

# *The* AUSTRALIAN MUSEUM MAGAZINE

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



Birds and the Bush - - *K. A. Hindwood, R.A.O.U.*

Alligator or Crocodile ? - *J. R. Kinghorn, C.M.Z.S.*

The Flight of Fishes - - - *T. C. Roughley*

Barrallier's Blue Mountain Exploration -  
*The late R. H. Cambage, C.B.E.*

A Naturalist in the Gulf Country - *Thos. G. Campbell*

With the Great Barrier Reef Expedition -  
*G. P. Whitley and W. Boardman*

The Lure of a Mangrove Swamp - *Anthony Musgrave*

Vol. III. No. 9.

JAN.-MAR., 1929.  
PUBLISHED QUARTERLY.

Price—ONE SHILLING.



# THE AUSTRALIAN MUSEUM

## COLLEGE STREET, SYDNEY

### BOARD OF TRUSTEES.

#### President :

MAJOR-GENERAL SIR CHARLES ROSENTHAL, K.C.B., C.M.G., D.S.O., V.D.

#### 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 AND MINISTER FOR RAILWAYS.

THE HON. THE MINISTER OF PUBLIC INSTRUCTION.

THE AUDITOR-GENERAL.

THE PRESIDENT OF THE N.S.WALES MEDICAL BOARD (T. STORIE DIXON, M.B., Ch.M.,  
KNIGHT OF GRACE OF THE ORDER OF ST. JOHN).

THE SURVEYOR-GENERAL AND CHIEF SURVEYOR.

THE CROWN SOLICITOR.

#### Elective Trustees :

J. R. M. ROBERTSON, M.D., C.M.

G. H. ABBOTT, B.A., M.B., Ch.M.

MAJ.-GEN. SIR CHARLES ROSENTHAL,  
K.C.B., C.M.G., D.S.O., V.D.

E. C. ANDREWS, B.A., F.G.S.

OCTAVIUS C. BEALE, F.R.S.L., F.R.H.S.

GORRIE M. BLAIR.

C. GORDON MACLEOD, M.A., M.D., Ch.M.

G. A. WATERHOUSE, D.Sc., B.E., F.E.S.

F. S. MANCE.

HON. F. E. WALL M.D., M.L.C.

PROF. A. N. ST. G. BURKITT, M.B., B.Sc.

#### Director :

CHARLES ANDERSON, M.A., D.Sc.

#### Secretary :

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

#### Scientific Staff :

WILLIAM W. THORPE, *Ethnologist.*

J. ROY KINGHORN, *Zoologist in charge of Birds, Reptiles, and Amphibians.*

ELLIS LE G. TROUGHTON, *Zoologist, in charge of Mammals and Skeletons.*

ANTHONY MUSGRAVE, *Entomologist.*

F. A. MCNEIL, *Zoologist, in charge of Lower Invertebrates.*

T. HODGE SMITH, *Mineralogist and Petrologist.*

TOM IREDALE, *Conchologist.*

GILBERT P. WHITLEY, *Ichthyologist.*

A. A. LIVINGSTONE, *Assistant Zoologist.*

T. G. CAMPBELL, *Assistant Entomologist.*

#### Librarian :

W. A. RAINBOW.



# THE AUSTRALIAN MUSEUM MAGAZINE

---

VOL. III., No. 9.                      CONTENTS.                      JAN.-MAR., 1929.

---

FEMALE LYRE BIRD ( <i>Menura novae-hollandiae</i> ) AP- PROACHING NEST                      ...                      ...                      ... <i>Frontispiece</i>	
BIRDS AND THE BUSH— <i>K. A. Hindwood</i> , R.A.O.U.                      ...                      291	
ALLIGATOR OR CROCODILE ?— <i>J. R. Kinghorn</i> , C.M.Z.S.                      295	
THE FLIGHT OF FISHES— <i>T. C. Roughley</i> ...                      ...                      298	
BARRALLIER'S BLUE MOUNTAIN EXPLORATION IN 1802— <i>The late R. H. Cambage</i> , C.B.E., F.L.S.                      ...                      ...                      301	
A NATURALIST IN THE GULF COUNTRY— <i>Thos. G. Campbell</i> 305	
WITH THE GREAT BARRIER REEF EXPEDITION— <i>G. P.</i> <i>Whitley and W. Boardman</i> ...                      ...                      ...                      ...                      313	
THE LURE OF A MANGROVE SWAMP— <i>Anthony Musgrave</i> 318	

---

Published Quarterly by the Trustees of the Australian Museum,  
College Street, Sydney, in the months of January, April, July, and  
October. Subscription 4/4, including postage.

Communications regarding subscriptions, advertising rates, and  
business matters generally in connection with THE AUSTRALIAN  
MUSEUM MAGAZINE should be addressed to the Secretary.





Female Lyre Bird (*Menura novae-hollandiae*) approaching nest.  
[Photo.—K. A. Hindwood.]





Published by the Australian Museum  
 Editor: C. ANDERSON, M.A., D.Sc.

College Street, Sydney  
 Annual Subscription, Post Free, 4/4

VOL. III., No. 9.

JANUARY-MARCH, 1929.

## Birds and the Bush.

By K. A. HINDWOOD, R.A.O.U.

**E**CONOMICALLY birds maintain an important role in nature, and their interrelation with trees and insects is extremely complex. A remarkable example is that of the bird-nest fly, *Passeromyia longicornis*, which deposits its eggs on the bodies of immature birds. The larvae penetrate the skin and feast on the blood of the unfortunate fledglings; eventually they drop from their unwilling hosts and pupate in the lining of the nest without causing any mortality among the young birds.

It is well known that many species of Honey-eaters (*Meliphagidae*) are partly responsible for the cross-fertilization of certain of our native flowers. The roving, nectar-loving brush-tongued parrots (*Loriidae*) effect the pollination of the eucalypts, whilst the mistletoe bird (*Dicaeum hirundinaceum*) is at least one of the media through which the parasitic *Loranthus* is distributed. Similarly the fruit and tree pigeons (*Treronidae*) scatter countless seeds of indigenous fruits.

Innumerable as such instances are they call rather for the investigation of the scientist than the consideration of the tyro.

The field for research is indeed comprehensive, though it demands an assiduous and specific application beyond the disposition of most nature lovers.

A census of the birds that inhabit the neighbourhood of Sydney reveals a varied and interesting avifauna; moreover, the habits of some of these birds are so interesting that they hold a unique place in natural history.

An outstanding instance is the lyre bird (*Menura novae-hollandiae*), that sombre, liquid-eyed denizen of the heavily timbered gullies of eastern Australia. Rivalling in its mimetic ability the mocking bird of North America and the West Indies, it likewise shares, with the great Ocellated Argus Pheasant of the Malay jungles the distinction of being one of the two birds in the world that construct dancing mounds for recreation and display.

The consciousness of the excitement felt when one watches for the first time a male lyre bird displaying, vividly remains after many years. A performance I witnessed recently near the head waters of Middle



Harbour, Sydney, will illustrate the versatility of this bird. Walking backwards and forwards, with his beautiful lyre-shaped tail vibrating with emotion and rustling faintly, he sang exultingly for nine minutes with but an occasional intermission. Meanwhile he listened intently for any sounds of intrusion. Such was the perfection of his mimicry that one thought only of a gathering of bush songsters vying with each other in the melodious cadences of their songs. He gave in quick succession, the various calls of the Grey Thrush, the "crack" of the Coach-whip bird; the "pipings" of the Sacred Kingfisher and the Yellow Robin; the "whistle" of the Crimson Rosella; the excited utterings of a flock of parrakeets and the whir of their wings; the blithesome notes of the Yellow-throated and White-browed Scrub Wrens; the liquid yodelling of the "Currawong" or Pied Bell Magpie; the harmonious calls of the elegant Golden and Rufous Breasted Whistlers; the "Guinea-a-Week" of the Pilot bird and the curious notes of the Satin Bower Bird, finishing with a half-hearted laugh of the kookaburra, repeating his repertoire again and again till the valley echoed with the beauty and volume of his song. Strangely enough he did not attempt the mellifluous notes of the Butcher Bird, though he essayed with success the squeaking of the young of this species and the plaintive calls of other young birds. There are authentic instances of the lyre bird imitating various musical instruments and the human voice, while the sounds associated with the activities of a bush saw-mill are rendered with amazing accuracy.

The female is as good a songster as her mate, though for many months she is busily occupied with nesting, incubation, and the rearing of her single chick. The egg takes eight weeks to hatch, and the youngster, even when a week old, has inordinately powerful legs and a voice that is startling in its intensity coming from one so very young. Its loud cries soon bring the apparently unconcerned mother scratching near the nest, whilst the male remains as shy and as elusive as ever. When searching for food, lyre birds place a foot well forward, grip a quantity of debris, and roll it backwards, revealing succulent worms, grubs, and lurking insects.

The dancing mounds of the male are best described as slightly elevated hillocks of loose earth or sandy loam about three feet across, usually constructed in scrubby situations. Many are used by a single bird and



**Butcher Bird (*Cracticus torquatus*) at nest. Observe the hooked bill.**

[Photo.—K. A. Hindwood.]

they are often connected by a narrow well-worn pathway. I always associate these wonderful birds with the musty odour of sodden humus, with the dripping early morning dew on the leafy under-scrub, when a white mist enshrouds the valleys and gorges, half revealing the fairylike tracery of twigs and leaves, for it is then that the lyre bird gives to the awakening day the very best of his glorious medley of sonorous music.

Another fascinating inhabitant of the coastal ranges is the Satin Bower Bird (*Ptilonorhynchus violaceus*), whose extraordinary habit of constructing a bower is common to eight species of the family Ptilonorhynchidae and has aroused universal interest.



Bowers are usually built in sheltered situations often near fallen logs. Several structures I have observed at National Park, near Sydney, were prettily placed amongst bracken. A flat groundwork of sticks and grass is first constructed into which is built the bower, two walls of twigs some six inches apart, usually ten inches long and about twelve inches high, not infrequently meeting above. Here it is that the birds court and play, performing many strange antics while moving and admiring the curious objects that adorn the bower. The shells of land snails, discarded pupal cases of cicadas, pieces of blue glass and china, blue parrots' feathers, scraps of blue paper and match boxes are collected, whilst every day small green and blue flowers are placed near the entrance of the bower. The decided penchant displayed by the birds for anything blue is most singular, and possibly has some bearing on the fact that the full plumage of the male is a beautiful lustrous blue-black, which he assumes after a number of years. The colouring of the female and young males is greenish grey above, the under surface being lighter, with numerous lunated markings. The food of the Satin Bower Bird consists mainly of native figs and wild berries, which grow amongst the dense sub-tropical vegetation of the coastal scrubs.

When most birds are silent the song of the Grey Butcher Bird (*Cracticus torquatus*) adds much to the quiet charm of the autumn, though it is in early spring that his joyous and impulsive outbursts of flute-like melody excite the wonder of the bush lover. That such a songster should be so savage seems not a little incongruous. Many small birds fall victims to his powerful hooked bill, and often their bodies are placed in the fork of a branch; should they be decapitated as sometimes happens one occasionally sees this assassin of the bird world thrusting their heads away in odd corners.

During September and October when Butcher Birds are nesting, they are particularly vicious, savagely attacking anyone who should chance to pass nearby.

Nocturnal birds are necessarily protectively coloured. When at rest during the day it is



White-Cheeked Honey-eater (*Meliornis niger*) at nest.

[Photo.—K. A. Hindwood.]

essential that they resemble their surroundings and so escape detection. With the Podargus or Tawny Frogmouth (*Podargus strigoides*) this means of defence is strengthened inasmuch as the bird sits along the branch it is resting on, and, if approached, stiffens its body in the attitude of a broken bough, closes its eyes and remains rigid until the danger has ceased. So remarkable is the blending of the markings of the bird with the colour of the bark that it usually escapes notice. The colloquial name for the Frogmouth is "Mopoke." However, this is a misnomer, for the bird which calls "Mopoke" is the Boobook Owl (*Ninox boobook*). The Podargus utters a dull "oom" repeated sometimes twenty or thirty times. The fearful and alarming expressions assumed by a harmless young Frogmouth are most ludicrous.

In the heat of midsummer when the stiff waxen Christmas Bells have replaced the



pleasantness of the flowering epacrids the heath-lands present a deserted and sterile appearance. The barren perspective of scattered clumps of Dwarf Apple Gums (*Angophora cordifolia*) and stunted banksias, set in a rank growth of grass and reeds, extends an apparently indifferent welcome, yet throughout the year the naturalist will discover much of interest in this type of country which is peculiar to the Hawkesbury sandstone. For days after heavy rainfall the heath-lands are often upland swamps, and with the coming of spring the White-Cheeked Honey-eater (*Meliornis niger*) builds its small cup-shaped nest in the stunted vegetation. The cream coloured eggs, washed with pink and spotted with magenta, are beautiful to look upon in their natural setting of rich brown velvet-like material, lining the nest, taken from the banksia cones. On the side of the throat of this bird the feathers of the cheeks are greatly developed; these fan-like shields of white are very prominent on the male, and with the black striated markings on the body and yellow patches on the wings make him a splendid bird indeed.

Like many species of birds which nest on, or near the ground the White-Cheeked Honey-eater practises deception to lead an intruder from its home; as it flutters away one is lured to follow it, then, flying to a prominent bush, it will harshly scold its pursuer.

The shy Variegated Wren (*Malurus lamberti*) is also a dweller of the heath-land and scrub-covered hillsides. The habits of all the members of this genus, which contains the common Blue-Wren (*M. cyaneus*) are similar: a tendency to keep to the undergrowth; small dome-shaped nests of grass and bark fibres, generally lined with feathers or hair, and built near the ground; brilliantly plumaged males, mostly drab-coloured females, and a strictly insectivorous diet.



Female Variegated Wren (*Malurus lamberti*) at nest.  
[Photo.—K. A. Hindwood.]

Radiantly coloured, the male Variegated Wren is cobalt blue above, with deep-red shoulders; the nape, lower back, and breast are velvety black. Usually the only indication of the presence of these delightful birds is a faint twitter. If one imitates a young bird they become greatly agitated and will flutter almost to one's feet.

To those who revere nature, the charm of birds is fundamentally aesthetic; a close association and intelligent study of their habits becomes an unceasing fountain of inspiration and contentment. Thus when one has attained an intimate and sympathetic knowledge of the divers facets of bird life, a bush ramble assumes an aspect other than a casual and often purposeless relaxation.



## Alligator or Crocodile?

BY J. R. KINGHORN, C.M.Z.S.

THE question is often asked "Are there any alligators in Australia?" The answer is that there are no alligators in Australia, although the larger of the two species of crocodile found in the north is often called an alligator.

Crocodiles and alligators belong to a very ancient order of reptiles, the Crocodilia, divided into several families, most of which are extinct. We do not know precisely what the earliest ancestors of the Crocodilia were, but it is believed that they originated in a stem form from which also the Dinosaurs branched. In spite of their external resemblance to lizards, they differ from them in many respects, and the two orders are not at all closely related. The nearest living relative of the Crocodilia is probably the little tuatara of New Zealand, which is often erroneously called a lizard.

The Crocodilia are distinguished from other reptiles chiefly by the structure of the palate and of the pelvis. They also exhibit certain external differences, but these are not so definite or satisfactory for purposes of classification. In the Crocodilia the bones of the palate are firmly united, forming a nearly complete roof to the mouth, and the posterior openings of the nasal passages are thus shunted far back just over the windpipe through which the inspired air passes to the lungs. The external nostrils are situated at the extreme upper end of the long flattened snout and can be closed by valves. The eyes and ears too are near the upper surface, so that Crocodilians can breathe, see, and hear, while only the upper surface of the head is above water. The teeth are conical and implanted in distinct sockets. The long and powerful tail is flattened vertically to act as a swimming organ, and the toes are more or less webbed.

Members of the order are found in all the great continents except Europe, frequenting the tropical and sub-tropical regions.

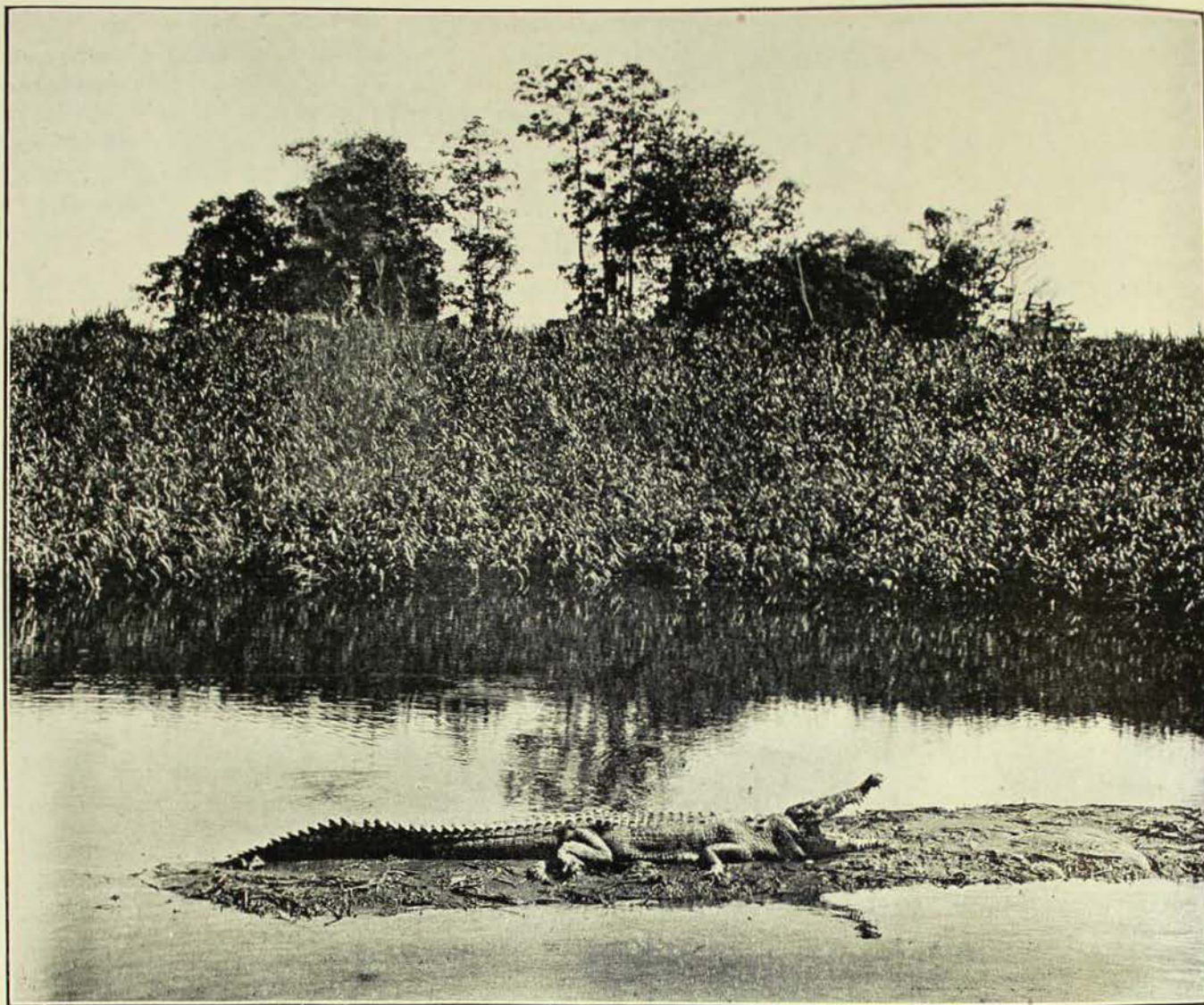
The surviving members are classified in various ways, but for our purposes we may group them into crocodiles, alligators, and gavials. Crocodiles, of which there are about a dozen species, are found in Africa, southern Asia, Malaysia, Papua, northern Australia, the Solomon Islands, the southern parts of North America, and the northern parts of South America. Alligators are common in the southern United States, and one species occurs in China, but they are not found elsewhere. The caiman, which is closely related to the alligator, is a native of Mexico and Central and South America. Gavials, which are distinguished by their long narrow snout, are found in India, Borneo, and Sumatra.

Existing crocodilians live mainly in fresh water, though both the crocodiles and the alligators can travel awkwardly on land, and the larger Australian crocodile has been known to make an ocean journey of a thousand miles.

The Crocodilia are the most thoroughly carnivorous of all reptiles. In their youth they probably live mainly on fish, and these form the food of the gavial throughout life, but the crocodile and the alligator seek other prey also, even large mammals and man himself. As the windpipe is produced well into the mouth, where it meets the internal nostrils, thus forming a closed tube from the external nostrils to the lungs, they are able to hold and drown their prey in their open mouths, beneath the surface of the water. They are accustomed to lie in wait in the water with only the tip of the snout showing, and frequently animals coming to drink are seized by the nose and pulled under.

Now how can one distinguish an alligator from a crocodile? Some believe that when an alligator opens its mouth the lower jaw moves, while in the crocodile it is the upper jaw that moves. The fact is,





Estuarine or Salt-water Crocodile (*Crocodylus porosus*) basking on a mud-bank.

[Photo.—Captain Frank Hurley.]

however, that in all reptiles, as in mammals, the mouth is ordinarily opened by depressing the lower jaw. But crocodilians spend much of their time lying on mud or sand banks, their heads resting along the surface, and then the action of the depressor muscle is to raise the upper jaw. So, for example, if the chin is rested on a table and the mouth is opened the top part of the head is raised, and the lower jaw remains stationary. We must therefore seek other means of separating the two. Generally speaking the alligator has a broad and rounded snout, while the crocodile has a narrow and more pointed one. The fourth tooth of the lower jaw of the crocodile, which projects like the tooth of a bulldog, fits in a groove on the outside of the upper jaw, while in the alligator this tooth

is received into a pit in the upper jaw and is concealed by the lips.

As explained above, the two species found in Australia are true crocodiles, the smaller, Johnston's crocodile (*Crocodylus johnstoni*), being confined to the mainland of the north, while the large (*C. porosus*) has a very wide distribution. Johnston's crocodile grows to a length of eight feet and is comparatively harmless, feeding mainly on fish and other aquatic creatures. The larger form, which may be called the Indian, or Estuarine crocodile, has been known to reach a length of twenty-two feet, and is a ferocious and dangerous creature, mammals forming its staple diet. Apart from the difference in size, Johnston's crocodile may be distinguished by its much narrower snout and more exposed teeth.



Crocodiles lay eggs in nests which they build near water holes, swamps, or the banks of rivers. The nest is composed of a mass of sticks and rubbish, and averages four feet across the base, two feet across the top, and three feet in depth. The egg is hard shelled, both ends being evenly rounded, and the size somewhat exceeds that of a duck's. The number of eggs varies with species, age, and season, and may be from twenty to eighty. A hole is scraped in the top of the nest, the eggs are laid, mostly in layers with leaves between, then covered over with leaves and sand. The mass of the nest decomposes, and, through the heat thus engendered, acts as a natural incubator, the temperature remaining fairly constant. Incubation takes about eight weeks, and during this time the female remains hidden in a hole close by ; she is made aware of the

hatching of the young by their squeaking. The voice of the young crocodile is a squeak or grunt, but in the adult a roar or bellow, which may be heard from a considerable distance; the voice of the male may be heard a mile away. The squeak of the young is easily imitated and in this way hunters are able to lure the female from her hiding place.

The hides of crocodiles and alligators are much sought after, and crocodile hunting affords occupation to many men in north Australia. So great is the demand for their skins that in America alligators are farmed on scientific lines with considerable profit. So far no attempt has been made to farm or conserve Australian crocodiles, but there is no reason why it should not be tried.

Mr. F. A. Coghlan, having resigned from the position of Auditor-General ceased to be an Official Trustee ; he is succeeded by Mr. John Spence, B.A., LL.B., formerly Chairman of the Public Service Board. Mr. Coghlan had been a Trustee since 1916, and in spite of his many and onerous duties as Auditor-General he took a very active part in the affairs of the Trust.

At the December meeting of the Board of Trustees the following committees were elected for the year 1929.

*House Committee :* Dr. T. Storie Dixon (President of the Medical Board), Messrs. H. B. Mathews (Surveyor-General), Gorrie M. Blair and F. S. Mance.

*Scientific and Publicity Committee :* Drs. G. H. Abbott and C. Gordon MacLeod, Mr. E. C. Andrews, B.A., F.G.S., and Prof. A. N. St. G. Burkitt, M.B., B.Sc.

*Finance and Publicity Committee :* Messrs. Jas. McKern (Crown Trustee), O. C. Beale, F.R.H.S., E. C. Andrews, B.A., F.G.S., and J. Spence, B.A., LL.B. (Auditor-General).

Mr. Melbourne Ward, who has enriched our collections considerably from time to time and in many other ways displayed a keen interest on the Australian Museum's behalf, recently returned from a collecting cruise in Torres Strait.

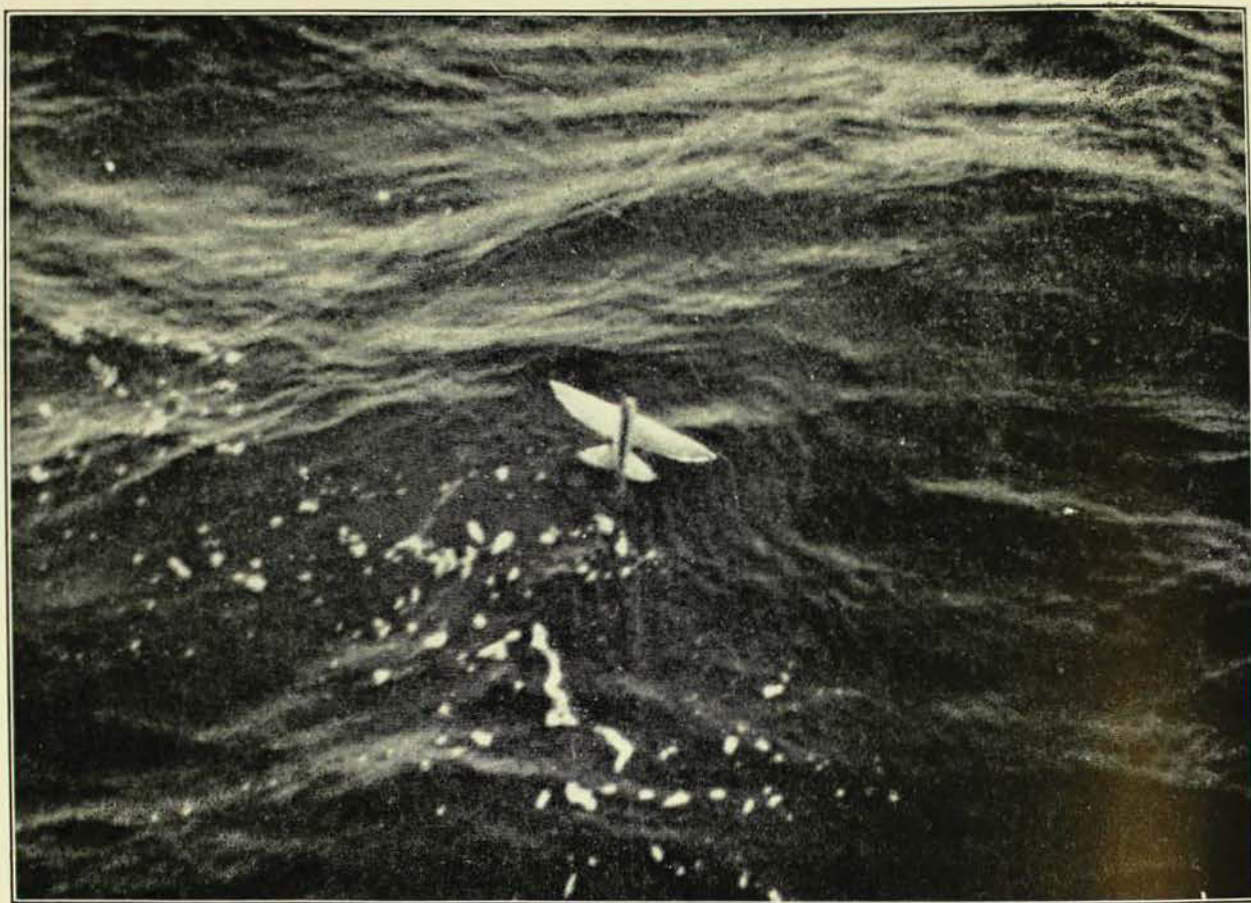
He visited Thursday and Murray Islands and made extensive collections of marine invertebrates, gathered both by shore and by means of the dredge, the latter being done principally in Albany Passage.

Now he is on his way to the Whitsunday Group, off Bowen, Queensland, where he accompanies Mr. E. M. Embury on a further quest.



## The Flight of Fishes.

By T. C. ROUGHLEY.



Flying Fish (probably *Cypselurus melanocercus*, Ogilby) photographed off the Queensland coast

[Photo—T. C. Roughley.]

IS there a finer sight in nature than the graceful flight of flying fishes? Standing recently on the bow of the *Canberra* as she ploughed her way north between the Great Barrier Reef and the Queensland coast, I watched these wonderful little creatures for hours, fascinated. Ever and anon a slim, sleek body was thrust through the surface of the water in a frantic endeavour to escape the huge, strange monster which was rapidly bearing down upon it, and then followed as graceful a flight as any bird is capable of, till the impetus was exhausted, when the flight terminated in an undignified flop into the water.

There is no doubt that the flight of flying fishes has developed through the ages from efforts on the part of the fish to escape their predatory foes. When pursued by other fish, or disturbed by the swift approach of

an oncoming vessel, the flying fish makes a wild dash for the surface; its impetus in the water carries the front of the body out into the air, and, with the caudal fin still in the water, the fish propels itself along as it frantically gathers the speed necessary for flight. This accomplished, it leaves the water entirely, and with the pectoral fins outstretched like the wings of a bird, and the ventral fins spread out to balance it, it soars above the crests of the waves with a speed approaching fifteen knots. The manner of the flying fish's flight has always been a bone of contention amongst writers of natural history, some maintaining that propulsion through the air is accomplished by an extremely rapid movement or vibration of the pectoral fins, others insisting that the fish has no power of propulsion once it is entirely in the air. There is no doubt



whatever that as the fish is struggling to leave the water, and perhaps for a short period afterwards, the pectoral fins or wings are in a state of rapid vibration, but it is a vibration transmitted to them from the powerful movements of the tail. Careful investigation has shown that the muscles controlling the movements of these fins are not sufficiently well developed to beat them against the air; they are capable only of spreading or folding them. When sufficient impetus has been gained at the surface of the water, the fish soars in a manner exactly similar to that of an albatross, and possibly the duration of the flight may be governed by the strength of the wind and the height of the waves, although it may be observed that flight is not confined to a direction against the wind.

Thirty or forty feet was about the average flight seen on the Queensland coast, but in the Indian Ocean, where flying fish are very common, flights up to two hundred yards have been recorded. Dr. E. H. Hankin, quoted in *New Natural History*, is convinced that much depends on the atmospheric conditions. In the Arabian Sea on a very still evening he noticed that the flying fishes did not glide in the air for more than a yard. They were also very liable to lateral instability or side-slip. On other occasions when there was sunshine and a light breeze the flight extended for from two hundred to four hundred yards. As with "sailing" birds, he considers that a breeze is essential for successful flight.

Although, normally, flying fish skim along just above the surface of the water, there are many instances on record where they have flown over or on to the decks of ocean-going vessels.

A graphic description of the pursuit and escape of a flying fish is given by William Beebe in his delightful *Arcturus Adventure*. "Almost on the last day of my diving at Cocos," he says, "I saw a beautiful flying-fish swimming over my mushroom coral city. I had hardly registered it when the reason for its presence in this unlikely spot was explained. A long, narrow fish came up behind, slowly at first, then with a rush—a needle-toothed garfish.\* The flying-fish gave two or three convulsive surges forward and then I saw what I had never

expected to—one of these fish rise from the water above me and disappear into the air. Somehow this made me feel more like one of the actual inhabitants of this underworld than anything which had occurred heretofore—I was seeing things from a real fish-eye-view.

"The gar missed his prey and I was interested to see that he became utterly confused, and made one short rush after the other in various directions. I saw the flying fish drop into the water only twenty feet away, coming into view with a flop. The gar showed no signs of having sensed this, and the last I saw of the two, the pursued was vanishing into the blue distance while the gar turned back the way it had come."

Against the great bulk of fishes the flying fish's excursions into the air undoubtedly give it a great measure of protection, but even there it enjoys no immunity from attack by the so-called dolphin fish (*Coryphaena*) which has learnt to take great leaps into the air and grab the flying fish on the wing. It seems a pity that pursuit should be carried thus far.

Mr. G. P. Whitley has called my attention to a quaint old description of flying fishes and their pursuit by dolphins or gilthead written by John Hawkins off Guinea in 1564 and printed in Hakluyt's voyages:—

There be also of sea fishes, which we saw comming along the coast flying which are of the bignesse of a smelt, the biggest sort whereof have foure wings, but the other have but two: of these wee sawe comming out of Guinea a hundred in a company, which being chased by the gilt-heads, otherwise called the bonitos, do to avoid them the better, take their flight out of the water, but yet are they not able to flie farre, because of the drying of their wings, which serve them not to flie but when they are moist, and therefore when they can flie no further they fall into the water, and having wet their wings, take a new flight againe. These bonitos be of bignesse like a carpe, and in colour like a makarell, but it is the swiftest fish in swimming that is, and followeth her prey very fiercely, not onely in the water, but also out of the water: for as the flying fish taketh her flight, so doeth this bonito leape after them, and taketh them sometimes above the water. There were some of those bonitos, which being galled by a fisgig, did follow our shippe comming out of Guinea 500 leagues. There is a sea-fowle also that chaseth this flying fish aswell as the bonito: for as the flying fish taketh her flight, so doth this fowle pursue to take her, which to beholde is a greater pleasure then hawking, for both the flights are as pleasant, and also more often then an hundred times: for the fowle can flie no way, but one or other lighteth

\*Usually called "Long Tom" in Australia.



in her paws, the number of them are so abundant. There is an innumerable young frie of these flying fishes, which commonly keepe about the ship, and are not so big as butter-flies, and yet by flying do avoid the unsatiableness of the bonito. Of the bigger sort of these fishes wee tooke many, which both night and day flew into the sailes of our ship, and there was not one of them which was not woorth a bonito: for being put upon a hooke drabbling in the water, the bonito would leap thereat, and so was taken. Also, we tooke many with a white cloth made fast to a hooke, which being tied so short in the water, that it might leape out and in, the greedie bonito thinking it to be a flying fish leapeth thereat, and so is deceived.

Flying fishes of many species occur in tropical and temperate waters all over the globe, the most widely distributed genus being *Exocoetus*. The fish shown in the photograph illustrating this article, taken on the Queensland coast, is probably *Cypselurus melanocercus*, Ogilby. It measured about ten inches in length. The bulk of flying fishes grow to ten or twelve inches in length, though some species may attain a length of about eighteen inches.

A small fresh water fish (*Pantodon buchholtzii*) which is capable of flight is found in the Congo. In this fish the pectoral fins are relatively smaller than in the true flying fishes, but they are united to the body along their length by a membrane. Doubtless extra air support is obtained by this adaptation. It grows only about three and a half inches long, and has been captured in a butterfly net.

Powers of flight are also possessed by flying gurnards, of which one species (*Dactyloptena orientalis*) occurs on the coast of

New South Wales. Flying gurnards are in no way related to the true flying fish, and resemble them only in the great development of the pectoral fins, which, although capable of sustaining them in the air for short distances, are not comparable in efficiency with those of the flying fish. The pectoral fins of the flying gurnard reach their greatest development only in the adult fish; in immature specimens they are little larger than in ordinary fishes; they are beautifully coloured and are divided into two parts, the posterior portion developing into a wing-like form, while the anterior, remaining very much smaller, is probably functionless for flight.

Ordinary gurnards, belonging to the family Triglidae, of which considerable numbers are captured by the trawlers on the coast of New South Wales, are frequently confused with the flying gurnards, and credited with the powers of flight. Although the beautiful butterfly-coloured pectoral fins of some species are somewhat enlarged, they are not adapted for flight; indeed, these fish rarely leave the bottom. Several of the lower rays of the pectoral fin are modified into finger-like processes which are used as feelers and assist the fish in the search for food on the ocean floor.

There are many other fish, such as the members of the garfish family, which skip over the surface of the water, sometimes in huge shoals, when pursued, but they do not possess the power of flight and cannot sustain themselves in the air.





## Barrallier's Blue Mountain Exploration in 1802.

BY THE LATE R. H. CAMBAGE, C.B.E., F.L.S.

(From a lecture delivered at the Australian Museum, July 12th, 1928.)

[EDITORIAL NOTE.—To discover from Barrallier's journal the route followed by the explorer in his heroic attempt in 1802 to cross the Blue Mountains, and to identify the point where the attempt was abandoned, demanded a knowledge of botany, of geology, and of surveying, as well as bush-craft and a good eye for country. These gifts and accomplishments are seldom found in combination, but Mr. Cabbage by nature and by training was peculiarly fitted for this task. By carefully following the clues afforded by Barrallier's topographical, geological, and botanical notes, and following in his tracks, Mr. Cabbage succeeded in tracing the route of this early explorer. A fuller account by Mr. Cabbage giving more detailed evidence for his conclusions, will be found in *The Surveyor*, Vol. XXIII., No. 8, 1910, pp. 141-152. Barrallier's Journal written in French, and a translation, is printed in *Historical Records of New South Wales*, Vol. V., 1803-1805, Appendix A., pp. 749-825.]

IN November, 1802, Ensign Francis Barrallier, of the New South Wales Corps, started from Parramatta in the hope that he would be able to find a passage westward across the Blue Mountains. His was not the first attempt to overcome this difficult barrier, which shut off the little settlement on the shores of Port Jackson from the western plains, for at an early period it was recognized that, if the community was to become self-supporting, land more suitable for cultivation than the barren if picturesque precincts of Sydney Cove would have to be found very soon.

Governor King, in writing to Sir Joseph Banks, May 8th, 1803, pointed out that he had experienced some difficulty in securing Barrallier's services for this exploratory work "and was obliged to effect a ruse," owing to some military order that soldiers were not to be taken off their regimental duty. King therefore claimed Barrallier as his aide-de-camp and "sent him on an embassy to the King of the Mountains."

According to his journal Barrallier travelled altogether one hundred and forty-seven miles into the mountains, beyond the Nepean, but, owing chiefly to the rough and almost inaccessible nature of the country traversed and the lack for some considerable time of a copy of his journal, which was forwarded by Governor King to Lord Hobart, for a hundred years the locality where his journey ended was not identified. Although he penetrated the mountains for some considerable distance his difficulties became so great, and his equipment was so meagre,

that he had to abandon the attempt before reaching the Great Divide.

Accompanied by four soldiers, five convicts, and a native named Gogy, who was afterwards joined by other natives, he crossed the Nepean River on 6th November, 1802, a few miles above where Camden now stands, the surrounding country being known as the Cow Pastures, a name it still bears and which was given to it because of the numbers of wild cattle running there. These were the offspring of a few head which strayed from Sydney in May, 1788, and were not found until November, 1795; by 1802 their numbers had increased to several hundreds. On November 7th he passed a swamp "called Manhandle by the natives."

His course afterwards took him very close to the spot now occupied by the town of Picton, and, when just north of Thirlmere, he turned first westerly and then north-westerly towards the Nattai River, eventually arriving at a spot on the high land overlooking the watershed of a tributary of that river. This particular spot had been previously visited by Barrallier, being near the terminal point of a former expedition, and was called Nattai; its position is approximately six miles north-westerly from the present town of Thirlmere, and near Shea's Creek. His goods had been brought this far in a waggon drawn by two bullocks, and here he formed a depot.

It seems likely that he was guided in some measure by the natives, and, had it not been for the unfriendly relations between members of different tribes, it is probable that

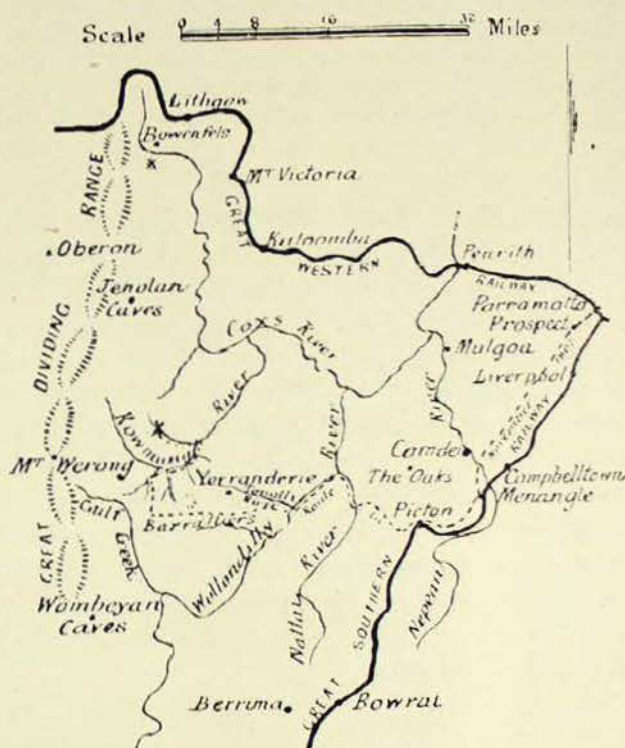


he would have got information which would have enabled him to cross the Main Divide. Some of the natives met with had never before seen a white man. Barrallier mentions that the natives when trying to attract another whose voice they heard in the distance "repeated several times the word coo-ee, shouting with all their strength." Near Nattai some natives "brought portion of a monkey (in the native language "colo") but they had cut it in pieces, and the head, which I should have liked to secure had disappeared." There can be little doubt that the animal referred to was the native bear, or koala, as it is now called.

On November 10th, Barrallier sent three men back with the waggon for provisions, and proceeded on foot westerly with his companions, following a creek (probably Shea's Creek) down a precipitous gorge to a river which had been the terminus of his first journey. This river is undoubtedly the present Nattai, and the spot referred to would be about six miles above its junction with the Wollondilly. Probably the earliest road into Burragorang was that which reached the Nattai just south of Shea's Creek. Barrallier noticed at the end of this creek a kind of slaty rock and fragments with the impressions of ferns and leaves. This slate corresponds with the Permo-Carboniferous shale beds and coal measures, which contain fossils and occur along the banks of the Nattai. Barrallier writes "These mountains are accessible up to a certain height, but at an altitude of a quarter of a mile they are perpendicular, and their summit forms a kind of vertical wall [*mur à plomb*]." The accessible portion is that formed by the sloping decomposed Permo-Carboniferous shales, while the vertical wall represents the Hawkesbury Sandstone cliffs.

On the 11th November, Barrallier followed the Nattai on its left bank to its junction with the Wollondilly, the identification of which is assisted by his reference to the pieces of granite in its bed. On the 12th he sighted what is now called the South Peak, some two or three miles south of Yerranderie. Owing to the denudation of the sandstone at one point, which leaves a gap in the cliffs, the rocks forming the South Peak are isolated, and the gap provides a passage accessible to horsemen. It is not unlikely that Barrallier was guided

to this passage by the natives, for, although those who accompanied him were beyond their own territory, they were acquainted with some who knew the locality. It is significant of the rugged nature of this region that this is the passage through which the whole of the stock traffic is conducted to the present day, between Burragorang and Oberon, and the greater part of the road between this passage and Mount Werong, about twenty-five miles distant, is still little better than a bridle track.



Barrallier's Blue Mountain Explorations. His terminal point, 1802, is indicated by x. Blaxland, Wentworth and Lawson's 1813, is shown by \*.  
[R. H. Cambage, del.]

In endeavouring to ascend the northern end of the mountain the explorer succeeded in climbing over the talus slopes for about three quarters of the height "where immense overhanging rocks, which seemed to be attached to nothing, offered an appalling scene. I made my men rest, and during these stoppages I glanced at the plain from that great height with a feeling of admiration mingled with awe." A soldier was sent to search the eastern face, but when scarcely a hundred yards distant he shot a "warring" and returned. There is no doubt that a warring is what we know as a rock wallaby. From personal knowledge I am able to say that forty-five years ago, before the advent





South Peak, Yerranderie.

[Photo.—A. Musgrave]

of settlers, this locality was literally alive with rock wallabies.

Descending the western side of the mountain Barrallier reached its base, where for more than a quarter of an hour he pursued some "pheasants" which he could hear, "but they were so shy that, at the slightest noise, they flew to the trees, where they perched. They run on the ground with such rapidity that one loses sight of them in the twinkling of an eye." This, beyond doubt, refers to the lyre bird, which is still called a pheasant by settlers in some of these mountainous districts.

Shortly after leaving the South Peak, the explorers met with some natives who showed such hostility to Gogy that the whole party returned to the depot at Nattai.

On 22nd November Barrallier started from Nattai on the second expedition, taking with him five of the strongest men and two young natives. At noon on the 24th November he passed the South Peak and proceeded towards Colong,<sup>1</sup> probably traversing much the same route as that followed by the present track. It is clear that he passed to the south of the "little Rick" or "Square Rock," for he mentions passing over granite

stones (really felsite); had this course taken him towards the northern side of the Little Rick he would have travelled over sedimentary rocks. At noon on the 25th November, a large rapid stream was reached in which were "granite stones fallen from the mountains." This was apparently Colong Creek, and the crossing was probably made near the site of the present woolshed, possibly about two hundred yards below it. On the night of the 25th November the party camped by the side of a swamp, which beyond question is

Bindook Swamp. Barrallier and his men congratulated themselves on having accomplished the passage of the Blue Mountains without accident, but their pleasure was premature as they discovered next day, when, proceeding in a westerly direction, they encountered hills which barred their passage. They tried in various directions to discover a way out, and, finding themselves eventually on a spur which divides the waters of the Wollondilly from those of the Kowmung, they passed into a gully which led either to Waterfall Creek or the left branch of Lannigan's Creek, probably the former. This they followed until it joined a large river, undoubtedly the Kowmung. The Kowmung was followed northerly for probably slightly more than two hours, when the party arrived at the mouth of Christy's Creek. Had Barrallier turned to the west when on the ridge dividing the waters of Gulf and Waterfall Creeks his troubles would have been over, and by nightfall he would have been on the plateau forming the Great Dividing Range at about 3800 feet above sea level, ready to descend the western slopes on the following morning.

At Christy's Creek Barrallier "picked up a few interesting stones, among which were some sandstone containing sea shell and several other foreign matters." The sea

<sup>1</sup>The Colong district is described in THE AUSTRALIAN MUSEUM MAGAZINE, Vol. III., No. 6, April-June, 1928.



shells referred to could only be fossils, and, in order to establish the identity of this spot, I went a short distance on the banks of Christy's Creek, and at once found fossils similar to those mentioned by Barrallier. They consisted of fairly well preserved forms of *Spirifer disjuncta*, a typical Devonian fossil, and occur in quartzite or altered sandstone.

On 27th November Barrallier proceeded up Christy's Creek, and near its head he found it so hemmed in, and so many waterfalls, that further progress became exceedingly difficult or even impossible. On 28th November he writes "I then seriously considered the situation in which I found myself, seeing no appearance of being able to procure any beasts for the subsistence of my troop, except some snakes, which it was repugnant to eat. Our provisions were nearly ex-

hausted. The small quantity of rice and flour left did not allow of my continuing to advance in a country offering absolutely no resource. The courage of my men was entirely abated, and nothing but the orders for the return journey would suffice to dispel their melancholy . . . After having cut a cross of St. Andrew on a tree to indicate the terminus of my second journey, I returned by the same route I had come."

The terminal point reached by this courageous explorer was, therefore, towards the head of Christy's Creek, about fifteen or sixteen miles in a direct line southerly from Jenolan Caves. Barrallier had unfortunately wandered into one of the roughest and most inaccessible parts of the Blue Mountains, and we must surely feel that his arduous and intrepid attempt to cross this formidable barrier deserved better success.

## Obituary.

RICHARD HIND CAMBAGE, C.B.E., L.S., F.L.S.

The sudden death of Mr. R. H. Cabbage, Trustee, which took place on November 28th, was a great shock to his many friends and a grievous loss to the ranks of scientific workers in Australia.

He was born at Milton on the South Coast in 1859, and, at the age of eighteen, he joined the surveying staff of Mr. J. Callaghan. In 1885, after serving three years as a draftsman in the Department of Lands and qualifying as a licensed surveyor, he joined the Mines Department as a mining surveyor. In the course of his duties he travelled extensively over New South Wales, and, being gifted with keen powers of observation and a retentive memory, he became an authority on the distribution of trees and their dependence on soils and temperature. In 1902 he became Chief Mining Surveyor, and in 1916 he was appointed Under Secretary for Mines, from which position he retired in 1924.

Mr. Cabbage was an active and honoured member of many scientific societies, where his organizing ability and tact made him an outstanding figure. He was a Foundation Fellow of the Institution of Surveyors, N.S. Wales, of which he was three times President. He had been a member of the Royal Society of N.S. Wales since 1904, was

for many years one of its Honorary Secretaries, and was twice President. He became a member of the Linnean Society of New South Wales in 1899, and was its President in 1924-25. He was President of the Australasian Association for the Advancement of Science at its Hobart meeting, January, 1928, and, at the time of his death, was President of the Australian National Research Council and of the Wild Life Preservation Society. In 1904 he was elected a Fellow of the Linnean Society of London. He took an active part in organizing the meeting of the Pan-Pacific Science Congress in Australia in 1923, and was one of the Australian delegates at the meeting held in Japan in 1926.

He was elected a Trustee of the Australian Museum in 1925, and his ripe experience and judgment, and his wide scientific knowledge were very highly esteemed by his colleagues.

He was kindly and sympathetic, always urbane, generous in thought, word, and deed, buoyant and optimistic in outlook. His fine record of public service and scientific achievement would be hard to surpass, and his endearing qualities and helpful nature won him a high place in the esteem and affection of all his friends.



## A Naturalist in the Gulf Country.

BY THOMAS G. CAMPBELL.

THE Gulf of Carpentaria seems a far away part of the Australian Continent, and, being somewhat off the beaten track, is perhaps known to the majority of Australians by name only. In August of this year it was the good fortune of the writer to traverse some of the country bordering on the southern shores of the Gulf as a member of a party organised by Dr. F. Antill Pockley, which went on an extended motor tour through New South Wales, Queensland, and North, Central, and South Australia. The following article is intended to give some account of the animal life and other interesting features of some of the country in the vicinity of the Gulf of Carpentaria.

Though only a short time was spent in this area, many interesting birds and animals were encountered, while new observations and experiences occupied every minute of our waking hours. The party travelled by car and trailer from Sydney, by way of Bourke, and then through the central west of Queensland as far north as Cloncurry. This town, the centre of a large copper-mining district has languished somewhat of late years on account of the depressed metal market and the high cost of production. Cattle raising is also carried on in the surrounding districts, but a prolonged drought, which has affected large areas throughout Queensland for some considerable time past, has had a very adverse effect on the pastoral industry.

Some time was spent in Cloncurry procuring the necessary stores, odd articles of clothing and equipment, as well as a plentiful supply of benzine before pushing north into the sparsely settled areas towards Burketown and Normanton. The Gulf country proper begins to the north of Cloncurry, and the south east trade wind is the main source from which it derives its rainfall. In the



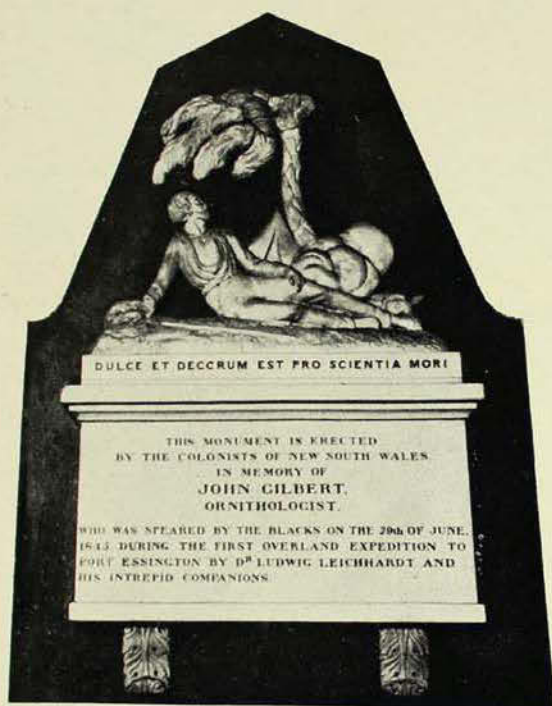
The Gulf Country of Queensland and its surroundings

southern Gulf districts the rainfall averages from sixteen to thirty-nine inches per annum. The mid-summer months constitute the wet season in the Gulf, and during such time travel in this area is extremely difficult. During the wet season the rivers are considerably swollen, and the boggy nature of the soil makes it almost impossible to use wheeled vehicles. On this account we chose the dry season, which corresponds with our southern winter, in which to make the journey.



## EARLY EXPLORATION.

The first white men to explore the Gulf country were under the command of Ludwig Leichhardt, whose expedition set out in 1844, and made its way north to the MacKenzie and Burdekin Rivers. After crossing the main watershed they came to a stream flowing towards the Gulf of Carpentaria.



Memorial Tablet in S. James' Church, Sydney, erected to the memory of John Gilbert, naturalist to the Leichhardt Expedition.

[Photo.—H. Barnes, Junr.]

This stream was named the Lynd, and Leichhardt followed it down to the Mitchell River. On June 28th, 1845, the party was attacked by natives, and Gilbert, the naturalist, was killed and two others were wounded. From the Mitchell River Leichhardt and his followers travelled along the shores of the Gulf, crossing a number of rivers, including the Gilbert and the Roper. On the Roper River trouble again beset the expedition, four horses were lost and Leichhardt was forced to abandon the whole of his botanical specimens. On the 17th December, 1845, after a ten months' journey, the expedition reached the settlement at Port Essington in an exhausted condition.

The first explorers to reach the coastal waters of the Gulf by travelling overland, were members of the ill-fated Burke and

Wills Expedition. They reached the tidal waters of the Flinders River and followed it down until it widened out into an estuary. Burke's brief diary for 28th March, 1861, states: "At the conclusion of report it would be well to say that we reached the sea, but we could not obtain a view of the open ocean, although we made every endeavour to do so." To these explorers the honour of first having crossed the continent is usually awarded.

A Queensland expedition sent out to search for traces of the Burke and Wills expedition, was under the leadership of William Landsborough, whose party sailed for the Gulf of Carpentaria in the brig "Firefly" in 1861, and landed at the mouth of the Albert River. This expedition discovered and named the Gregory River, and later the Georgina River. Landsborough followed the Flinders to its source, and then came back to civilization by way of the Thomson, Barcoo, and Warrego Rivers. His explorations helped materially towards the pastoral occupation of additional large areas. In 1861 Frederick Walker travelled by way of the Barcoo towards a tributary of the Albert, which he called the Barclay, but which was really the head of the Flinders. Near the Flinders and Norman Rivers he discovered traces of the Burke and Wills expedition. Walker then crossed the Leichhardt River and reached the depot on the Albert River. After spending a short time there he set out and followed the tracks of the lost explorers for some distance, and after an arduous journey got back to the settlements of the Burdekin River in April, 1862. This expedition not only found traces of the Burke and Wills expedition, but was also the means of opening up a considerable area of suitable pastoral country.

In 1865 Duncan McIntyre examined the country towards the Gulf of Carpentaria, and when three hundred miles from the sea he discovered what were regarded as traces of the Leichhardt expedition which had vanished from human ken somewhere near the Elsey River in 1848. On his return an expedition was organised to search for Leichhardt and his party, but, owing to their failure to find enough water along the route, the expedition was forced to retrace its steps and ended in failure. McIntyre again journeyed to the Gulf of Carpentaria, which he reached only to succumb to the effects of Gulf fever shortly afterwards.



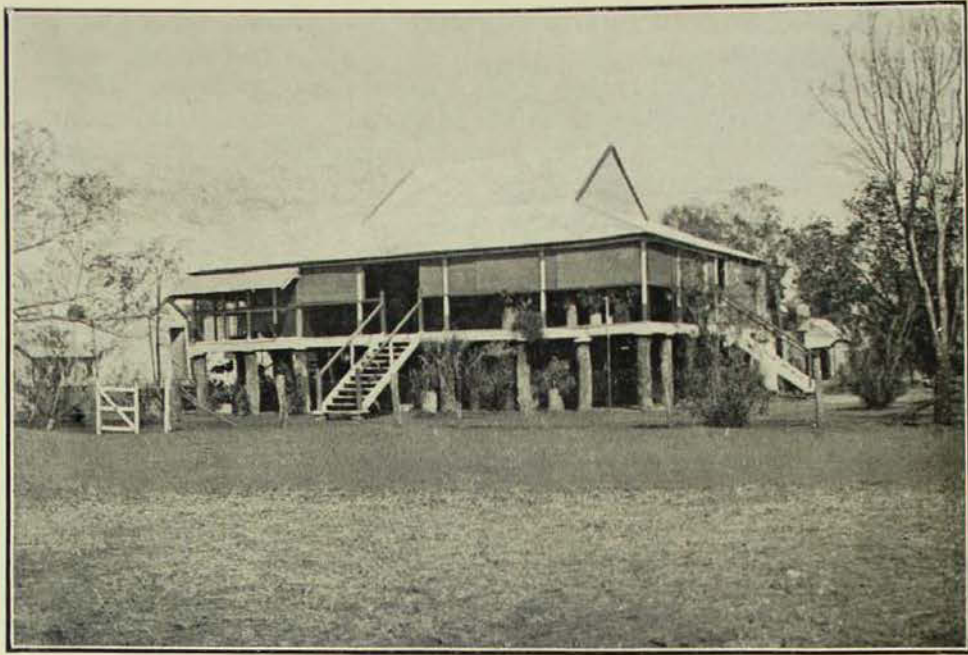
### THE LEICHHARDT RIVER.

After leaving Coolullah Station, which is situated about seventy miles north of Cloncurry, we followed the right bank of the Leichhardt River for almost one hundred miles. The Leichhardt River is one of the argest rivers flowing into the southern shores of the Gulf of Carpentaria, but owing to the dryness of the season it had ceased to flow, and had become a succession of deep pools. The depth of its gorge and the width between its banks, gave some idea of its volume when swollen by the tropical rains. Numerous tributaries on its left bank and the confluence of the Alexander River on its right, result in the draining of hundreds of square miles of country. The Leichhardt finally empties into the sea about twenty miles north-east of Burketown, and just east of the Albert River estuary, on which the town is situated.

The Leichhardt River was discovered and named by A. C. Gregory, who set out from the Victoria River, North Australia, in 1855. The object of his expedition was to traverse North Australia in a west-east direction, and search for Leichhardt's expedition at the same time. A river which Leichhardt had, on a previous expedition considered to be the Albert discovered by Captain Stokes, was proved by Gregory to be quite distinct, and this he named the Leichhardt.

### CROCODILES.

It was in the lower waters of the Leichhardt that we expected to see crocodiles, but in this we were sadly disappointed. The hurried nature of our visit did not permit our wandering along the river banks in the glorious sunshine, looking for the most favoured haunts of the saurians, and we had



Coolullah Station, on the Leichhardt River, some seventy miles north of Cloncurry. Throughout the Gulf districts, as well as in other parts of Queensland the houses are raised on piles to keep them dry and cool during the wet season.

[Photo.—T. G. Campbell.]

to content ourselves with examining skulls, or small specimens in bottles. One skull which was shown to me belonged to a reptile which was said to have measured over nineteen feet in length.

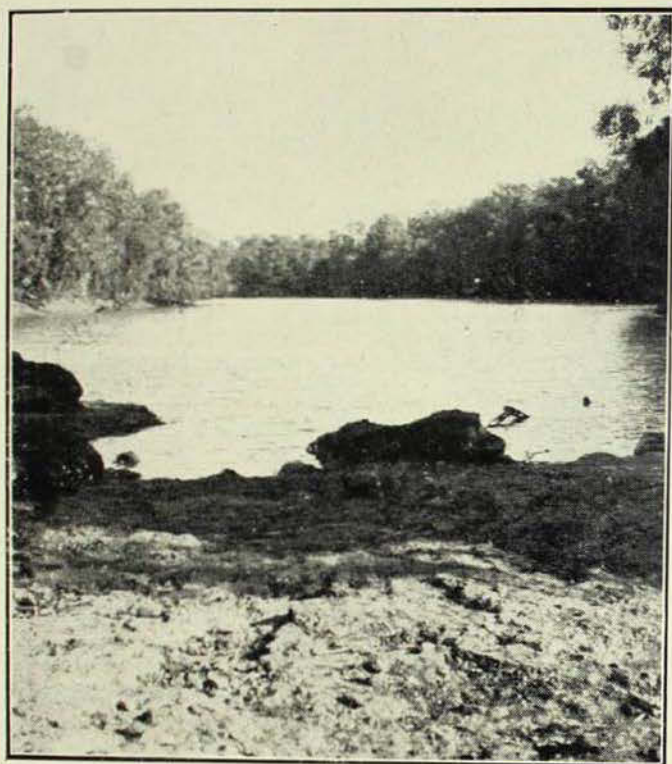
A smaller species which also inhabits the Gulf country is Johnston's crocodile, *Crocodilus johnstoni*, which is known to occur only in North Australia. This species attains a length of about eight feet, and has a much smoother head than the estuarine species; it is comparatively harmless and its diet is said to consist mainly of fish. Several residents of the Gulf country, with whom I discussed these interesting reptiles assured me that in certain of the rivers there were "alligators" as well as crocodiles, and I was regaled with numerous accounts of the rapaciousness of the "gators," whereas it seemed to be generally agreed that the smaller crocodiles were quite harmless, and, even if not the most agreeable companions when swimming, still need not be given any very serious consideration.

In the Gulf country the Estuarine crocodile exacts a considerable toll in cattle and horses. Unsuspecting beasts are often seized while drinking, and once in the water their efforts to escape are usually futile.



## BIRD LIFE OF THE GULF COUNTRY.

The birds of the Gulf region were a never-ending source of delight, and as we motored along we passed stately native companions and bustards resting beneath the shade of trees, or else disturbed flocks of querulous little budgerygars from among the dry grass. A sharp whirring sound, as numbers of pigeons hastily took to flight at our approach, and the loud screech of black cockatoos,



A deep pool in the bed of the Leichhardt River. It is in such pools that the large crocodiles occur.

[Photo.—T. G. Campbell.]

disporting their wonderful black and red tails, were some of the experiences to be enjoyed in this bird stronghold. Overhead in the open spaces of the forest hawks soared majestically on noiseless wings, ever on the alert to swoop down on some unfortunate animal should it venture into the open. They were very numerous, and while we were at meals would often come down quite close.

Native companions, or "brolgas," *Antigone rubicunda*, occurred plentifully throughout the journey. This stately bird is the sole Australian representative of the crane family, though numerous other aquatic and wading birds are often incorrectly referred to as

such. Brolgas are light grey in colour with a red patch on the back of the head. What a picture of dignified contentment these birds made, as with stately deportment they moved about slowly in the open spaces, or rested beneath the shade of trees during the fierce heat of the day. Usually they were to be seen in small flocks of four or upwards, while the most seen together was in the neighbourhood of twenty birds. Their food consists of lizards and insects, as well as roots and bulbs of native plants. The female lays two eggs either on the ground or upon a tuft of grass; no attempt is made to construct any nest. The queer antics of these birds when "dancing" is well known, and in North Queensland certain of the native corroboree dances imitate the movements of these birds. In his *Confessions of a Beachcomber*, p. 273, the late E. J. Banfield gives a description of such a dance.

The Plain Turkey or bustard, *Eupodotis australis*, was another bird frequently met with throughout the Gulf regions. This large bird is widely distributed throughout the inland portions of Australia, but like the Native Companion, does not occur in Tasmania. The Plain Turkey feeds largely on insects and is responsible for the destruction of great numbers of grasshoppers. Unfortunately it is much sought after for food, its flesh being held in considerable esteem. This, coupled with the ravages of the fox, is rapidly depleting the numbers of the birds, so that in settled districts they are rapidly becoming scarce. Male turkeys attain to a considerable size, and may weigh as much as eighteen pounds. Captain James Cook was the first white man to record the occurrence of the Australian Plain Turkey, while on the north Queensland coast on 23rd May, 1770. His first meeting with the bird was a little distance north of the present site of Bundaberg. He states: "Upon the shore we saw a species of the Bustard, one of which we shot, it was as large as a turkey and weighed 17½ pounds. We all agreed that this was the best bird we had eaten since leaving England, and in honour of it we called this inlet Bustard Bay." Usually the Plain Turkey frequents the inland portion of the continent; their presence on the coast may be due to unfavourable conditions inland, such as droughts, which would bring about a diminution of the normal food supply.



Cockatoos were seen in large numbers, and the Rose-breasted Cockatoo or Galah, *Cacatua roseicapilla*, was by far the most plentiful. Not only did they occur in large flocks throughout the Gulf country, but they occurred in practically every part of inland Australia visited by us during the



The car and trailer climbing the steep bank after crossing the Leichhardt River. At this point a hard band of rock crosses the river bed and makes a solid, but extremely rough natural crossing.

[Photo.—T. G. Campbell.]

five thousand odd miles travelled. So numerous were they in places that the ground appeared pink and grey in colour, as the birds fed together in large numbers.

One of the most striking birds of this group was the Banksian or Red-tailed Cockatoo, *Calyptorhynchus banksi*. This species is more aboreal in its habits than most members of the cockatoo family. It has a wide distribution throughout inland Australia, usually occurring in small flocks of less than a dozen individuals. Their stout beaks enable them to crush the hard woody fruits of native plants and eucalyptus seed capsules, while the bark of trees is stripped off in their search for beetle grubs and other wood-boring insect larvae. Sulphur-crested Cockatoos, *Kakatoe galerita*, were also seen in considerable numbers,

particularly in the early morning along the river banks. As they perched on trees overhanging the water, the reflections of these beautiful white birds were mirrored in the still waters below. On being approached more closely they would take to flight, uttering shrill cries of alarm, wheeling round overhead or else flying away to some more secure place, further removed from the prying eyes of the traveller. Occasionally flying in company with the sulphur-crested species were observed odd individuals of the Pink or Major Mitchell Cockatoo, one of the most beautiful, but at the same time less plentiful of the inland species.

Pigeons and doves were very numerous, and the former usually heralded their presence by a sharp whirring sound as the car disturbed them while feeding upon the ground. Top-knot Pigeons, *Lopholaimus antarcticus*, were met with in large numbers, and along the banks of the Leichhardt flocks numbering hundreds of individuals would be seen resting on trees or else feeding together on the ground. This interesting fruit pigeon derives its vernacular name from a peculiar crest upon its head, and is a widely distributed species throughout various parts of Eastern Australia. Owing to the fact that this pigeon makes very good eating, its numbers are becoming considerably depleted in the more settled areas. However, it is pleasing to see that this bird is still plentiful, and in the vast spaces of the Gulf country it should find a sanctuary in which to breed unmolested. Captain Cook first made the acquaintance of this bird at the Endeavour River, near Cooktown, where some of the birds were shot for food.

Another very common bird in the north is the Diamond Dove, *Geopelia cuneata*, which in common with other allied species is usually referred to as a "dove," though really it is a small pigeon. Small and large flocks, varying in numbers from less than a dozen to fifty or more individuals, were to be seen in every direction. Of a general brown colouration, these graceful little birds could be readily distinguished by a number of clearly defined white marks on the shoulders.

In the more open spaces covered with Mitchell and Flinders Grass Budgerygars, *Melopsittacus undulatus*, were extremely abundant. Large flocks consisting of hun-



dreds of individuals would circle round, wheeling swiftly before making a landing. When settled they covered the ground with a restless heaving mantle of green, ever and anon some individuals hovering up and down on the outskirts of the flock, so that the birds were always in a constant state of unrest. When on the wing they were being constantly preyed upon by hawks, which would swoop down from above in their endeavour to seize a victim from among the swiftly moving flock. A wonderful sight was presented by these small parrots, which, flying at great speed, would suddenly wheel as one individual in order to avoid the onslaught of some marauding hawk. As they wheeled in precipitous flight brilliant splashes of colour appeared for an instant like the flash of an opal, as the sunlight played upon their green and gold plumage, and then in a flash disappeared. What was always a source of wonderment to an observer was the precision with which the birds would change the direction of their flight. One second they would be flying rapidly in one direction, and the next they would be travelling back the way they had come. Every individual in the flock would turn in quite a confined space, accomplishing the turn with apparent ease, and without in the least interfering with or jostling his neighbours. It was during these rapid aerial manoeuvres that the sunlight made such a wonderful display of their brilliant colours.

A pleasant interlude to our trip was a call at Armanald Station, some forty miles distant from Burketown, where, during the few hours of our stay, we were hospitably entertained by Mr. and Mrs. Stadham and their family. While there we had an opportunity of examining the skull of a large Estuarine crocodile, *Crocodylus porosus*, which Mr. Stadham had secured near where we crossed the rocky floor of the Leichhardt River, about eight miles from Augustus Downs Station. The cavernous jaws of this reptile, with their rows of teeth gave some idea of what their owner must have been capable, and were a strong argument in favour of bathing in a benzine tin on the river bank, rather than in the river itself.

On a lagoon at the back of the homestead numerous birds swam about quietly, waded

in the shallows, or else rested beneath the trees lining its banks. Though only a stone's throw from the house these birds were quite unperturbed, and enjoyed the sanctuary provided for them. Mr. Stadham had not permitted them to be hunted or disturbed in any way, and it was a pleasant and rather rare sight to see such a variety and concentration of bird life in such close proximity to human habitation. Herons and egrets waded about in the shallow water at the edge of the lagoon, searching for small crustacea and other suitable morsels. Black Ducks, *Anas superciliosa*, swam up and down the lagoon, but looked very small indeed when compared to the huge bulk of a pelican, *Pelicanus conspicillatus*, which appeared like an ocean leviathan alongside the smaller ducks. This bird is the only member of the family Pelicanidae found in Australia, and, though the family has a wide distribution throughout the world, the Australian species is the largest member. Pelicans are widely distributed throughout Australia, Tasmania, and New Guinea. Though usually found inhabiting lakes and rivers, they are also to be found at times on the sea coast. This bird was first recorded by the Dutch explorer, Vlamingh, who saw them on the Swan River in 1697, and some years later Dampier recorded the birds from Shark Bay, Western Australia. In his journal Vlamingh refers to these birds under the very appropriate name of "kropganzen," the English meaning of which is "crop geese."

#### THE BARCLAY RIVER.

A short time amidst pleasant surroundings was spent on the Barclay River, which, with two other large tributaries, runs into the Albert River, and upon which the town of Burketown is situated. Though the river was only a few inches deep near our camp, and one could easily leap across it in most places, it contained clear running water, and this was a welcome change from the dry river beds or chains of muddy water-holes which prevailed in the drought-stricken areas further south. Along the banks pandanus palms overhung the water, and a host of other plants, growing in crowded profusion, gave a tropical atmosphere which was a delightfully new experience. As it





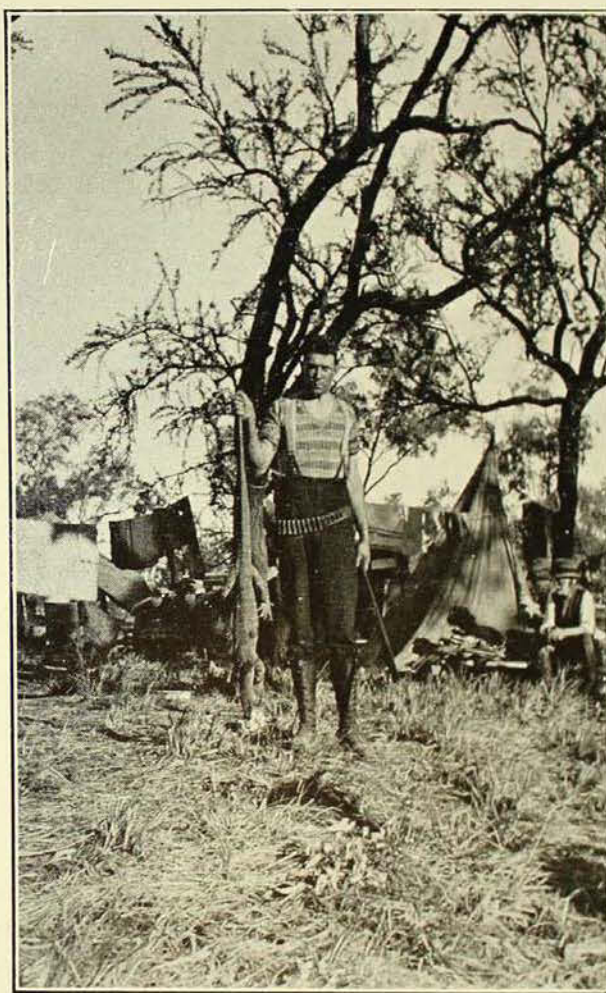
A profusion of *Pandanus* and other tropical vegetation along the banks of the Barclay River. The long grass in the fore-ground was the haunt of numerous wallabies.

[Photo.—T. G. Campbell.]

was late in the afternoon when we selected a camp site, I was able to bestow but little more than a glance upon our surroundings, but that night I sought my sleeping-bag with a firm resolve to explore along the river banks, for a short distance at least, on the morrow. The next morning I was off immediately after breakfast, and taking camera, gun, and collecting material, I set out along the river bank. In the bright sunshine various species of butterflies were hovering over flowering shrubs, and after much trouble I succeeded in securing a few examples of *Euploea corinna*, *Acraea andromacha*, and *Hypolimnas bolina*, besides one or two smaller and less conspicuous species.

Back from the river bank a few yards the tufts of the Flinders Grass provided ample hiding for numerous wallabies, which as far as could be ascertained were *Macropus agilis*. As I walked through the grass these wallabies would be disturbed and go bounding away at my approach. Well defined "squats" from which the animals were disturbed could be found by searching in the vicinity. It was no uncommon sight to see three or four wallabies at a time, either hopping lazily away into the timber,

or else sitting up a few yards distant gazing at the intruder. Sometimes one would almost walk on top of a resting wallaby, and the sudden scurry of the frightened animal as it bounded away was somewhat startling until one became accustomed to it. In trees overhanging the creek pigeons called softly to one another while resting in the peaceful security of the river's pandanus-filled banks. From their retreats among the roots of shrubs and accumulations of flood debris lining the stream, lizards of various



A large "goanna" *Varanus varius*, secured on the Barclay River.

[Photo.—T. G. Campbell.]

kinds came out to enjoy the glorious sunshine; even during the month of August it was quite hot during the middle of the day.

While wandering along the bank in search of specimens I was startled by a commotion among the stems of some pandanus palms, and was just in time to see a large wild pig, which had been disturbed at my approach go scurrying away among the undergrowth. I examined the spot and found the retreat which it had so hastily vacated, snugly



concealed among the palms a few feet from the water's edge. Wild pigs, which are the domestic species thrown back to the wild state, are fairly common in some parts of Queensland. In river beds and other favourable situations, where the soil is soft, they are able to dig for various roots and tubers of native plants. I was told that pigs occur in appreciable numbers in the Diamantina Valley, in the vicinity of Winton, and they are apparently widely distributed elsewhere, but only on this occasion was I fortunate enough to catch a glimpse of one.

#### CONCLUSION.

During our travels in the Gulf country we visited many interesting places, and on numerous occasions enjoyed the warm hos-

pitality which was extended to us by the various station folk and others who populate this sparsely settled portion of Australia. To them I am indebted for much useful information, and for showing me things of interest which I, unaccustomed to the country, would otherwise have missed. Thanks to their kind generosity and ever ready help, I was able to gain at least some slight knowledge of the country and its denizens, which materially assisted my own observations. Owing, however, to the dry conditions prevailing at the time of our visit, we did not see the country at its best, but enough was seen during our short stay to establish a desire to again visit this region, and enjoy further the delights and wonders of nature in the Gulf country.

---

## Obituary.

### GEORGE WILLIAM McANDREW.

Mr. G. W. McAndrew, who died at Shellharbour, South Coast, on November 2nd, 1928, at the age of fifty-three, was in April, 1926, elected as Honorary Correspondent of the Museum in recognition of his valuable services as a voluntary collector. His avocation was the study of the molluscs and other marine invertebrates found on the coast near Shellharbour. He had a natural gift and great discrimination as a collector, and the Museum is indebted to him for many valuable finds and novelties. He was quick

to recognize specific differences and the new species and records for which he was responsible form an imposing list. He had devoted special attention to the chitons and his collection of these primitive molluscs was remarkable for its wealth of varieties and the splendid condition of the specimens. He was quiet and unassuming in manner and exceedingly obliging in disposition, always willing to make a painstaking search for any desired marine organism. His death is a serious loss to the Museum.



## With the Great Barrier Reef Expedition.

by

G. P. WHITLEY and W. BOARDMAN.



The headquarters of the British Great Barrier Reef Expedition on Low Island, off Port Douglas, North Queensland. The lighthouse and coconut palms are dominant features of the colourful little island whilst, in the foreground, blocks of coral and small clams have been exposed by the falling tide.

[Photo.—W. Boardman.

At six in the evening, the northermost land in sight bore N. by W.  $\frac{1}{2}$  W. and two low woody islands, which some of us took to be rocks above water, bore N.  $\frac{1}{2}$  W.

THESE few words from the journal of Captain Cook were penned in June, 1770, a few days before his vessel, the *Endeavour*, went aground on a coral reef, and provide us with the first impression recorded by a white man concerning Low Isles— Isles destined to become famous in the annals of Australian marine biology by reason of their selection as the headquarters of the British Great Barrier Reef Expedition. Since Cook's discovery, however, certain attention has been given to these tropic isles by scientific workers. Some of the charming pictures which adorn Saville-

Kent's *Great Barrier Reef of Australia* were secured on the Low Isles reefs. H.M.S. *Penguin* visited the locality in 1905 to make surveys, and, in recent years, the late Charles Hedley and the late Surgeon-Lieutenant W. E. J. Paradise, R.A.N., landed there when attached to H.M.A.S. *Geranium*. A lighthouse was erected on Low Woody Island in 1877 and has given continuous service for more than half a century.

The Low Isles lie off Port Douglas at the eastern base of Cape York Peninsula. They are approximately half-way between the outer Barrier Reef and the mainland so that the expedition is within easy reach of either. Both isles are true coral formations but differ much in character and fauna. Low Woody Isle, on which the expedition





"Skull Reef," Low Isles, where blocks of Brain Corals, exposed at exceptionally low water, suggested to Saville-Kent a battlefield strewn with skulls.

[Photo.—W. Boardman.

has its headquarters, is hardly four acres in extent, and on it are also situated the lighthouse and the homes of its keepers. This "speck of land" rises only a few feet above high water level and is surrounded by a beach of coral sand and shell debris. The other island is much larger, being about a mile long and one quarter wide, and lies half a mile or so to the eastward. The two isles are connected by a sand flat, which is exposed at low spring water but which becomes a shallow lagoon when the tide is full. Both are surrounded by an irregular ring of more or less exposed dead coral fragments, in parts only a few feet wide, in others many yards. This bank of dead coral, which must weigh hundreds of thousands of tons, is evidently mostly heaped up by the fury of gales. Here and there one sees where a newer and whiter coral layer has been piled on a discoloured older one. A dense tropical mangrove swamp covers the larger island, within whose confines some of our most interesting experiences were gained, and after a day or two at work on the main lagoon flat we would be drawn once more into its mysterious depths as if attracted by some magnetic force. The lines of approach to the centre of this swamp lie along tree-lined avenues, which usually narrow to form mere tunnels through the foliage and finally lose themselves amongst a maze of roots.

The coral growths at Low Isles are not very prolific, no rich reef-crest or luxuriant coral, such as is usually found in like situations, being present. However, the great sand-flat in the lagoon harbours an assemblage of marine forms amazing in variety and interest. Resting on the surface are scores of Horseshoe Clams (*Hippopus*) with emerald green mantles, and beneath every boulder is a wealth of brittle stars, crabs, sea worms, sponges, and the like.

At the time of our visit, as guests of the expedition, last October,

Low Islet was a hive of industry, its thirty odd inhabitants making the little spot probably one of the most densely populated places in Queensland.

The main work of the expedition is of a highly technical and purely scientific character, but the results gained will doubtless



Clams and exposed corals in the "moat" at Low Isles. Mangrove forest in the distance.

[Photo.—W. Boardman.





Members of the British Great Barrier Reef Expedition. Left to right: (back row) C. Wishart, A. G. Nicholls, J. E. Young, G. Tandy, G. W. Otter, H. C. Vidgen, and F. W. Moorhouse; (front row) Mrs. Stephenson, Dr. T. A. Stephenson, Miss S. M. Marshall, Dr. C. M. Yonge (leader), Mrs. Yonge, F. S. Russell, Mrs. Russell, and A. P. Orr.

[Photo.—J. H. Carter.]

throw much light on many economic problems concerned with the Great Barrier Reef, and commercial ends will thus be indirectly served.

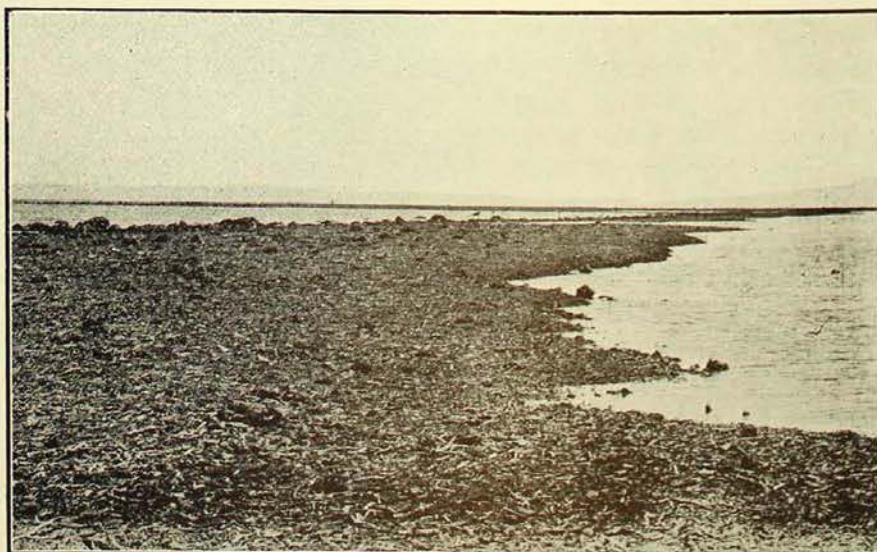
Dr. C. M. Yonge, the leader of the expedition, is studying the feeding habits of the coral animals and the methods by which they digest their food. Tiny plants, known as symbiotic algae, live actually in the flesh of the coral polyps and play an important part in producing oxygen for the use of the animals. These algae have also been found in the tissues of such diverse animals as clams, certain sea anemones, and a few kinds of worms. Dr. Yonge is also investigating the breeding habits of the pearl oyster, and hopes, when the season is favourable, to obtain their fertile eggs and study the development of the young. Mrs. Yonge assists her husband with his work and, being a doctor of medicine, looks after the health of the islanders.

Mr. F. S. Russell, of the Marine Biological Association, Plymouth, is investigating the plankton or minute floating

organisms of our northern seas. This is a most important piece of research, as it is largely upon plankton that fishes and other commercially valuable marine animals depend for food. Mr. Russell goes out in the expedition launch *Luana* every week to take samples of the plankton by hauling very fine-meshed nets vertically and horizontally through the water. The results have shown the presence of many small shrimp-like creatures (Copepoda), fish eggs and larvae, arrow worms, and other microscopic forms of animals and plant life in varying proportions. Mr. Russell predicts a richer harvest later but he will probably have left Low Isles before its advent. Mr. J. C. Colman, of Oxford University, who will have taken

over his work, will, it is hoped, see the fulfilment of this prophecy.

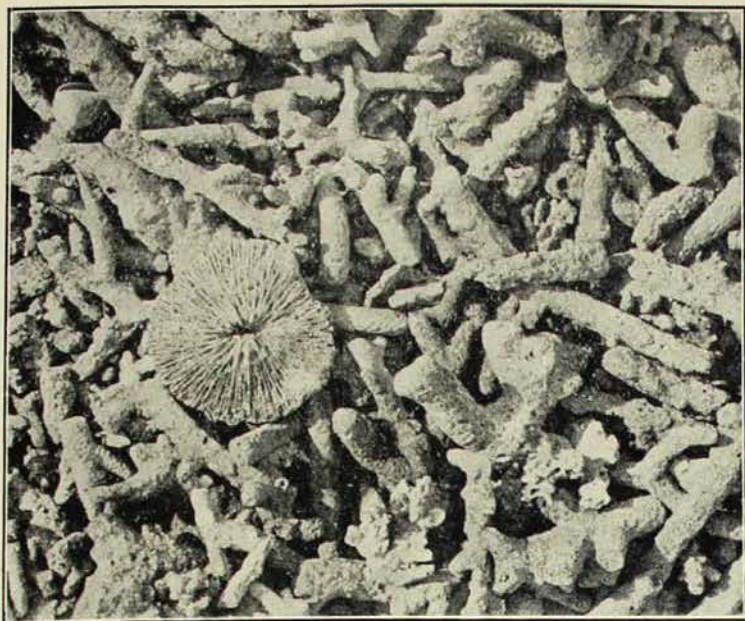
Mr. A. P. Orr is the chemist and analyses samples of seawater taken at various depths at different stations by means of an ingenious invention in the form of a bottle which seals itself automatically when required. The salinity, temperature, acidity or alkalinity, phosphate and oxygen content, and hydrogen concentration of the water are constantly studied, and their effects on the marine life recorded.



View of the bank of dead coral fragments which almost encloses Low Isles and is exposed at low water.

[Photo.—W. Boardman.]





A closer view of part of the detritus bank showing dead coral fragments, amongst which a worn mushroom coral is prominent.

[Photo.—W. Boardman.]

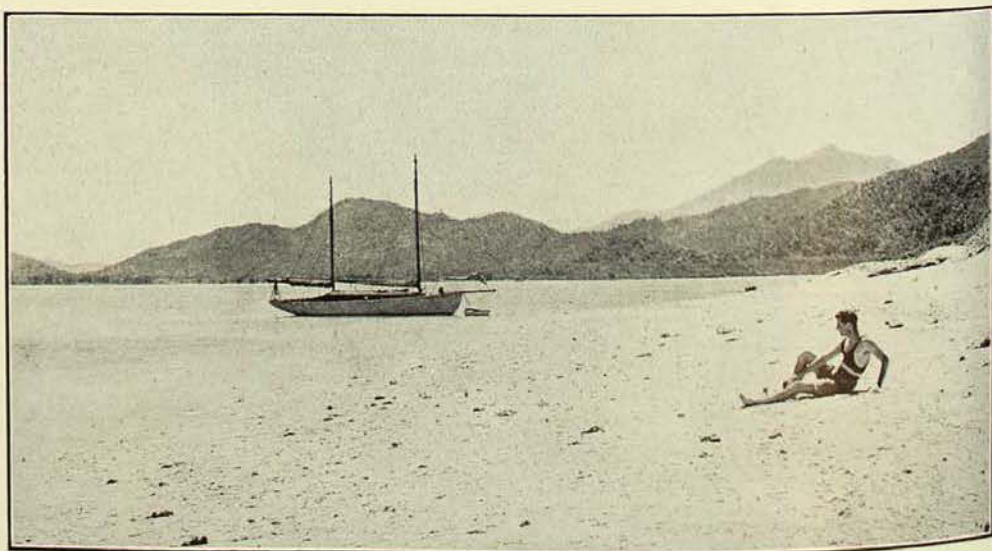
Miss S. M. Marshall, of the Scottish Marine Biological Association, co-operates with Mr. Orr in his investigations and these two scientists have written standard treatises in collaboration. By means of a centrifuge, Miss Marshall obtains a precipitated mass of the smallest organisms in a given sample of sea water and then counts them under the microscope, employing a very exacting technique demanding tremendous patience. Diatoms, which are very small aquatic plants, are Miss Marshall's speciality, and the relative abundance of the various oceanic and inshore species has been the main object of her investigations on Low Isles.

Dr. T. A. Stephenson, from the University College, London, is particularly keen on the study of the growth-rate and life-histories of corals. Some hundreds of pieces of living corals have been mounted on cement blocks and photographed beside a graduated rule from identical aspects, so that

all are portrayed to the same scale. After a year has elapsed, these blocks will be photographed again by the same means and definite knowledge of the growth-rate of the corals will be gained. The task of keeping the delicate corals alive and unbroken, the cataloguing of the coral blocks, their photography, and their deposition in very carefully selected parts of the lagoon, constitute work of considerable magnitude, and Dr. Stephenson frequently worked from dawn to after dark, day after day, to complete even the initial preparations. Nevertheless, successful results are hopefully anticipated and eagerly awaited. Mrs. Stephenson is also employed in zoological research, the breeding habits of various types of marine animals receiving her attention. In a cool place near the laboratory, there are many kinds of live young animals in jars, dishes, and finger-bowls. Of these, "Angeline" and "Beatrice," a couple of Blue

Swimming Crabs, have yielded interesting results.

The botanist of the party, Mr. Geoffrey Tandy, of the British Museum (Natural History), is engaged in investigating the breeding of algae and the collection and identification of species. Every marine plant, from the minute algae which form a "sea-sawdust" as they teem in millions in the water, to the stately mangroves on their



The expedition's launch, "Luana" anchored at Snapper Island. On the mainland, the heights of Alexandra are seen in the background and the Daintree Valley on the left.

[Photo.—W. Boardman.]



arched roots, claim his expert attention. Whereas most of the members of the expedition are photographers, Mr. Tandy is also a cinematographer, and has exposed many interesting films dealing with the work of the expedition and the curiosities of reef life.

Mr. Guy W. Otter, from Cambridge University, is specialising in the study of the life-histories of marine boring organisms, and has placed, with unremitting energy, many slabs of stone and pieces of wood in selected positions on the reefs to catch shipworms and other boring molluscs together with their crustacean associates. His work is of considerable economic importance, as the damage done by these animals in harbour structures and wooden ships is colossal.

The geographical side of the expedition's work is being performed by Messrs. J. A. Steers and F. M. Spender of the Royal Geographical Society.

Two Australian university graduates are attached to the expedition. Mr. F. W. Moorhouse, of Brisbane, is investigating the life-histories of the Trochus or pearl button shell, mangrove and rock oysters, bêche-de-mer, and other animals of commercial value. Mr. Aubrey Nicholls, of Perth, assists Dr. Yonge in his intricate and difficult work of examining extremely small objects, such as the living cells of coral tissues, and in the study of the bio-nomics of the pearl oysters.

A seaplane of the Royal Australian Air Force took aerial photographs of Low Isles and the adjacent reefs. From these has been made a large mosaic giving a bird's eye view of the whole field of investigations, and upon this future work in the mapping out of the distribution of marine life in various zones will be based.

The present article is the introduction to a short series describing and illustrating some of the more interesting invertebrates, fishes, and other features of Low Isles.

---

Among recent visitors to the Museum may be mentioned the following :—Mr. V. Bent, Manager of Lever Brothers' Estate, British Solomons, who is interested in ethnology, and who, on his return to the islands, will endeavour to secure specimens for our collection ; Mr. J. Thomas Peet, member of the Historical Society of Western Australia, seeking information on the early history of his State ; Mr. E. V. Knapp, Nelson, New Zealand, worker on Maori flake-work ; Mr. Keith Kennedy, student of primitive musical instruments ; Dr. R. Hamlyn Harris, City Entomologist, Brisbane.

During October, the Rev. R. T. Wade, M.A., The King's School, Parramatta, worked at the Museum studying fish skeletons.

On 15 October Miss M. Deer, B.Sc., Teachers' Training College, Sydney University, brought a party of students to the

Museum, and inspected the exhibits, especially the section of Australian mammals.

The five members of the Museum staff, Messrs. F. A. McNeill, T. Iredale, G. P. Whitley, A. A. Livingstone, and W. Boardman, who were detailed to work on the Great Barrier Reef, with the British Expedition under the leadership of Dr. C. M. Yonge, have now returned to the Museum bringing a large and varied collection of specimens secured on the Reef.

Mr. W. W. Thorpe, Ethnologist, has recently classified and arranged the flaked stone implements in the Department of Geography, Sydney University.

The Anthropological Society of New South Wales held its inaugural meeting on November 8th in the Museum Lecture Hall, when Dr. W. L. Warner lectured on his recent investigations among the aborigines of Arnhem Land.

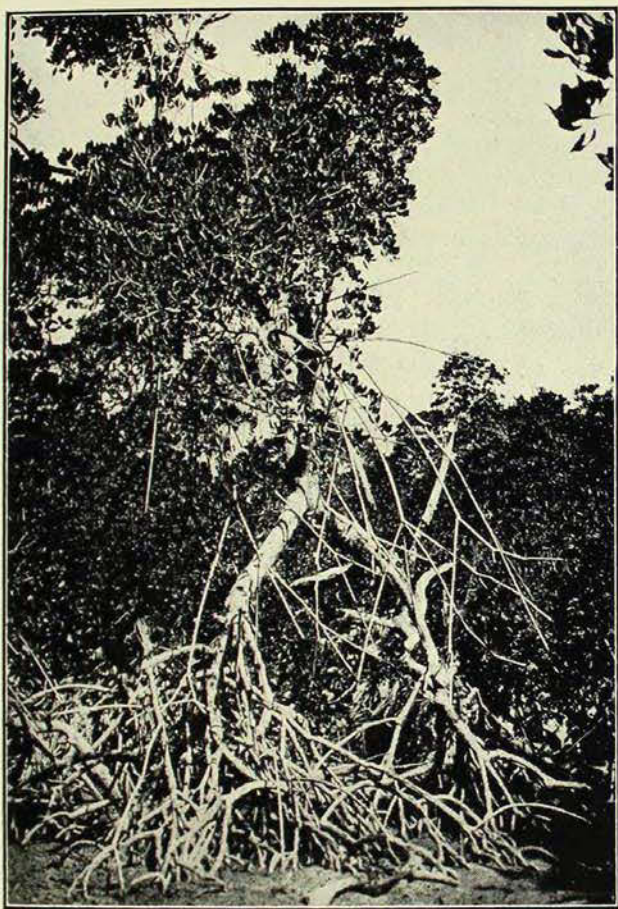


## The Lure of a Mangrove Swamp.

BY ANTHONY MUSGRAVE.

IN a recent number of *Punch* Topsy, M.P., writing to a friend from Jamaica says, "have you ever been in a mangrove

He writes, "It has been the fashion to regard a mangrove swamp as a noisome, repulsive, and unpleasant place. But I find it pretty, interesting, and attractive. Looking down from a hilltop, the mangrove swamp stretches below like some vast green meadow, and if the tide be full the green is veined with silver. Transported to the silver streak one may row up a long green lane hedged in by walls of dense and glossy foliage."<sup>1</sup>



The Red Mangrove, *Rhizophora mucronata*, growing at Low Isles, N. Queensland. The aerial and arching roots are here seen to advantage.

[Photo.—W. Boardman.]

swamp, my dear. Nature at its most revolting . . . if you can imagine the *smelliest* forest merely growing in a *deep* drain, and of course the *most* emetical *red* and *black* crabs quite clambering about the branches, my dear *too* nephritic." To offset this delightfully harrowing description we may turn to a presidential address of the late Charles Hedley to the members of the Australasian Association for the Advancement of Science, and read the opinion of one who had "delightful recollections" of the strange fauna and flora of a mangrove swamp.



Seeds of *Rhizophora mucronata*, attached to a tree growing at Low Isles, off Port Douglas, N. Queensland.

[Photo.—W. Boardman.]

In this article I hope to prove myself a true disciple of a man who has done so much to enrich our knowledge of the mangrove swamp, by endeavouring to dispel the miasma of ignorance and prejudice which envelops the minds of many of Topsy's constituents.

<sup>1</sup>Hedley, *Rep. Austr. Ass. Advanc. Sci.*, 12th Meeting, Brisbane, 1909 (1910), p. 341.





"Fair Girls and Grey Mangroves." The arching and twisted limbs of these trees afford delightful subjects for the artist, and conceal many interesting problems for the biologist. This picture taken at Middle Harbour, Port Jackson, shows an *Avicennia* at low water with seedlings and pneumatophores clustered about its base.

[Photo.—A. Musgrave.]

Before touching on the animal life to be found among the mangroves, the plants themselves claim our attention.

What are mangroves? Mangroves are evergreen trees or shrubs occurring in salt-marshes and along sea-coasts in tropical and sub-tropical regions throughout the world. The origin of the term "mangrove" is hidden in obscurity. About fifteen different kinds of mangroves have been recorded from Australia, and these are included in no less than eight distinct orders of plants. Most of our Australian species occur in Asia, and some extend to America. It has been suggested by Saville-Kent in his *Naturalist in Australia*, that the term "mangrove" would be more fittingly restricted to the plants of the order Rhizophoraceae, so it is with this group that I will deal first.

#### EXPOSED ROOT-BEARING MANGROVES.

The Rhizophoraceae, or exposed root-bearing mangroves, constitute plants almost entirely tropical in their distribution and occur in Asia, Africa, America, and Australia. These trees or shrubs are characterised by having opposite leathery leaves and the flowers in small clusters. The four genera *Rhizophora*, *Bruguiera*, *Ceriops*, and *Carallia*, have representatives in Asia and some of these extend down into Australia. They are tropical plants occurring in salt-marshes, and, with the exception of *Carallia*, their seeds when they fall from the tree are in an advanced stage of germination, a state known as "vivipary" and a mangrove characteristic, and one which Strasburger in his *Text Book of Botany*, states, "is to be regarded as an





*Bruguiera rheedii* growing at Moreton Bay, Queensland. The woody "knees" are conspicuous in the foreground.

[Photo.—C. T. White.]

oecological adaptation to the conditions of life."

The outer wall of the seed is split by the radicle or future root of the embryo which first grows from the attached end of the seed. This radicle may measure thirty-nine inches in *Rhizophora*. Its lower portion swells to a certain extent and the embryo hangs by the seed leaves or cotyledons until, as a result of its weight, it separates from the tree and falls into the soft mud or into the sea. Should it chance to fall into the sea it may at length be deposited on a neighbouring mud-bank where conditions are favourable for its future development, or it may be swept out to sea to perish.

Stilt-roots, or respiratory roots, are developed by these mangroves on the lower part of the tree; these arch and branch, forming a complicated network, which anchors the tree in the mud in which it grows. Aerial roots are given off from the main branches, and grow towards the mud.

The genus *Rhizophora* includes three species, two in Asia, and one in Australia. The Red or Orange Mangrove, *Rhizophora mucronata*, is the only species of the genus in Australia. Its bark has been used extensively for tanning, as it has been estimated to yield from 28 to 40 per cent. of tannin. It is the dominant form at Port Curtis, Yeppoon, and at many other places along the coast of north Queensland. The tree derives its specific name of *mucronata* from the leaves, which are mucronate, each leaf having the mid-rib produced into a little

hard, sharp, point. This point is usually absent in older leaves.

A near ally of *Rhizophora* is the genus *Bruguiera*, which includes four species in Australia, though two of these, viz., *Bruguiera rheedii* and *B. gymnorrhiza* are considered by some botanists to be one and the same species. *B. rheedii* extends down into northern New South Wales, and leaves of this plant collected by Banks and Solander in 1770 are preserved in the herbarium in the Sydney Botanic Gardens. This tree, which is also called the Red or Orange Mangrove, is remarkable for the hard, woody projections or "knees" which it sends out some distance from the stem and which are covered with



A specimen of the Black or River Mangrove, *Aegiceras majus*, growing at Port Hacking, N.S. Wales. Note the rounded apices to the leaves. The pneumatophores in background belong to a nearby *Avicennia*. [Photo.—A. Musgrave.]

breathing apertures. *Rhizophora* may be distinguished from *Bruguiera* by the lobes of the calyx of the seeds. In *Rhizophora* there are four calyx segments, in *Bruguiera* from eight to fifteen.

The Buttressed Mangrove, *Ceriops can-dolleana*, which ranges from Asia to Moreton Bay, Queensland, relies on buttresses for support. Mr. Francis, Assistant Government Botanist of Queensland, has pointed





Grey Mangroves, *Avicennia officinalis*, growing at Patonga Creek, Hawkesbury River, N.S. Wales. Their branches are so orientated to shade the pneumatophores which extend for some little distance from the stem.

[Photo.—A. Musgrave.]

out that, with the exception of *Ceriops*, all the Queensland buttressed trees are rain-forest trees.

Another interesting inhabitant of a mangrove swamp is the Milky Mangrove or River Poison Tree, *Excaecaria agallocha*, a member of the family Euphorbiaceae, occurring from New South Wales to northern Australia. According to the late J. H. Maiden<sup>2</sup> when an incision is made in the bark, a milky white sap exudes, and this is so volatile that no one can gather a quarter of a pint without being affected by it. The symptoms are said to be a burning sensation in the throat, sore eyes, and a headache. A single drop falling into the eyes is said to cause blindness. It is stated that the natives of eastern Australia, as well as those of New Guinea, use this poisonous juice to cure leprosy, but "in Fiji the patient is fumigated with the smoke of the burning wood." In India the sap is called "tiger's milk" and is applied with good effect to inveterate ulcers.

#### THE MANGROVES OF PORT JACKSON.

Coming south to Sydney we meet with only two species of mangroves, the White or

Grey Mangrove, *Avicennia officinalis*, of the order Verbenaceae, and the Black or River Mangrove, *Aegiceras majus*, of the order Myrsineae.

The River Mangrove is also found at Port Hacking and at Bateman's Bay, which is probably the southern limit of its range, but the Grey Mangrove occurs along the coast around Australia, but not in Tasmania. The River Mangrove ranges from Ceylon and India through the Malay Archipelago to Australia and the islands of the Pacific. It is a tall bush about six feet or more in

height, with glossy-green foliage and red branches. Its leaves are at once distinguished from those of the Grey Mangrove by the rounded apices, and are remarkable for the fact that in the early morning they are covered with salt-crystals secreted by special glands. The roots of the River Mangrove, unlike those of the Grey Mangrove, do not extend very far from the plant, and pneumatophores or "cobblers pegs" are absent, but the roots sometimes run over the surface of the mud for some distance, or may be raised into knee-like projections similar to those of *Bruguiera*. In the roots is a special air-storing tissue which connects with large pneumathodes.

The flowers of the River Mangrove are white and sweet-smelling, and attract numerous insects. The seeds of this plant are horn-shaped, hence the generic name, *Aegiceras*, which means "goat's horns." The seeds are viviparous, germinating on the tree.

#### THE GREY MANGROVE.

The White or Grey Mangrove, *Avicennia officinalis*, has formed the subject of an interesting paper by Mr. R. T. Baker,<sup>3</sup>

<sup>2</sup>Maiden, *Useful Plants of Australia*, 1889, p. 187.

<sup>3</sup>Baker, *Journ. Roy. Soc. N.S. Wales*, xlix., 1915, p. 257.



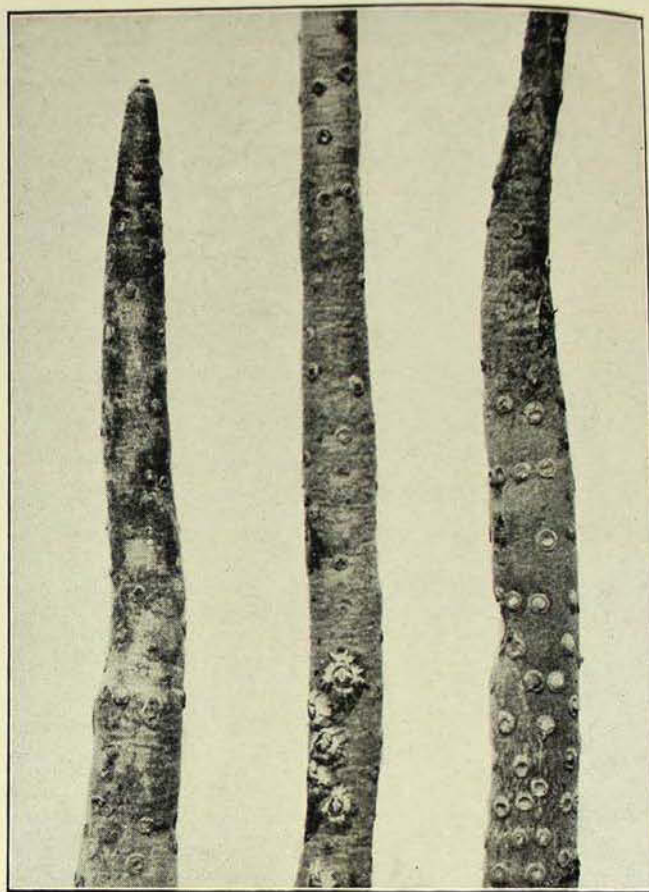
and most of the information I have gleaned about this plant has been derived from this source. The late Charles Hedley,<sup>4</sup> Mr. A. A. Hamilton,<sup>5</sup> and Miss M. I. Collins<sup>6</sup> have contributed much that is interesting to the ecology of this plant.

In sheltered land-locked bays, and on the banks of tidal streams the Grey Mangrove flourishes in the soft black mud. It grows to a height of about thirty feet, and the trunk is usually short and gives off twisted branches which are densely clothed with grey-green leaves which throw a dense shade. The leaves are opposite and pointed. The upper side of each leaf is glossy, the under side covered with short yellowish-coloured hairs. On the upper side of each leaf are numerous little pits, which Mr. Baker found "to be quite different morphologically from what obtains generally in stomata," and "efforts were next made to find out what functions other than those which usually obtain with leaves, are performed by those of this mangrove. Studying the trees carefully in their native habitat it was noticed that the stems almost invariably were inclined at an angle (more or less acute) with the foreshore. It was at first thought to be due to prevailing winds, but this, however, was found not to be the cause. Next, it was observed that the leaves of all the trees were disposed towards the north—a case of heliotropism apparently, and the question naturally arose, why? The answer came in the observation that by such an orientation, the pneumatophores were in shade, and so it worked out that the directing influence was to shade these breathing organs, and in order to get this protection, the stem, but more often the branches, grew in whatever direction this shade was obtainable. It was also noted that wherever the breathing roots became exposed for a length of time to the sun's rays, they perished, and then the branches on that side of the tree died and fell off—a truly botanical sympathy. Judging from the structure, the storage of a large amount of water is also an important function of these leaves."

<sup>4</sup>Hedley, *loc. cit.*, p. 15.

<sup>5</sup>Hamilton, *Proc. Linn. Soc. N.S. Wales*, liv., 1919, p. 363.

<sup>6</sup>Collins, *loc. cit.*, xlv., 1921, p. 376.



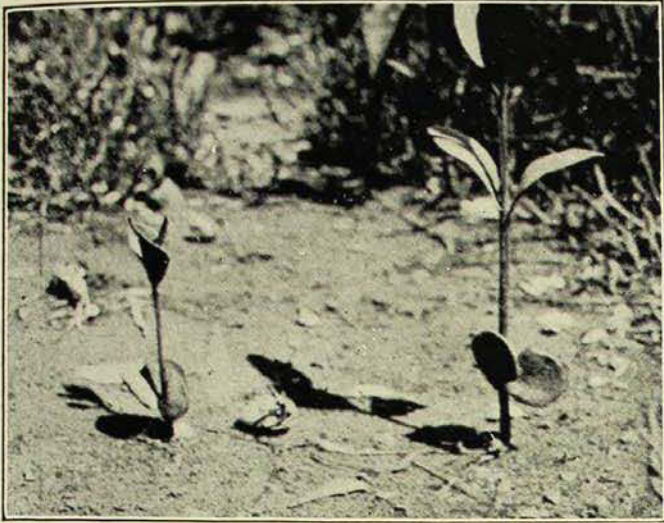
**Pneumatophores or "cobbler's pegs" of the Grey Mangrove showing the pores or pneumathodes which admit air to the root-system.**

[Photo.—A. Musgrave.]

The method of respiration in mangroves provides one of the most interesting features of these plants. According to Saville-Kent, the true interpretation of the function of the pneumatophores of *Avicennia* was first made by Dr. J. Bancroft of Brisbane, for in a paper read before the Australasian Association for the Advancement of Science for 1887, he gives an account of the breathing roots of *Avicennia*, as well as of those of other mangroves.

The asparagus-like pneumatophores of *Avicennia* grow upwards from the horizontal roots and project for about eight inches above the mud. Each pneumatophore is about the thickness of a pencil and its surface is covered with rounded pores called pneumathodes, which admit air and which communicate with a system of air-passages in the roots. These pneumathodes vary somewhat from the lenticels of plants which maintain a gaseous interchange between the outside and the gases present in the intercellular spaces of the plant. Dr. Bancroft noticed a white powder floating on the





Seedlings of the Grey Mangrove growing at Middle Harbour, Port Jackson. The seed-leaves are still attached and a seed with developing roots lies between them.

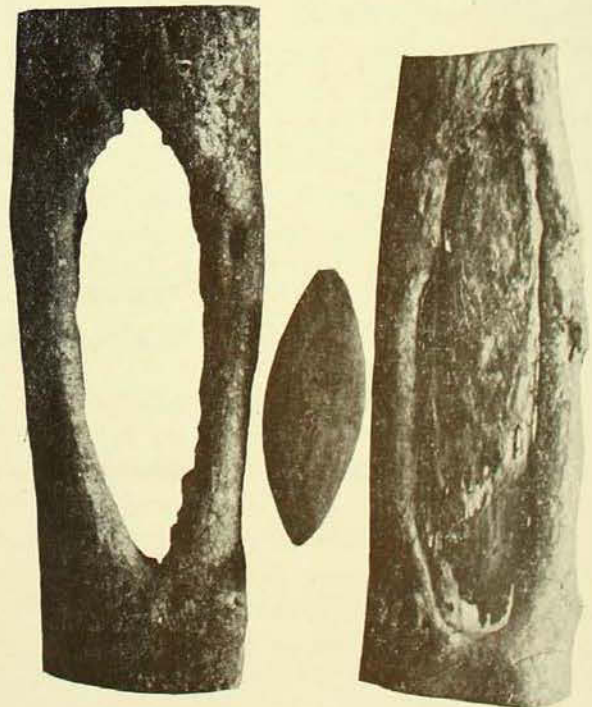
[Photo.—A. Musgrave.]

surface of the water among the Grey Mangroves, and on closer inspection found that it issued from the pneumatophores. To ascertain the function of these organs the doctor tried a simple experiment. He tied a rubber bulb to the cut part of the root and immersed the aerial portion in water. On compressing the bulb, "air was found to issue freely from the pores, and at no other parts." The function then of the pores, he considered, was "to supply air to the root-system of the mud-inhabiting *Avicennia* tree; the office of the discharged powder being to establish communication between the air vessels of the plant and the outer atmosphere by bursting open the cuticle of the root." The pneumatophores may be regarded as serving the purpose of preventing the horizontal roots, which are always in soft mud, from becoming waterlogged.

The pneumatophores are considered to constitute important factors in building up the land, as they retain all debris like a comb and so cause a gradual increase in the surface depth of the mangrove swamp. Though the pneumatophores of the Grey Mangrove grow only to a height of about eight inches, there is a mangrove occurring in Queensland called *Sonneratia alba*, a member of the order *Lythrarieae*, which has pneumatophores attaining to a height of six feet and measuring about four inches in thickness at the base.

The viviparous fruits of the Grey Mangrove have flattened capsules which consist of two thick valves one of which is seeded. The fruit falls on to the mud and there sheds its outer skin or pericarp, and the stem "begins to grow beyond the bunch of simple hairs or blunt ending, from which roots are sent at varying angles."

The timber of the Grey Mangrove has been shown by Mr. Baker to be of considerable interest. It is "pale-coloured, very hard, heavy, cross laminated timber." It is used for boat-building. According to Mr. Baker, the wood cannot be split radially, though tangentially it is more easily split than other timbers. This is due to the peculiar structure of the wood, which somewhat resembles three-ply wood, the fibres not extending vertically upwards but diverging. The fissile nature of the wood was known to the Australian aborigines, and they obtained their shields or helimans almost entirely from this tree. The methods they employed have been described by the late Thomas Dick of Port Macquarie,<sup>7</sup> and the various phases photographed.



Aboriginal shield scars on portions of trunk of Grey Mangrove in the Australian Museum Collection, together with a shield.

[Photo.—G. C. Clutton.]

<sup>7</sup>Dick, *Journ. Roy. Soc. N.S. Wales*, xlix., 1915 (1916), p. 282.



Examination of a transverse section of a mangrove trunk shows that the annual rings are not continuous, the break being caused by the intrusion of another circle. Mr. Baker has stated that, as the mangrove must carry an ample foliage to shade its pneumatophores, it requires the maximum of strength in its trunk to support the weight of foliage and to resist tides and currents and it acquires this strength by the peculiar cross-lamination.

#### A SYDNEY MANGROVE SWAMP.

The ecology of the mangrove swamps near Sydney have been dealt with by the workers previously mentioned. Two zones may be recognised in a tidal marsh near Sydney, (1) an outer, tidal, woodland or mangrove formation, (2) an inner salt-marsh formation. The first zone consists of the Grey Mangrove and the Black Mangrove. The second zone is divided into two distinct plant associations, an outer one in which the Glass wort or "samphire," *Salicornia australis*, and *Suaeda australis* are the dominant plants, and an inner area on the landward limit of the marsh characterised by the rush, *Juncus maritimus*.

Thus if we proceed into a mangrove marsh near Sydney from its seaward side, we encounter first the large trees of the Grey Mangrove, behind them the Black Mangrove bushes, next we come to the Samphire flats, then to the area occupied by the rush and finally we arrive at the fluvial zone where the Swamp Oak is the

dominant plant, and which marks "the encroachment of fresh-water conditions upon brackish and saline." These zones overlap to a certain extent in different localities. Dwarf forms of the Grey Mangrove occur at such localities as Port Hacking, Botany Bay, and Homebush Bay, Port Jackson. These stunted forms may measure only about a foot in height and give off lateral branches which extend parallel with the ground. Mr. Hamilton has attributed their stunted form to dilution of the tidal waters by fresh water from inland drainage channels. The Black Mangrove is comparatively rare about Sydney, the Grey being the dominant form. Mr. Hamilton has pointed out that "the various formations, by collecting soil and debris, finally raise the marsh until it becomes unfitted for their further occupation and are eventually destroyed by the conditions in whose production they have played such a prominent part."

Only a few of the mangroves occurring in Australia are mentioned in this article, and these have been treated all too briefly. To the papers to which reference has already been made, I refer those who care to pursue the subject further.

While the object of this article is primarily to attempt to dispel the prevailing conception that a mangrove swamp is "too nephritic" a place entirely devoid of interest, at the same time it is hoped that the information garnered from the works of various scientific workers may prove of some service to those who already know something of the lure of a Mangrove Swamp.

---