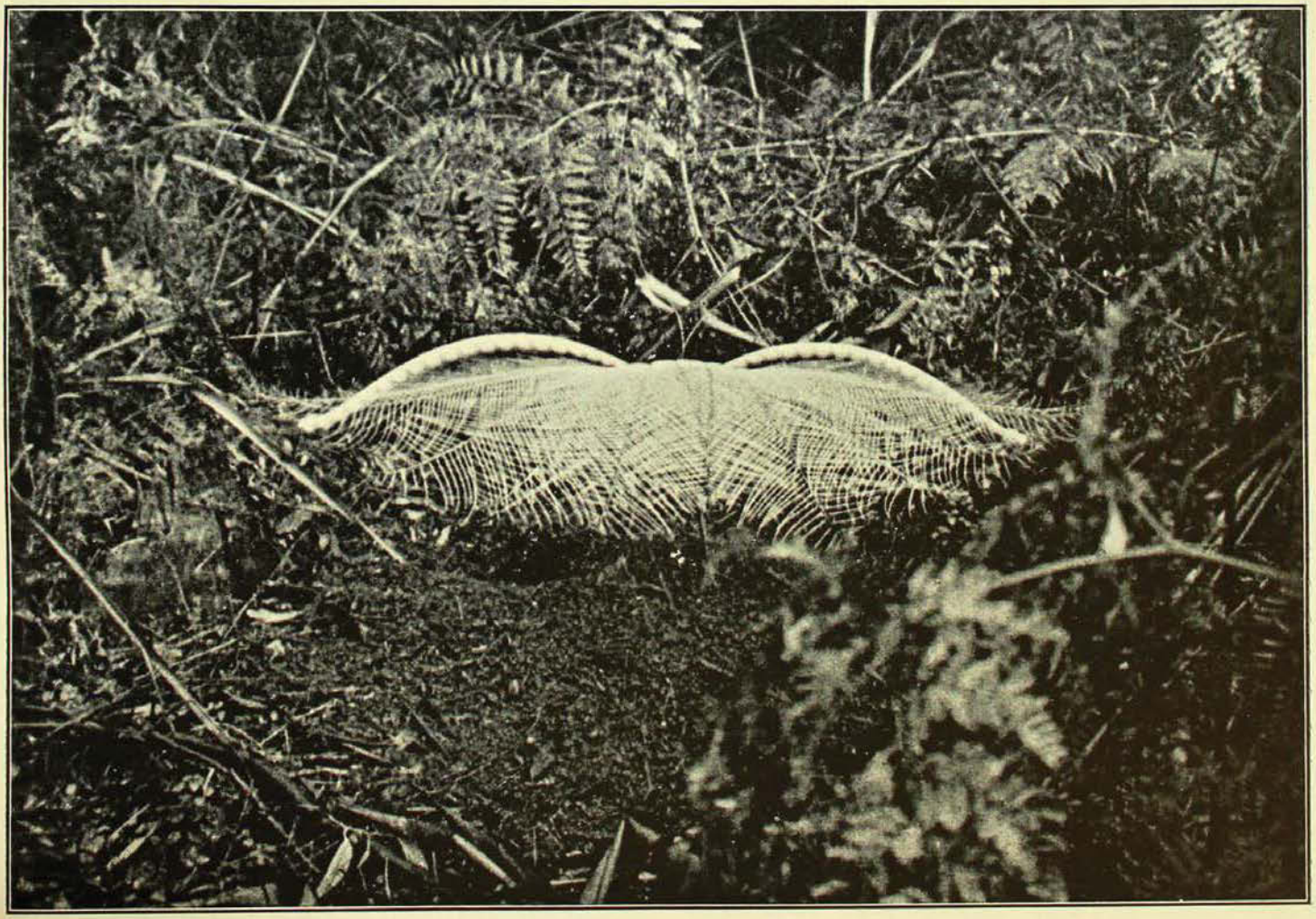
Male Lyrebird displaying. The filmy feathers are not fully depressed. The beak is wide open during the louder notes of the song.
[Photo.—*R. T. Littlejohns.*

The box was then fitted with a movable shutter so arranged that tension on the operating line uncovered the lens a moment before the operation of the motor was effected. The apparatus was transferred, then, to another mound amongst the bracken and hidden carefully, as before, at a measured fifteen feet. The new method was successful at once. In less than three hours after the camera had been set up the familiar song sounded from the ferns directly in front of the apparatus. The end of the line controlling the motor had been drawn to a position about sixty feet from the camera, and considerable excitement attended the progress of the writer through dripping ferns to that point. Through the intervening fern stems occasional flashes of white could be seen which indicated that the head of the performer would be covered by the filmy tail feathers. In such circumstances there was little danger that the uncovering of the lens would be noticed by the performer. But what of the noise? Even in its muffled box the camera was not completely silenced, and the bird's attitude towards the sound of the motor had yet to be ascertained. It seemed an age before a particularly loud burst of song formed a satisfactory cloak for the starting of the motor. The tension on the line was increased, then, until the whirring of the camera could be heard plainly. The operator held his breath, expecting each instant that the sudden ceasing of the song would indicate that the bird had become alarmed and had made a hurried departure. But the song continued unabated. After twenty seconds the whirring of the camera

ceased, the spring having then run down. Here was the greatest triumph in ten years devoted to lyrebirds in their natural setting. Certainly there was some disappointment occasioned by the fact that, because it was not possible to reach the camera to rewind the motor, precious minutes of dancing went unrecorded.

The reason for the excitement over this twenty feet of celluloid ribbon was that, in three main respects, the film just secured would be an improvement on the record of the "dance" made by the writer in previous years. Firstly, the light was probably twenty times more efficient than that available in situations where the previous film was obtained. Secondly, it was the first occasion on which film had been taken with the camera fixed at a measured distance, thus assuring sharpness and steadiness in the picture. Furthermore, it was almost the first occasion on which it had been possible to obtain a clear view of the ceremony from such short distance.

During following days five other sections of film, each of twenty feet, were exposed under similar satisfactory conditions. And one other opportunity, the second, was lost through the breaking of the line. This, at the time, was regarded as a disaster of major importance, but, fortunately, was redeemed during subsequent days. Altogether the muffled and camouflaged camera stood before this mound on fourteen days, and on eight of them the bird displayed, once only each day, on the little clearing. On two of the



Male Lyrebird in full display attitude. The bird is facing the camera and is almost completely hidden by the twelve filmy plumes of the tail. The large outer feathers are spread laterally. This picture is extracted from the most convincing scene in the film.

[Photo.—*R. T. Littlejohns.*

Female Lyrebird at Nest.

[Photo.—*R. T. Littlejohns.*

later occasions no film was exposed because a special item of which record was desired was not given.

Strangely enough, after the excitement referred to, other opportunities, even more satisfactory, presented themselves whilst the operator carried the camera in his hand. Film obtained previously in this way had not been entirely successful, but, by remarkable good fortune, several "shots" made thus provide the highlights of the picture. Early one morning when the sun was just peeping above the scrub the same bird was heard singing at the forest edge. As it was considered that the light, at that early hour, would not be sufficient to imprint any image on the film, the writer walked quite recklessly to the spot. And, although the mound on which he stood was without the usual screen of fern, the bird continued singing, his body and head hidden completely under the filmy canopy of his outspread tail. Such a scene at a distance of only ten feet was so entrancing that the dulness of the light was forgotten in the anxiety to perpetuate the incident. Even the noisy operation of the camera without its padded box did not deter the performer nor yet the re-winding of the motor when the first twenty feet had been run. The result obtained was a complete surprise, the efficiency of the newest negative film being such that the picture is quite clear and effective. No less remarkable was a later experience when, in the perfect light of early afternoon,

Young Lyrebird which, at five and a half weeks, has just left nest.
[Photo.—*R. T. Littlejohns.*

four sections of film were exposed whilst the operator sat on the ground nine feet from a mound and chose desirable incidents from one of the most varied performances the writer had witnessed in ten years. On this occasion, certainly, the view was obstructed somewhat by fern stems, but this fact does not detract in any way from the efficiency of the picture on the screen, even if it rather spoils the "still" pictures cut from it.

The film has been completed now, with a record of the nesting activities of the female and the early life of the chick. It will be synchronized, at an early date, with the fine sound recording already referred to. Every aspect of the film, therefore, features wild birds in their natural surroundings at Sherbrooke.

The present may be a suitable occasion to express appreciation of the part played by the Australian Broadcasting Commission in fostering a public sentiment in favour of the Lyrebird. The annual transmission from the forest undoubtedly has accounted, largely, for the fact that the species has escaped the danger of extinction which threatened it, and, today, is one of the most appreciated and best protected creatures of this country. And now, as a result of the enterprise of another public organization, it is likely that the species may achieve a reputation overseas.

EGYPTOLOGICAL ADDITIONS TO OUR COLLECTIONS.

A CORRECTION.

In our previous issue we illustrated a limited selection from some recent donations to our collections of Egyptology by Mr. Ernest Wunderlich, F.R.A.S., a former Trustee and President of this Museum.

Inadvertently it was stated that Mr. Wunderlich had been associated with Sir Flinders Petrie on various occasions in excavating work. Whilst Mr. Wunderlich had had the pleasure of visiting Sir Flinders Petrie at the site, he was not actually associated with him. The inadvertence is regretted.

Ant-Lions

By NANCY B. ADAMS.

THE squat rather repulsive little creatures known as Ant-lions, and the cunning means by which they secure their prey, are familiar to most people, but it is perhaps not so well known that these insects eventually develop into very graceful creatures, slender and fragile, with dainty gauzy wings. Economically they are of no importance, but their remarkable habits have made them a popular subject of study by a long line of famous naturalists.

They belong to the family Myrmeleontidæ, which is widely distributed throughout the world, though its members are found in greater numbers in tropical and subtropical climates. The name of the family is derived from the Greek word *murmex*, an ant, and *leon*, a lion. In the Greek version of the Book of Job the curious word "myrmecoleon" appears in a passage which is now translated as "the old lion perisheth for lack of prey". Many amusing speculations as to the meaning of this word are to be found in mediæval literature. One ingenious author stated that the "myrmecoleon" was the offspring of a lion and an ant, and since it had inherited the forepart of one parent, together with its carnivorous habits, and the hind parts and plant-eating tendencies of the other, it could eat neither meat nor plant food, and so perished miserably of starvation.

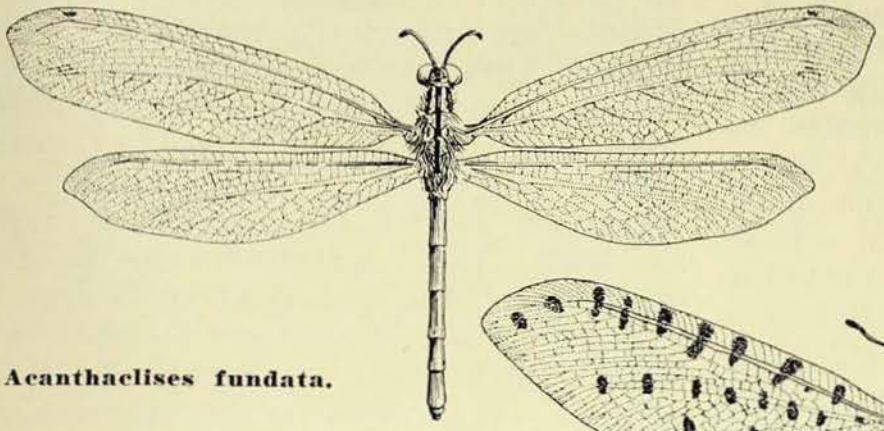
LIFE HISTORY.

The small, white, elliptical eggs are deposited in sandy soil, and from these eggs hatch the larvæ. These are rough-skinned short-legged creatures with prominent heads set on a flexible neck. The head is armed with a pair of formidable jaws known as mandibles, long and flat, and curved in towards each other at the tips, which are sharply pointed; along the inner margin of each jaw are three stout teeth. The insect is adapted to lead a purely sedentary life, for it can move backwards only, and its eyes are of a primitive type.

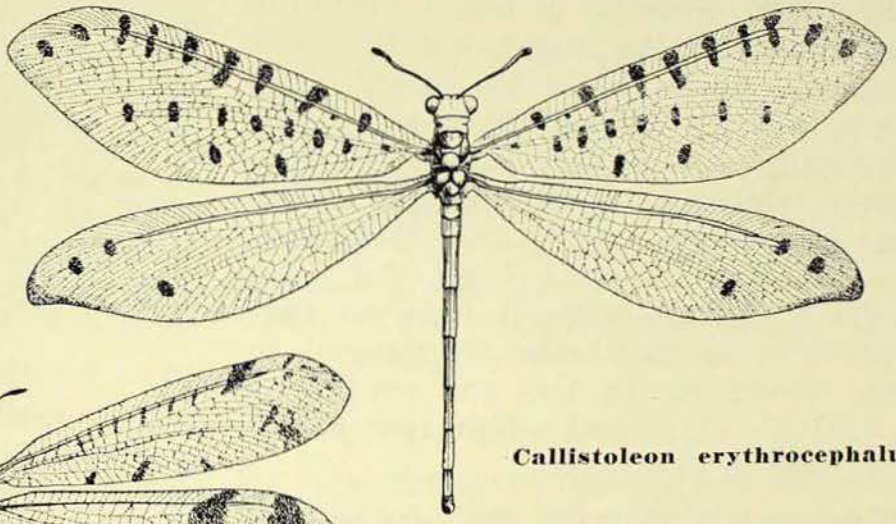
The larva soon commences to dig the pit which serves as a home for itself and a snare for its prey. These pits are usually constructed at night, and in the shelter of logs or rock ledges, for a breath of wind fills up the tiny hollows, a shower of rain obliterates them, and the ant-lion finds it impossible to rebuild its pit when the soil is damp. The larva travels backwards, marking out a shallow circular furrow with the tip of its abdomen, and tossing the sand outside the circle by means of its broad head and flattened jaws. Having completed this groove it continues to burrow downwards in a gradually contracting spiral, energetically shovelling out the sand as it goes, until a shallow conical pit has been excavated. The ant-lion now buries itself in the soil at the bottom, leaving only its jaws exposed, and settles down to wait for its first victim.

Sooner or later an unwary ant is certain to approach this innocuous-looking little hollow. It pauses on the edge for a moment to survey this apparently empty depression, the rim suddenly crumbles away and the unfortunate ant is precipitated down the steeply sloping walls. The frantically struggling insect sometimes manages to regain a footing on the treacherous sides of the trap and strives to reach the surface. Again and again the loose sand gives way when the ant is in sight of safety, and it slips down once more. In the meantime the crafty ant-lion, determined to allow its prey no chance of

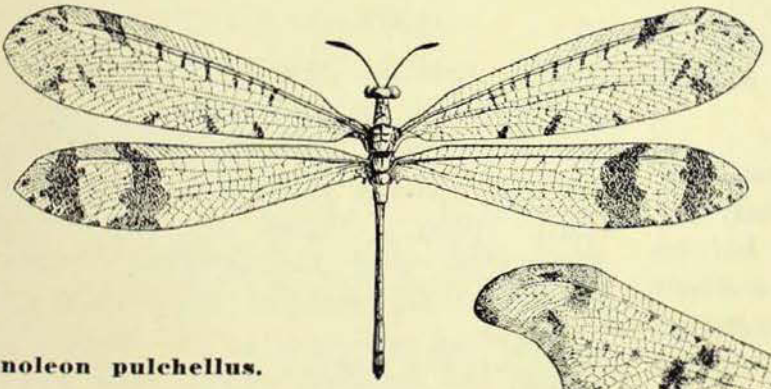
escape, vigorously showers the now desperate ant with sand thrown up from the bottom of the pit by its shovel-like head. Slowly but surely the miserable ant slips down to the waiting jaws below, which seize the struggling creature in a relentless grasp.



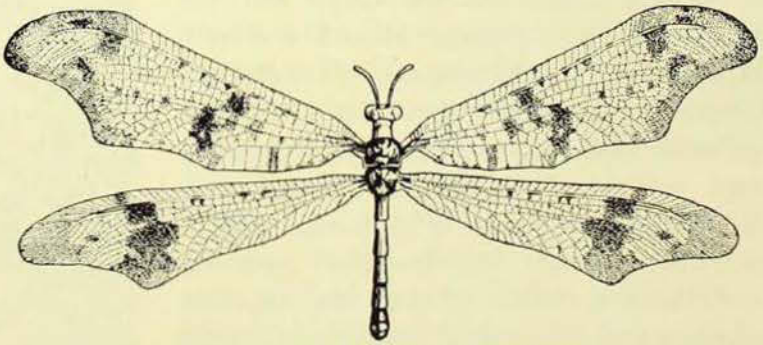
Acanthaclises fundata.



Callistoleon erythrocephalus.



Glenoleon pulchellus.



Periclystus circuiter.

[Nancy B. Adams, *del.*

The mouth is specially constructed to suck the juices of the victim. The jaws which seize and hold the prey are grooved along the inner sides, and within this channel lie the slender maxillæ by means of which the fluid food is conveyed to the digestive system of the ant-lion. When the insect is sucked dry the empty shell is tossed out of the pit. The ant-lion does not confine itself to a diet of ants only, but will devour with relish small beetles and other creatures that are so unfortunate as to blunder into its lair. Since ants are by far the commonest insects to be found in localities favoured by the ant-lion, they are its usual victims.

Should an insect, having fallen into the trap, be lucky enough to escape, the ant-lion, if it is particularly hungry, leaves its den and pursues its quarry over the sand, but since it can move backwards only, is almost invariably unsuccessful and returns unsatisfied.

An interesting unnamed species from New Guinea was recorded by Biró as making a double pitfall, a small funnel at the lower end of the main pit. This insect does not hesitate to leave its burrow in pursuit of its victim. Unlike the true myrmeleons, which can travel backwards only, this species runs forwards with great speed. Biró states that he often saw several of these larvæ chasing the same insect.

In his book *Demons of the Dust*, W. M. Wheeler says that a species from the

Mojave Desert "not only excavates a steep-sided pit, but prolongs its centre downwards as a narrow tube. Since the pitfalls are made in the open desert, the tubular deepening may be an arrangement for enabling the larva to lie in wait for its prey as far as possible from the hot surface layer of the sand".

These insects are capable of fasting for extraordinarily long periods. For weeks the ant-lion may wait patiently for a meal. Its existence is not, however, so precarious as might be supposed, for it is provided with unusually large quantities of fat which sustain it almost indefinitely. Scarcity of food retards the development of the insect, but it is not uncommon for a larva to pupate after several months without food, to emerge eventually as a perfect insect. Species closely related to these pit-digging ant-lions but which actively seek their prey are known to remain inert for long stretches of time without food, so that apparently lengthy fasts are natural to these creatures. In fact the ant-lion is an example of perfect adaptation to the conditions of existence.

The larva periodically casts its skin as it grows, until at last it is ready to pupate. It rests for a few days before enclosing itself in a round silken cocoon which it spins under the sand. Grains of sand adhere to the outside of this cocoon which effectively camouflage its appearance, and within this shelter the larva changes into a pupa. While the pupa remains motionless inside the cocoon various changes take place inside the pupal skin, until the adult insect is ready to emerge.

As soon as climatic conditions are favourable the pupa cuts its way out of the cocoon by means of a pair of stout jaws specially provided for this purpose. It burrows to the surface of the ground, and there the pupal skin splits and is cast aside, a crumpled shell, by the adult insect. On first emerging this is a sorry looking creature with limp bedraggled wings. It crawls up a nearby twig and clings there with its forelegs, weak and defenceless. Gradually its body lengthens and grows firm, its wings open out and dry. In a little while a fairy-like creature with twin pairs of dainty transparent wings leaves the twig and flies unsteadily away. Anything less like the ugly little hobgoblin of its youth would be difficult to imagine. These mature insects are popularly known as lace-wings. They have large prominent eyes and their mouths are specially modified for biting. Their food consists of small insects caught on the wing at dusk, for lacewings do not venture abroad until twilight. They lay their eggs in dry sandy localities, and from these eggs a new generation of ant-lions is developed. These insects are very short-lived. It is strange that, when so much time is occupied by the development of the immature stages, and the months of preparation result in so lovely a creature, its life should be so short.

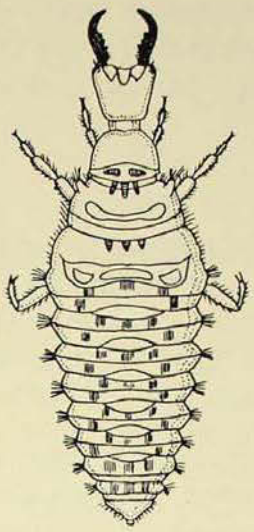
AUSTRALIAN ANT-LIONS.

The family Myrmeleontidæ is well represented in Australia, though there are only two groups whose larvæ are known to make pits in the sand to snare their prey. These are the genera *Myrmelon* and *Callistoleon*. The two species *Myrmeleon pictifrons* and *Myrmeleon uniseriatus* are very common along the eastern coast, and the little funnel-shaped depressions in dry soil under houses or in sheltered localities in the bush are usually made by these two species. *Myrmeleon pictifrons* is a dainty insect measuring about two and a half inches across its wings. The wings are clear and transparent with a beautiful iridescent sheen. The best known, but at the same time a rather rarely seen member of the genus *Callistoleon,* is *Callistoleon erythrocephalus,* a fairly large lacewing with a number of conspicuous dark spots scattered over its wings. The remaining Australian members of this family vary greatly in their habits; none of them are pit-forming insects.

The genus *Glenurus* contains several well-known species, of which *Glenurus pulchellus* is the commonest, though its life history is obscure. It measures about two and a half inches across the wings. The forewings are speckled with very dark brown, and the hindwings are marked with two dark brown blotches. These insects when at rest fold their wings over their backs, and if disturbed fly away rather awkwardly.

Xantholeon helmsi is a curious species larva of which is recorded by Dr. R. J. Tillyard as living in the sand on the floor of caves about Sydney. It is a very fragile lacewing, brownish, with the wings covered with a fine network of light brown veins.

The handsome species *Periclystus circuiter* deserves mention on account of its remarkably shaped wings, which have a large piece cut away from the hind margin.



Acanthaclises fundata.
[N. B. Adams, *del.*

The larvæ of the genus *Acanthaclisis* are large creatures which conceal themselves under loose sand and debris at the foot of trees. *Acanthaclisis fundata* is a heavily built insect, the prothorax densely covered with greyish white hairs and marked down the centre with a dark stripe. It is widely distributed throughout Australia.

THE RED CENTRE: MAN AND BEAST IN THE HEART OF AUSTRALIA. By H. H. Finlayson. (Angus & Robertson Ltd., Sydney, 1935.) Pp. 146, with map and fifty-two full-page plates. Price: 7s. 6d.

Central Australia, despite its relative inaccesibility and the somewhat trying conditions of its terrain, has a definite lure, and many who have sojourned there for longer or shorter periods have felt constrained to share their experiences with the reading public. The present work, by the mammalogist of the South Australian Museum, stands out as one of the most informative and entertaining of all the books that have been written on this fascinating region.

The book is the outcome of trips made in the summers of 1931-1935, the total time spent in the Centre amounting to thirteen months. These trips were mainly for the purpose of making collections of mammals and investigating their distribution, but the author missed no opportunity of making and recording observations on the fauna generally (including the human inhabitants), and on the physical features of the country traversed. His descriptions will dispel various misconceptions regarding the topography and aspect of the Centre which many picture as a flat, treeless, and monotonous region.

The descriptions of animal life are a strong feature of the book, and the account of the re-discovery of the Plain Rat Kangaroo (*Caloprymnus campestris*), first described by John Gould in 1843, reads like a romance. The deft capture by one of the blacks of a mother and its young enabled photographs to be taken of a living example of this "little pale ghost of the 1840's".

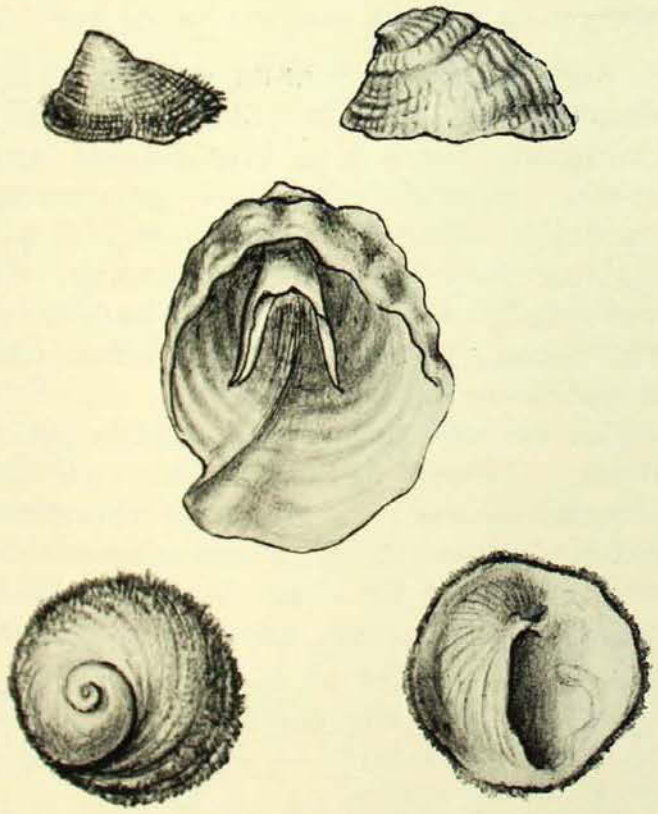
The work, which is illustrated by a fine series of photographs by the author, has been excellently produced, and sets a high standard of publication. The map is worthy of special note, for it is the finest we have yet seen.—C.A.

Australian Shells

THE SLIPPER, CUP-AND-SAUCER, CAP AND HORSE-HOOF LIMPETS, HORN SHELLS AND TRIPHORAS.

By JOYCE ALLAN.

THE small limpet-like shells known as Slipper, Cup-and-saucer, Cap, and Horse-hoof Limpets, are sometimes collectively known as Bonnet Limpets, and belong to the family Calyptræidæ. Members of the family are common round the shores of Australia, and are amongst the first favourites of children. They are usually found adhering to stones and shells, most of them staying in one spot all their lives and adapting the shape of their shell to the irregularities of the chosen locality. Some species wear away the space beneath their foot and others secrete a shelly base. Their form and colour depend a great deal on the situation in which they grow, those found in the cavity of dead shells being generally flat and colourless. They feed on seaweeds and animalculæ, and occasionally show cannibalistic tendencies. Some lay their eggs under the foot of the animal, as in a brood pouch, and so hatch them.



The figure on the left of the upper row is Pilosabia barbata, a Horse-hoof Limpet, and next to it a Cap Limpet, Capulus australis. The True Cup-and-Saucer Limpet, Cheilea undulata, is in the centre, and below it, a very common Cup-and-saucer Limpet, Sigapatella calyptræformis.

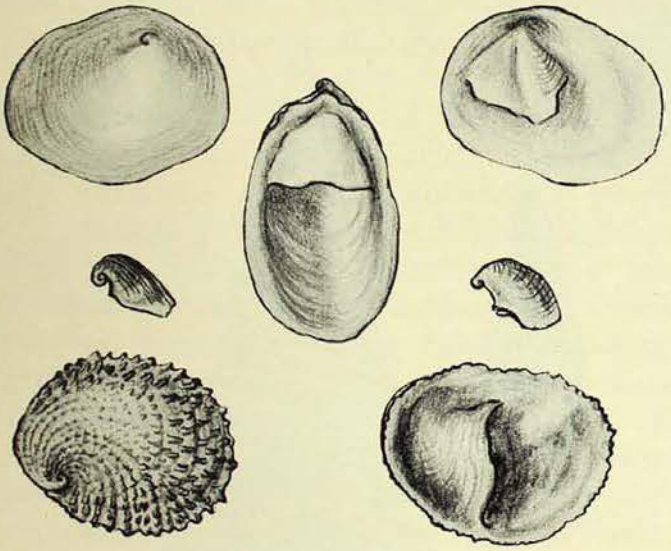
[Joyce Allan, *del.*

The main genera of the family are *Crepidula*, the Slipper or Boat Limpets, in which the oval shell has a horizontal plate closing about one-half of the aperture like the deck of a boat; *Sigapatella*, Cup-and-saucer Limpets, almost circular shells with more or less distinct spires, the aperture basal, and the interior with an almost complete sub-spiral partition, and *Capulus*, Cap Limpets, small conical shells, provided with epidermis, possessing no internal processes, but having a horseshoe-shaped muscular impression on the inner wall. Other genera are *Pilosabia*, the Horse-hoof Limpets, obliquely conical shells with roughened surface and their muscle-scars horse-hoof-shaped, and a shelly base instead of an operculum; *Ergæa*, flat shells, with a small internal process produced in front; and *Cheilea*, conical rather irregular shells with a central half-cup-shaped process, open in front, free at the sides, and attached in the interior at the apex.

SLIPPER LIMPETS.

The genera are world wide in their distribution, and are well represented in Australia by many well-known forms, the commoner of which are figured in this

article. The Slipper Limpets, which are very variable in shape and colour according to their situation, are represented by *Crepidula aculeata*, a white, yellow, or brownish shell about an inch and a half long, the upper surface covered with prickly or spinose ridges, and the interior often blotched with brown, and *C. immersa*, a narrow whitish form, about one and one-quarter inches long, which is found in coastal waters of New South Wales round to south-west Australia. The former species also lives in New South Wales, Victoria and south-west Australia.



In the top row are upper and lower views of the Little Slipper Shell, Ergæa walshii, with the Elongated Slipper Limpet, Crepidula immersa, between them. The two small Cap Limpets on each side of this are respectively Capulus violaceus and Capulus devotus, and in the bottom row are upper and lower views of the Common Slipper Limpet, Crepidula aculeata.

[Joyce Allan, *del.*

CUP-AND-SAUCER LIMPETS.

The Cup-and-saucer Limpet figured is *Sigapatella calyptræformis*, a white or yellow-white shell, marked by growth lines and covered by a thin yellowish epidermis. The white interior is more or less blotched with violet. The shell not only serves to protect the animal, but acts as a shield for the offspring of the female, who hatches her eggs, contained in yellow membranous capsules, and keeps the fry between her foot and the foreign body to which she adheres. The shells are found in shallow water between tide marks, attached to pebbles and stones, along the southern Australian coast. It is a very common shell, empty ones often being found washed up on sandy beaches.

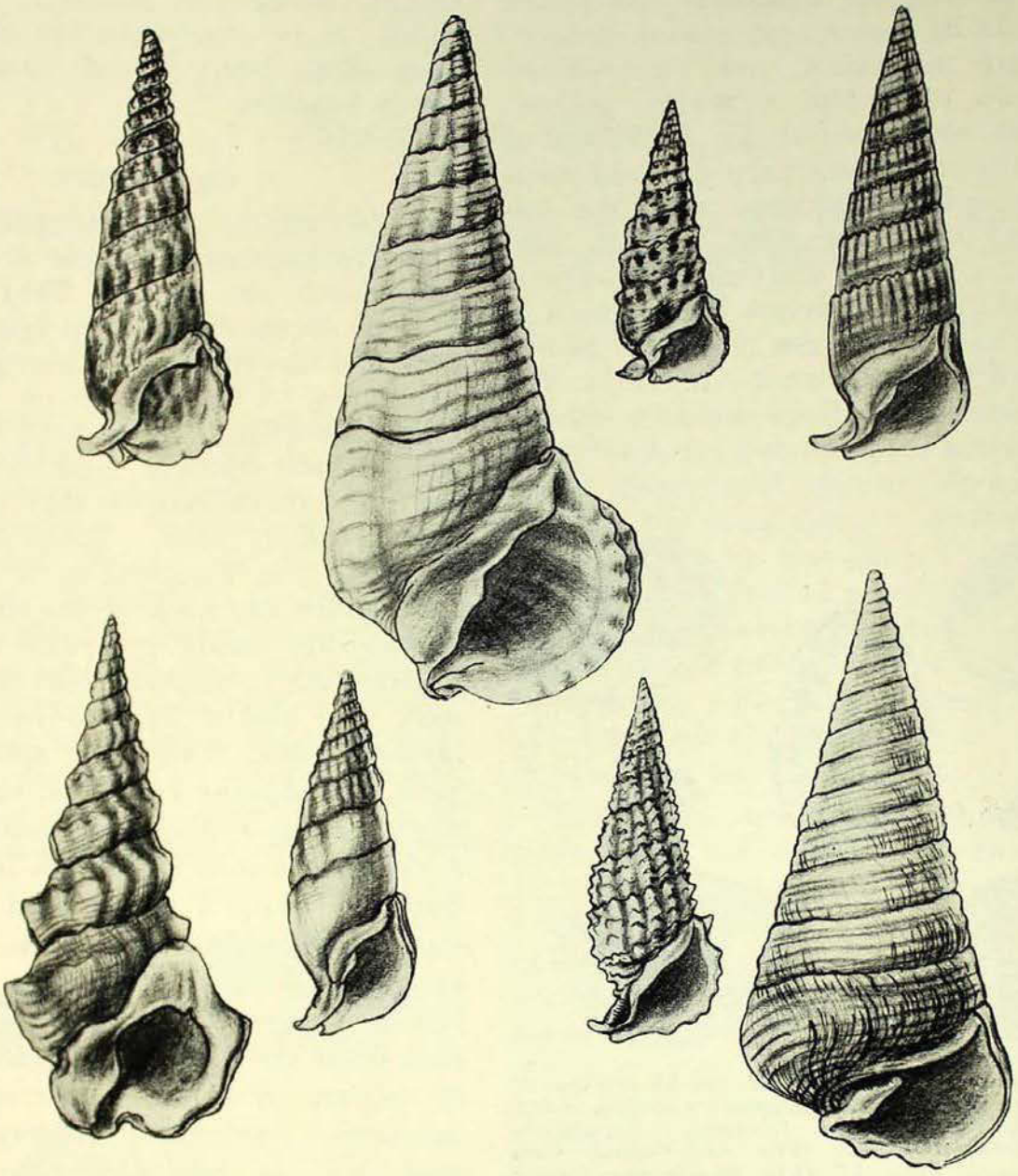
CAP LIMPETS.

There are only a few species of Cap Limpets known, and these are scattered throughout the world. They have very limited locomotion, being usually adherent, and modifying the margin of their apertures to the surface on which they live. Sometimes they even wear away the surface beneath their foot, forming shallow excavations, or they form an imperfect shelly base. Their membranous egg-cases are attached in a tuft to the foot under the neck of the animal. The species are small, generally only a few millimetres in diameter, the largest being only one and a half to two inches in measurement. Two small species figured here are *Capulus violaceus*, sixteen millimetres long, radiately striped, and with a violaceous interior, which lives in New South Wales, Victoria and Tasmania, and *Capulus devotus*, a deep water shell ranging in its distribution from New South Wales to south-west Australia, somewhat the size of *violaceus*, but white in colour. A rather larger species from southern Australian waters, *Capulus australis*, is pinkish-orange coloured. *Capulus intortus*, from south-west Australia, possesses a yellowish hairy epidermis, and is thin and obliquely spiral.

THE HORSE-HOOF LIMPETS AND OTHERS.

The Horse-hoof Limpets form a shelly base, or excavate a cavity in the surface of the place to which they adhere, whether rock or living shell. A small depressed whitish species, with a brown hairy epidermis and about three-quarters of an inch long, occurs in Western Australia. It is figured here under the name *Pilosabia barbata*.

Other limpet-like shells illustrated are *Cheilea undulata*, from Queensland and New South Wales, and *Ergæa walshii*, which occurs in Queensland.



Horn Shells. In the upper row from left to right are Pseudovertagus cumingi, Terebralia palustris, Cerithium pulcher, a North Australian shell, and Cerithium fasciatum. Below these are the Sydney Whelk or Hercules Club, Pyrazus ebeninus, Cerithium vertagus, Cerithium asperum and Telescopium telescopium.

[Joyce Allan, *del.*

HORN SHELLS.

The Horn Shells or Cerites are a large family of tropical and subtropical shells living among rocks or marine vegetation along the shores, or in shallow water; some of them live in brackish or even fresh waters. The shells are very variable in form, especially about the aperture, but the general shape is spiral, elongated and many-whorled, generally with the surface nodulose, spiny or varicose. The outer lip in adult forms is usually expanded, and under abnormal conditions the shells may become very much elongated or the lip greatly expanded. Members of this family range in size from less than an inch to over eight inches.

The family has been a difficult one for conchologists to work upon, and has resulted in the formation of many genera. All the genera were until recently placed in the one family, Cerithiidæ, but are now divided into the families Telescopiidæ, which mostly embraces mangrove and harbour estuaries forms; Cerithiidæ, principally coral reef living shells; Cerithiopsidæ, very small forms; and Finellidæ. These families are divided into

numerous sub-families, which are not of any importance here, and the divisions are made on the structure of the raduka principally, the operculum and the general shape.

In the family Telescopiidæ, the genera represented in Australia are *Telescopium*, *Pyrazus* and *Terebralia*. These are large shells, often known as Mud Whelks, particularly *Pyrazus ebeninus*, the common whelk of New South Wales, also known as the Hercules Club shell. This species is found in great numbers on mud flats at low tide along the New South Wales coast, and is very common in such places as Gunnamatta Bay, Port Hacking, on the mud flats in the Parramatta and Lane Cove Rivers, and in Broken Bay. It is an edible mollusc, and formed one of the staple shellfish foods of the aborigines, vast numbers of empty bleached shells being found today in the kitchen middens along the coast. The Hercules Club was amongst the first lot of Australian shells to reach England, being taken there by Captain Cook, and was the first Australian shell to be figured in colour. It was known then as the "Black Hercules Shell from Botany Bay". The shell grows to about four inches high, and is easily recognized by its dark colour, peculiar shape, with conspicuous nodules and spiral operculum, which fits completely into the aperture of the shell. It has a much smaller relative, only about one and a half inches high, *Pyrazus australis*, which is found in similar places. There is a larger, much more nodulose whelk than the Hercules Club, but very like it, found living on the coral reefs of Queensland. This is *Contumax nodulosus*, belonging to the family Cerithiidæ, and is mentioned here, though not figured, because of its similarity to the previously mentioned whelk.

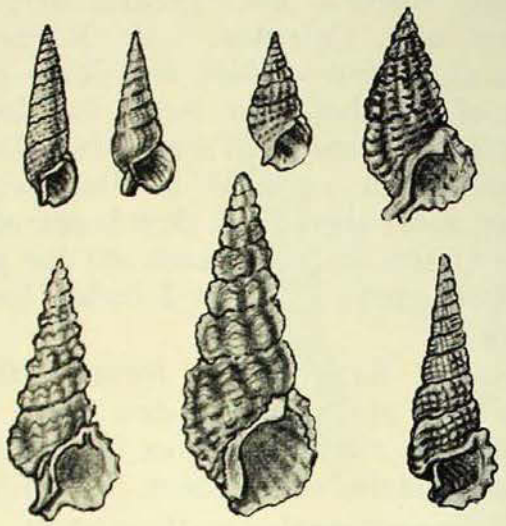
The other two genera, *Telescopium* and *Terebralia*, have an extended range through the Indo-Pacific. In Australia they are represented by two large species, *Telescopium telescopium* and *Terebralia palustris*, both easily recognized shells. The former, which occurs here in northern Australia only, is about 3 to 4 inches high, but may reach a much greater length in Borneo and Calcutta. In Borneo it forms an article of diet, and large quantities of the shells are burnt for lime in Calcutta. The species *Terebralia palustris* is also eaten as food in Borneo; the natives roast them first, then break off the spires of the shell and suck out the meat. The shell grows to about 4 inches long in Australia.

A small dark brown form, with an expanded aperture, known as *Cerithideopsilla cingulata*, lives in quantities in the estuaries of northern Australia.

The largest species of Horn shell, *Campanile symbolicum*, is placed in the family Cerithiidæ, most species of which are coral-living forms. This is found only in south-west Australia, commonly round Point Irwin, and lives in stretches of shallow water with a sandy bottom. Dead, bleached shells, heavily eroded, are found in numbers washed up on nearby beaches, or lying wedged between loose rocks. The shells grow to a length of about eight inches, consist of many whorls, and are somewhat like *Terebralia palustris* in shape.

There is a small species of Horn shell, about three-quarters of an inch high, found in southern Australia. It is known as *Cacozeliana lacertina*, and is distinguished by the sculpture on the whorls being cut into numerous beads. Its colour is usually reddish-brown or chocolate colour, and it is common in rock pools round the New South Wales coast. Another small shell of somewhat similar shape and size is *Ataxocerithium serotinum*; this species, however, is obtained in deeper water by means of a dredge. It is white or pale brown, has spiral and longitudinal sculpture, and lives in eastern and southern Australian waters. Queensland possesses a small species about the same size, *Clypeomorus torresi*, but this shell has conspicuous varices on some of its whorls.

Many of the coral-living forms of the family Cerithiidæ are about the same size, and some are separated by only a few characteristics. There are several small solid forms for instance, each measuring



In this figure are the smaller forms of Horn Shells. The four top ones are a common Sydney shell, Cacozeliana lacertina, Ataxocerithium serotinum, Clypeomorus torresi, and Clypeomorus concisus. The three lower shells are Ischnocerithium columna, Pyrazus australis and Cerithideopsilla cingulata. [Joyce Allan, *del.*

only about an inch high, which are separated mainly by the density or arrangement of the beaded sculpture. Such are *Clypeomorus concisus* from Queensland and West Australia, with a white aperture and light coloured shell covered with small black beads; *C. dorsuosus*, larger and fatter than *concisus*, with fewer black beads but having white ones, rather flattened, between them; and *C. petrosus*, a slighter form of this. Both of these latter ones are from Queensland.

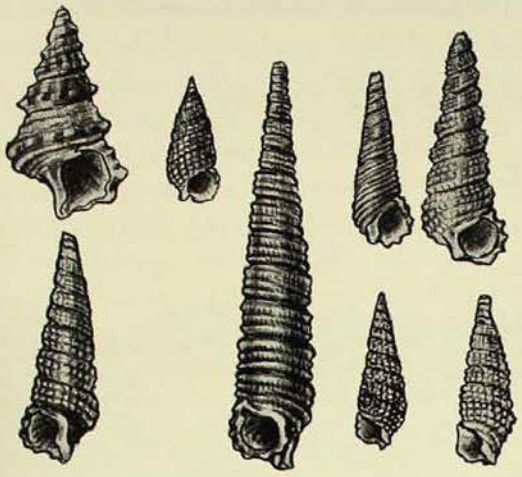
Two forms not figured here, but grouped in with the small ones, are *Clypeomorus gemmulatus* of north-west Australia and *C. baccatus* of northern Australia. The former has transverse lines of black beads on the whorls, and the latter similar sculpture, but the aperture of the shell appears to have a rosy tinge.

Of the larger forms of this family, *Ischnocerithium columna*, a white shell, two inches high, marked with alternate large and small spiral ridges, comes from north Australia and south Pacific islands; *Cerithium fasciatum*, three to four inches high, smooth in the lower whorls and sculptured in the upper, is creamy-white with chocolate bands on the body whorl and above and below the sutures on all whorls, and comes from northern Australia as well as the Indo-Pacific; *C. vertagus*, a relative, also from the Indo-Pacific and northern Australia, is shorter and fatter without distinct bands, and is yellowish white, stained with or entirely chestnut colour. Numerous pinched-up obliquely longitudinal ribs, separated by the crossing of spiral lines, characterize the white or yellowish-white *C. asperum*, from the south Pacific islands and Queensland. Sometimes the spiral ribs of this shell, which is about two inches high, are chestnut coloured. In north Australia occurs one of the most striking species of this group. It is large and free from sculpture except on the few upper whorls, and is cream, heavily marked with close irregular longitudinal lines and blotches, ranging from red to black in colour. This species is *Pseudovertagus cumingii*, and has a shorter relative, *Pseudovertagus aluco*, which has its whorls nodulose below the sutures and less distinct markings.

The small species of the family Cerithiopsidæ are represented in this article by *Cerithiopsis angasi*, a rather thin, very small, pale yellowish-brown shell of many flattened whorls, each whorl encircled by three distinct rounded riblets crossed by close longitudinal raised striæ; it is found in Port Jackson, New South Wales. Another small form, *Hypotrochus monachus*, from South Australia, is thin, subtranslucent and reddish-brown, with minute chestnut markings. Also illustrated are *Joculator ridiculus* from Torres Strait, and *Notoseila albosutura* from New South Wales.

THE TRIPHORAS.

The Triphoras, family Triphoridæ, are a very difficult group for an amateur to work upon, owing to their small size, the characteristics separating the different species being so minute. There are well over a hundred different kinds known, all minute forms, and these are scattered through the West Indies, Europe, Indian Ocean, and Polynesia. They can, however, be quickly separated, as far as their



Small Horn Shells and Triphoras. In the upper row are Hypotrochus monachus, Joculator ridiculus, Notoseila albosutura, and Cerithiopsis angasi. In the lower row, four Triphora shells, Teretriphora angasi, Triphora corrugata, Notosinister innotabilis, and Cautor labiatus.

[Joyce Allan, *del.*

family goes, from the majority of other small shells by the fact that the shell is coiled to the left, making the opening appear on the left side instead of the right. This is not an abnormality, but a family characteristic. The shell is elongated, with numerous granulated whorls, and, unlike most molluscs, it retains its larval form until it is a considerable size. In colour they vary from white to pink, violet, brown or cream banded with chestnut brown. Occasionally the colours vary in the same species. Specimens of these small shells are often found in shell sand. Of the four species chosen from the large number recorded from Australia for illustrating the family in this article, *Triphora corrugata*, from the south Pacific islands and Queensland, is the largest. It is about three-quarters of an inch high, brown coloured, and has numerous whorls three-keeled, the middle one the smallest. *Teretriphora angasi* is also brown, occurs in New South Wales and southern Australia, has three and four rows of flattened tubercles on the whorls, and a white band on the body whorl. The remaining two species, *Cautor labiatus*, a chocolate brown shell, from southern Australian waters, and *Notosinister innotabilis*, from New South Wales, are about the same size, that is, about four millimetres.

Notes and News

In January, through the kindness of Dr. A. J. Spiller Brandon, Mr. Keith C. McKeown, Assistant Entomologist, was enabled to visit the Tuross River, New South Wales, where a week was spent at Dr. Brandon's trout fishing camp. Investigations were carried out on stream conditions and the aquatic insects inhabiting the river, in connection with the investigations which have been in progress for some time on the food of trout in Australian rivers. A large general collection was made, much of which will also have bearing on trout food, since many insects which fall from the trees and bushes fringing the water are readily consumed by the fish. The area surrounding the head-waters of the Tuross River appear to have been but little worked by collectors and are of considerable interest to scientists; a preliminary study of the insects collected reveals a number of rare and interesting creatures.

* * * *

Recent visitors include Dr. Joseph Pearson, Director of the Tasmanian Museum, Hobart; Professor G. E. Nicholls, University of Western Australia, who is on his way to Europe and America; Mr. W. H. Hemingway, Auckland, a well-known entomologist; Dr. A. L., Rand and Mr. G. H. H. Tate, American Museum of Natural History, who are bound for New Guinea to make zoological and botanical collections for that institution.

The Myall Lakes: Then and Now.

by

A. J. MARSHALL.

The picturesque Myall Lakes, some ninety miles north of Newcastle, are perhaps the most interesting of the New South Wales coastal lakes. The scene is on the broad canal between Booloombayt and the Broadwater.

[Photo.—*K. Plomley.*

IN May and June last a Sydney University expedition, under the leadship of Professor T. G. B. Osborn, D.Sc., visited the Myall Lakes in order to continue biological researches begun during the previous spring. A place of placid waterways, shifting sand-dunes, rugged ranges and swampy heathlands, the region in question is ideal for such a purpose, for each of these widely diverse habitats supports a characteristic and correspondingly diverse community of plants and animals.

The riddle of the ridges, lakes and dunes has been unravelled, and to questing geologists a most fascinating story has been revealed. This story of prehistoric activity, when the earth's crust warped upwards, when sea-water inundated the lowlands, and much later, when once more the land began to regain lost territory, is still in the telling, for the region is even now slowly changing day by day.

PREHISTORIC EVENTS.

To recount the story of Myall one must go back to Tertiary times, when, many millions of years ago, the general contour of the country was of low relief, the Great Dividing Range having not yet been elevated. Came the great general uplift during which the Myall area was raised some thirteen hundred feet. Streams next appeared and gradually eroded the deep valleys which were the beginnings of the Myall River system of today.

The next disturbance caused a subsidence of about four hundred feet, when parts of the valleys were drowned by the inflow of the sea which flooded the lowlands. Many of the peaks of the earlier landscape now became islands, and even today they differ in all respects from the sand-dune country which, through the action of wind and tide, was later formed around them. These dunes are of comparatively recent origin; they are unstable, ever-shifting and ever-changing. So this, the third part of the story, is still in the telling. The land slowly gained on the sea, the islands became connected by sand-bars, and gradually the Myall Lakes came into being as a vast salt-water lagoon, separated from the

ocean by a great discontinuous sand-barrier about twenty miles in length.

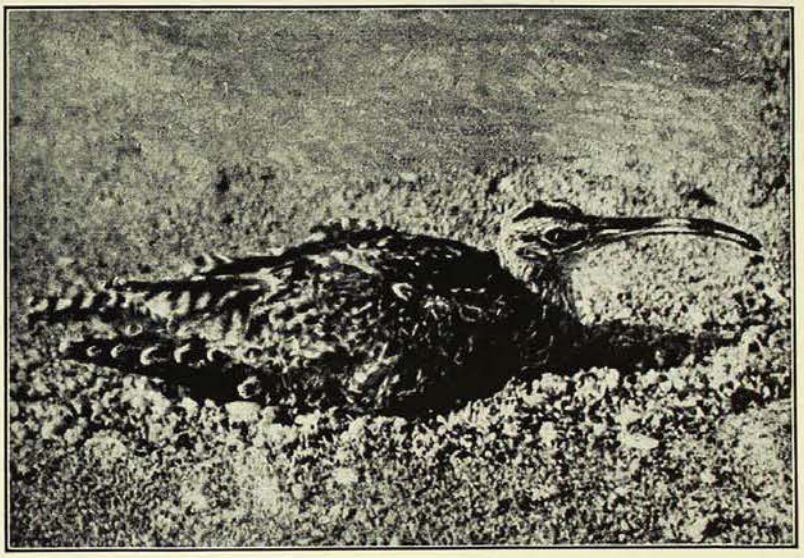
The process of reclamation proceeded apace. From the westward the streams carried silting debris out of the ranges. And to the east the wind and waves assisted in the inland march of the sand-dunes until on every side we are able to see evidence of the recent reclamation of the lakes. Some day these picturesque coastal lagoons will become broad timbered valleys. Up Booloombayt way we saw one such valley already formed. It was besprinkled with timber, creeks and a farm or two, yet in geologically recent times it was undoubtedly part of the great fading lake system.

PLANT COMMUNITIES.

On expeditions such as these, botanists do much more than merely collect specimens. Considerable work was done on the determination of plant communities, when it was found that the chief formations were the vegetation of the sand-dunes, that of the swamps, the patches of brush or sub-tropic jungle, and finally the open sunlit eucalypt forests. And it was found that the story of the development of all these plant communities is intimately linked up with the story of the physiography of the area. In many cases the plants assist in the building up of the land. Some of them bind the dunes, the grasses preparing the way for shrubs, the shrubs for the larger and more stable trees, until that which was formerly loose drifting sand is now solid soil.

The swamp and lake plants, too, have played an equally important part in the story of the reclamation. Picture a prolific growth of aquatic plants flourishing on the lake bottom. They began to collect silt and gradually formed miniature sand-banks. Next developed rushes and sedges, their roots binding the mud as the lakes slowly became shallower. This enabled the lofty paper-barks and swamp-oaks to encroach, building up soil which in turn became alluvial flats upon which appeared swamp-mahogany and other hardwoods.

The rugged hills are of tuff (consolidated volcanic ash) formation, and are covered with eucalypt forest. In certain situations, however, were found patches of rain forest or jungle, whilst in seemingly similar situations elsewhere was found the typical eucalypt forest. The explanation of this phenomenon presents a most difficult problem, and to make absolutely sure of their facts the botanists surveyed a traverse around the edge of a large tract of jungle. It was an extraordinarily difficult survey, for laneways had to be cut through thorny vines and stinging trees in order that "sights" could be taken, during which myriads of land-leeches made full use of their powerful suckers, small but very efficient cutting teeth and the extensive "reservoir" system in which they stored our blood!

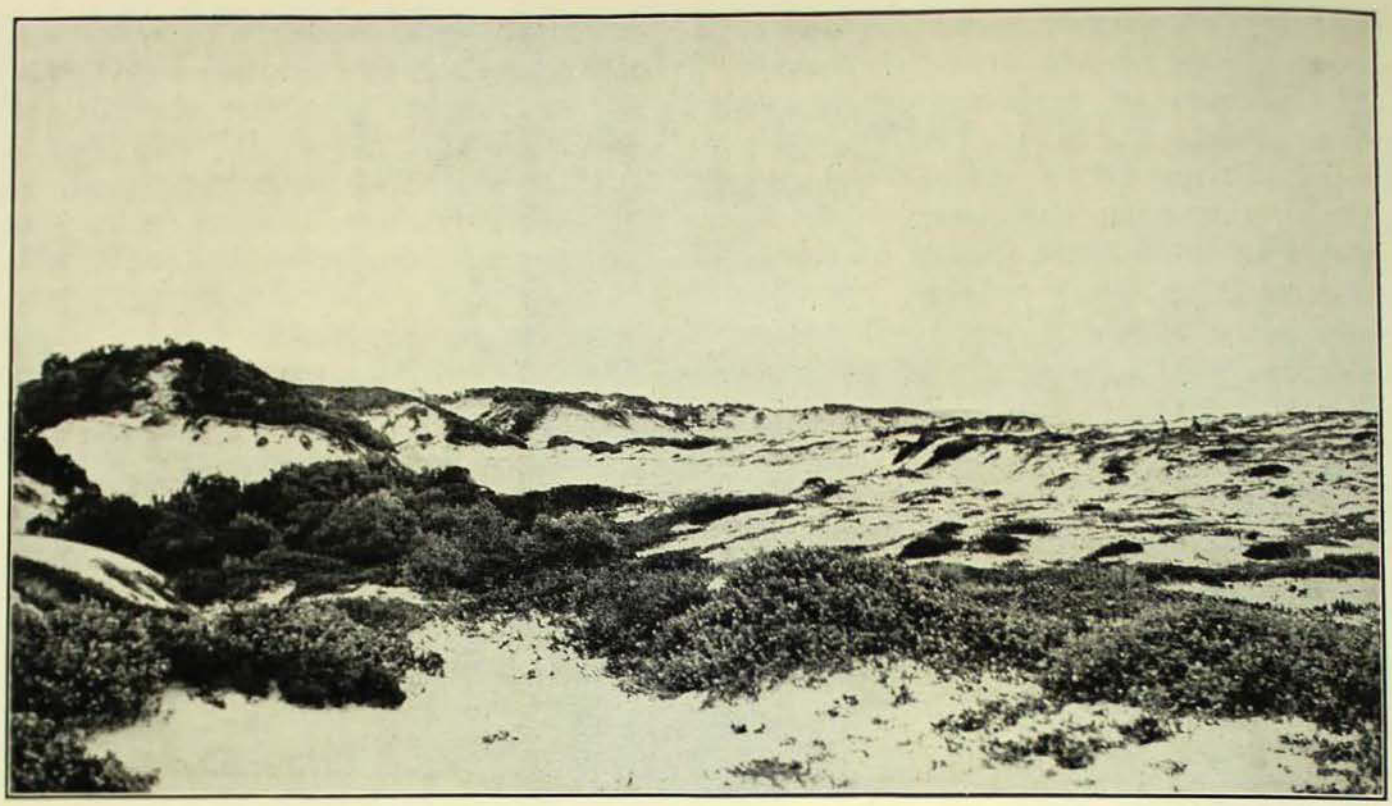


The Sea Curlew, a long-legged, strong-winged wanderer which comes to us each spring from far-off Siberia. Returning during the autumn to breed on the tundras, the curlew is but one of the many sombre-plumaged northern waders which each year cross the Equator on their long southern journey. It must not be confused with our local Stone Curlew, the lonely caller on moonlight nights.

[Photo.—*A. J. Marshall.*

LAKE LIFE.

The New South Wales coastal lakes of the Myall type are particularly interesting from a marine zoological viewpoint because they are connected with the sea, and saline water enters and mixes with the fresh water from the range-fed



The coastal dunes. Situated between ocean and lake, these undulations often reach considerable height, banked by the action of wind and wave. A typical vegetation soon makes its appearance and assists in the binding and stabilizing of the dunes into permanent country.

[Photo.—*K. Plomley.*

streams. Thus the lake animals must adapt themselves to these ever-changing conditions, and they have succeeded to such an extent that many are able to pass from the lakes to the ocean and *vice versa*. One of the most interesting problems awaiting solution is the discovery of the physiological mechanism which renders this possible.

There are, however, many other problems of a more direct economic application. For the Myall Lakes are one of the important centres for the capture of prawns and food-fishes, and, as there is a general lack of knowledge concerning the life-history of these highly important animals, efforts were made to collect eggs and juveniles. This section of the work, carried out by Mr. A. N. Colefax, B.Sc., involved the towing of special nets through the surface waters of the lakes and Port Stephens. Unfortunately, the continued heavy rains experienced during the investigations nullified every effort, and comparatively few relevant specimens were obtained.

The lake-birds were a never-ending source of interest. The entire Black Swan population appeared to be congregated in two huge flocks, each numbering hundreds, which were passed in mid-lake during a trip to Mungo Brush. Nearby a large flock of sooty black Coots (*Fulica atra*) excitedly made way for the speeding launch, whilst a mighty Sea-Eagle (*Haliæetus leucogaster*) soared low over the feeding flocks as though desirous of varying its customary diet of fish and refuse with something more interesting.

Little Pied Cormorants were present in hundreds, fishing from every vantage point, and grotesquely holding bedraggled pinions aloft to dry in the sun as we passed. Snowy Egrets (*Egretta* sp. ?) and sombre Blue Herons (*Notophoyx novæ-hollandiæ*) fished along the sandspits and perched in the river-oaks, whilst Dabchicks (*Podiceps ruficollis*) in dozens dived and fed along the reedy lake margins. On one occasion a flock of about twenty-five of these attractive little Grebes responded to my calls from the

casuarina-lined shore, and, resembling a miniature regatta, swam and fluttered across a small bay to within a few yards of the tree in which I was concealed. One bird, perhaps a self-appointed "scout", swam cautiously around the reed-bed near my tree, and his confidence appeared to stimulate his distant brethren, who spurted energetically every time I called afresh in a somewhat pale imitation of a young bird in distress.

The fringing paper-barks were in full flower and, attracted by the nectar, brush-tongued Honey-Parrots (Trichoglossidæ) screeched and flitted amid the blossoms. Although these birds numbered many thousands, it is probable that a search a few weeks later would reveal not more than a few stragglers, for Rainbow and Musk Lorikeets—the species in question—are true nomads, and usually remain in a district only until the food-supply is exhausted.

A worthwhile ornithological find was a flock of a dozen Sea-Curlews (*Numenius cyanopus*) which we noted on a dredging trip to Port Stephens. As we passed down the narrow winding stream towards the old township of Tea Gardens, numerous Straw-necked Ibis were observed feeding on the moist reedy flats; and nearer the Port itself we disturbed the Curlews from a mud flat where they were feeding. Normally the species at this time of the year should have been breeding in the northern hemisphere, for Sea-Curlews and many other sombre long-winged wanderers customarily leave Australia in the early autumn for their breeding sites on the tundras of Siberia. Although it is not unusual for odd Asiatic stragglers to be seen during the colder months, the presence of a flock is worthy of record.

A DUNE-GIRT "ISLE".

Although it is now completely surrounded by sand-dunes, maps of sixty years ago denote Mungo Brush as an island. Mungo is actually a delightful patch of virgin rain-forest situated on what was once the top of a mountain in a long-gone era. A riot of palms, monkey-ropes, stinging trees and other typical jungle vegetation, Mungo lies hard between ocean and lake, and is the home of the glorious black and gold Regent Bower-Bird (*Sericulus*), an old playground of which was relocated by a member of the previous party. The bower was built in a typical situation beneath a spreading cabbage-tree palm (*Livistonia*) in a semi-sunlit part of the brush and had been in use during the previous spring.

At Mungo Brush the dunes nearest the ocean appear to be changing and support recent vegetation only, whilst those nearer the lake seem to be of a much more permanent nature. But further north the dunes were universally unstable, seemingly being reared and broken down almost overnight. In several places we found evidence of large trees being covered by newly-reared sandhills which are gradually marching inland towards the swampy heathlands between ocean-front and lake. *Banksia* is the predominant dune vegetation, and as a consequence the bird fauna is largely comprised of melivorous species, such as silver-eyes and the various members of the honey-eater family.

Tracks of birds, mammals and reptiles were numerous amid the dunes, and many interesting moments were spent identifying and following the pads. Dingo and pups, wallabies, goanna and, surprisingly enough, emu tracks were found, the last-named being particularly abundant, the tracks crossing and recrossing the beach and dunes in all directions. The prints ranged from small juvenile tracks to adult tracks some ten inches in length. Most of the dune animals appeared to be resting out of the midday heat when we investigated their habitat, for with the exception of small birds and a wallaby, nothing of interest was noted. On the previous spring expedition, however, a young emu was captured and several adults were observed.

What is the explanation of this surprising occurrence of emus on the coast in these days of congested settlement? It

is improbable that these birds were forced coastwards by dry conditions in the interior, for to reach the locality in which we found them would necessitate a long journey across the Great Divide and through closely settled farm-country. Rather it seems that we discovered an isolated race of emus which have flourished unchecked in a favourable, if unusual, locality. Protected by a splendid isolation, the birds have continued to hold their own against natural enemies, and, as man is a rare visitor to the area where they dwell, it seems that the colony will survive for many years longer.

THE OLD COLONIAL DAYS.

We have discussed at some length the natural history of the Myall country and of scarcely less interest is the history of man's endeavours in the region. During 1824 a company was formed in England for the purpose of exploiting part of New South Wales to which a great deal of attention had been drawn by the report of Commissioner Bigge. Thus the famous A.A. Coy. (Australian Agricultural Company) came into being with a view to "obtain a grant of land in the colony of New South Wales, to extend and improve the flocks of merino sheep, and for other purposes".

The capital of the company was £1,000,000, and one million acres of land was granted by the English Government on condition that it would be developed to the extent of half a crown per acre. In 1825 an area lying roughly between the Manning River in the north and Port Stephens in the south was selected by the company's first agent. For some time operations were carried out on the Myall Lakes, and local residents of today tell tales of how the bare necessities of life were brought by packhorse from the A.A. Company's Stroud depôt. Maize was grown and ground, wild honey was used for sweetening, and only the most essential goods were imported. For a time the district was one of considerable industry, but as wool production was the primary pursuit of the company, the Myall region was not retained, when, after much governmental negotiation, about half the original grant was exchanged for pasture lands in New England. And so, in 1850, we find that:

> Entirely abandoned to unbroken solitude, the Myall lakes are peculiarly the stronghold and abiding-place of the remnant of our sable brethren, whose forefathers were at one time a numerous and powerful tribe. The Australian Agricultural Co., and illicit distillation at the lakes and on the river's banks, have thinned the ranks of the athletic and graceful native blacks, and only here and there on the borders of the charming lakes are they to be found.

Nowadays even the blackfellows have gone, and despite an occasional dwelling, a spirit of quietude, even somnolence, broods over the region. Everywhere will the keen observer find relics of the past. The timber is almost exclusively second-growth and of the old-time forest patriarchs only scarred stumps remain. The ridges are flanked by overgrown timber-tracks; the flats bear traces of ancient camp-sites. Sometimes one stumbles on an abandoned selection where the fast-falling humpy and a few ragged fruit-trees are the sole remnants of a human's hopes and labours. And down by the lakes one finds ruined jetties of stout timbers, and where a school and a virile community once flourished we find only forlorn relics and second- or third-growth saplings.

Occasional timber-mills are still working, and old-time bullock teams are no novelty in the district; whilst on the Myall River quaint old paddle-wheel timber barges provide a picturesque note as they chug heavily laden to the saw-mills. But above all else the visitor to the lakes is aware of a scarcely definable charm—subtle, perhaps, but of a quality as real as the hospitality of the few scattered families who dwell upon their banks.