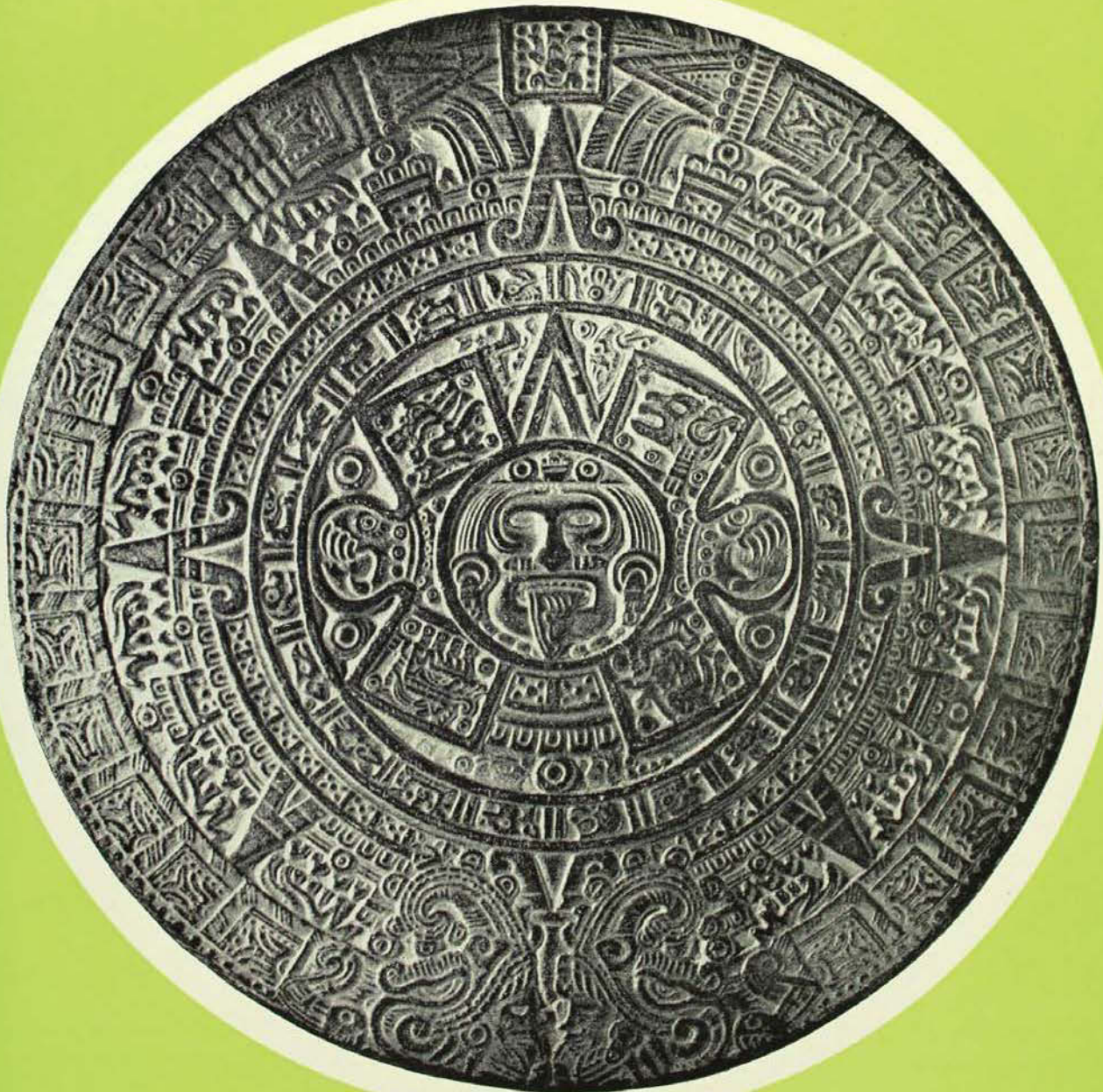


*The*  
AUSTRALIAN  
MUSEUM  
MAGAZINE

Vol. VI, No. 3.

JULY-SEPTEMBER, 1936.

Price—ONE SHILLING.



The Aztec Calendar Stone.

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*Photography, unless otherwise stated, is by G. C. Clutton.*



*THE AZTEC CALENDAR STONE.*

*A small scale replica of the famous Aztec Calendar Stone, presented to the Trustees of the Australian Museum by Mr. E. J. Bryce, F.R.G.S., to whom the Museum is deeply indebted for many acts of generosity.*



*Published by the Australian Museum . . . . . College Street, Sydney*

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VOL. VI, No. 3.

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## The Aztec Calendar Stone

THE Mexican Indians, on arrival of their Spanish conquerors in 1519, were found to be in possession of a method of measuring divisions of time quite comparable to that obtaining in Europe at that period. The device is represented in the famous Aztec Calendar Stone engraved within a circle eleven feet in diameter and weighing over twenty tons.

This elaborately carved stone disk is in reality not only a calendar but also an Aztec history of the world, a prophecy, and a record of Aztec myths. It is characteristic of the conventionalized art developed by these people. The sculptured figures, which at first appear complicated, consist of symbols and glyphs arranged about the central figure of Tonatiuh the Sun God, with the symbol Olin, a sign signifying an earthquake. The historical portion is divided into five suns or ages, four of the past and one of the present. The present age or period is dominated by the existing sun symbol Olin-Tonatiuh because the earth, according to the Aztec prophecy, is destined to be destroyed by earthquake. Arranged about the symbol Olin are the four past

suns or cycles, each enclosed in a rectangle and designed to be read from right to left. The first of these symbols is Ocelotl or the Jaguar, the next Ehecatl or the Wind, the third Quiahuitl or Fire-Rain, and the last Atl or Water. The interpretation of these symbols is that the first sun or epoch was destroyed by jaguars, the second cycle or sun by hurricanes, the third by a rain of fire, and the fourth by a flood. Next comes the present epoch, which, it was believed, would end in earthquakes.

Outside the historical portion of the stone are the twenty day symbols. Surrounding all are two reptilian monsters meeting face to face and with their tails at the top of the stone; these are the two Turquoise Snakes and the symbols of fire and water. In the mouth of each is a human head representing the Fire God Xiuhtecuitli, who was also Lord of the Year.

The Aztecs adjusted their civil year to correspond with the solar year. They divided it into eighteen months of twenty days each, and each day had a distinct name. Five supplementary days were added to make up the full number of

three hundred and sixty-five, as in ancient Egypt; they belonged to no month, and were regarded as particularly unlucky. The Aztecs, and perhaps their predecessors the Toltecs, realized that the year actually lasted six hours longer than three hundred and sixty-five days, and, with astonishing precision, accounted for this period by intercalating twelve and a half days each fifty-two years—a nicer adjustment of civil to solar time than allowed by modern calendars.

At the end of each cycle a great festival was held, which took the form of a national jubilee celebrating the rejuvenation of the world. As we have seen, the traditional belief was that the world had been destroyed at four successive epochs, and, at the end of each subsequent cycle, another such catastrophe was expected, when the darkness of chaos would settle over the habitable globe. The five unlucky days

which closed this period fell in the dreariest season of the year, and the people, taking their cue from nature, abandoned themselves to despair. They destroyed all their possessions, dismantled their homes, and extinguished their hearth fires. In the gloom of the last evening they followed the procession of priests to a lofty mountain two leagues from the capital, silently to await the kindling of the "new fire". This was accomplished upon the breast of a living captive, and, if the flame sprang up immediately, it was an augury to the watching multitude that the world would be spared for another great span of years. Then followed the sacrifice of the captive, the spreading of the new fire by means of torches throughout the country, and, finally, glorious days of revelry and rejoicing to usher in the new epoch.

E.B.

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SPIDER WONDERS OF AUSTRALIA. By KEITH C. McKEOWN. (Angus and Robertson, Limited, Sydney.) Svo, xiv + 270 pages, 17 plates. 6s.

In comparison with the insects and many other invertebrate classes, the spiders have been much neglected by zoological research workers, particularly with regard to the bionomical and experimental aspects. Up to the present, no comprehensive work, of either a popular or scientific nature, dealing with the biology of Australian spiders has appeared. This popular account of their habits is therefore particularly valuable, not only to the general reader, but also to the zoologist. Considering the few Australian workers on this group, an amazing amount of field observation has been carried out; previous work has been very carefully collected by Mr. McKeown and incorporated with his own extensive observations, which extend over many years; the whole forms a very complete account of the habits of our spiders as they are known at present. The observa-

tions recorded raise many fascinating problems which still await exact scientific investigation, particularly with regard to the senses, tropisms and instinctive behaviour of spiders. Mr. McKeown shows clearly how the whole biology of spiders is intimately connected with their extraordinary powers of silk production, and gives a vivid account of the many diverse ways in which they utilize the silk for snaring prey, providing shelter, and constructing egg capsules. One of the most valuable and interesting sections is that in which the habits of the poisonous Red Backed and Funnel Web (Trapdoor) Spiders are described in detail. The symptoms arising from the bites of these spiders are described, and the method of treatment is outlined. It must be emphasized that this book is one which should prove absorbingly interesting to the general reader who has a leaning towards biological subjects; technicalities have been entirely omitted, and the frankly anthropocentric style of writing should insure its lasting popularity.

A.R.W.

# Birds that Dive for a Living

## Specialization in Many Groups

By M. S. R. SHARLAND, R.A.O.U.\*

**A** MOST interesting fact which emerges from a study of birds is that so many groups have become adapted to special environments, which have demanded, and brought about, an endless diversity of form, structure, and mode of existence. Birds are most highly specialized creatures and show examples of adaptive modification in many ways. Beaks, bills, feet, and wings, as well as colour and form, have all been developed along lines to enable the owners to maintain life under the conditions which prevail in the haunts which they have selected as being most suitable for their needs. Each group has become modified in some respect to take advantage of every niche of opportunity in the great battle of life. There are birds which derive their principal food from the upper air, others from the forests, the plains and the ground; there are some that live by climbing trees in search of insects, others by descending the same trees; some feed on the nectar from the blossoms, others, again, pass these blossoms by to seek insects on the outer foliage. Many spend all their lives in the reeds of swamps and marshes, and others feed on the surface of the water and in its depths. Thus every "haunt of life" has become well tenanted by diverse forms, whose contribution to man's material welfare and enjoyment is almost beyond estimation.

### DIVING ADAPTATIONS.

A knowledge of birds further shows that adaptations and specialized feeding habits are not always confined to special groups or families, but that one particular way of feeding may be common to totally unrelated groups, each at some time having experimented independently

and, finding it profitable, adapted themselves accordingly.† This fact is apparent in a consideration of those species which derive their living by means of diving. Almost all of the divers are aquatic birds, but they are spread over a wide range of families, for between the gannet—the largest of the divers—and the little grebe, which is the smallest, there exists a particularly varied assortment of birds which inhabit rivers, lagoons, ponds, and the sea, and have to dive for their fish, vegetable, or insect food.

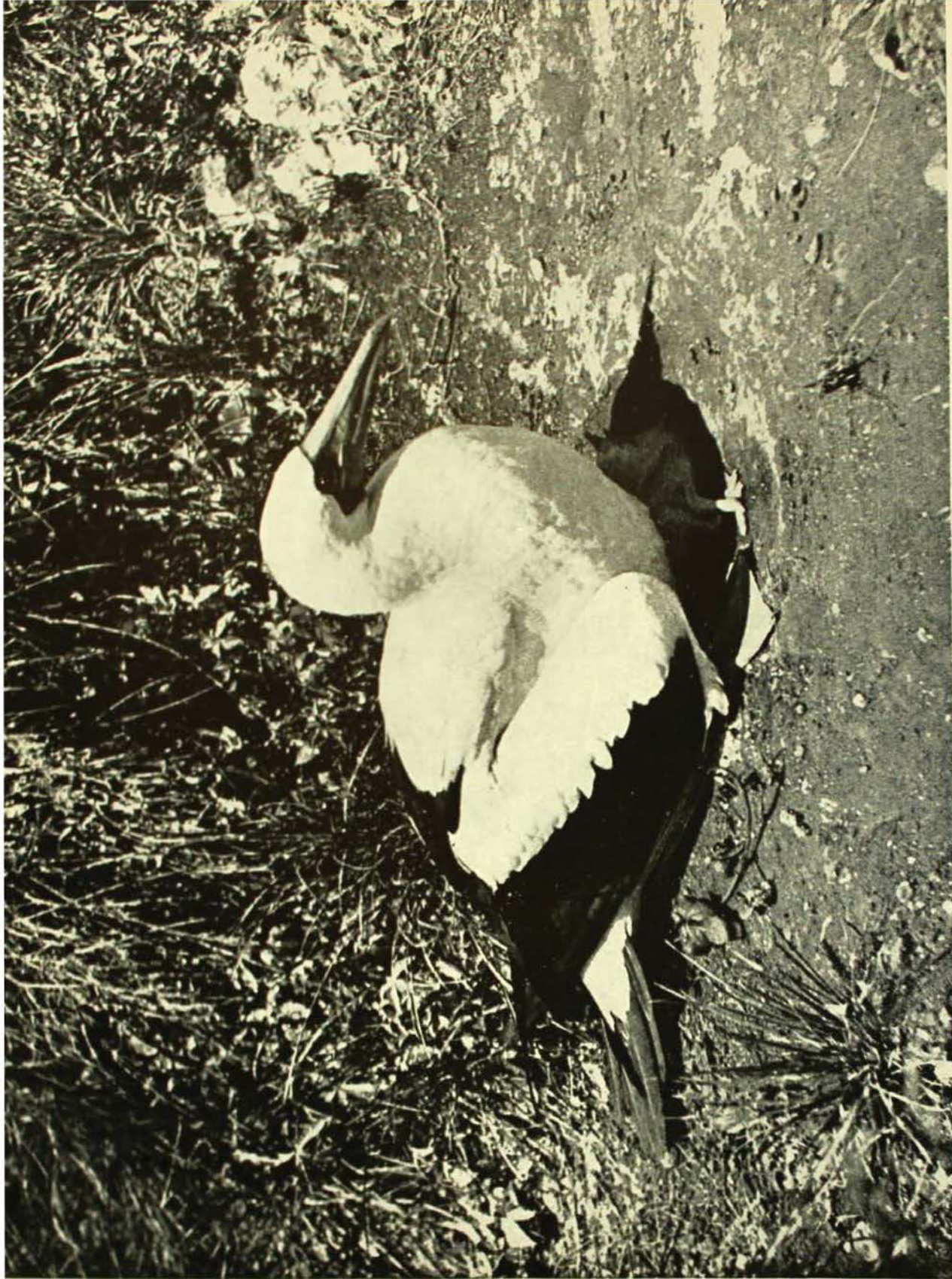
The freedom of the waters belongs to those birds which can pass freely beneath them; and it is won at a price. No first-rate diver is a competent walker. Most diving birds rise with difficulty from the water, though they may exhibit mastery of flight once aloft. In the penguin tribe, however, the power of flight has been lost. The wings, which are used habitually under water, have grown small and compact, and we know them as flippers. So agile is the penguin under water that it has been described, fittingly enough, as flying in this element. Though long ago lost to use for bearing the bird through the air, the flippers act as paddles which propel the little bird over a short distance almost as rapidly as a fast motor boat, and enable it to capture small fish and other aquatic food. Access to more food is the true diving bird's great gain, and, above all, to more fish food. The penguin ransacks the waters which the kingfisher and tern merely skim.

### THE GANNET.

Pride of place as a plunging or high-diving bird must be given to the gannet. By reason of its length of wing and

† It is to be understood that adaptation in animals is not the result of conscious striving, but of natural selection.

\* Photographs by the author.

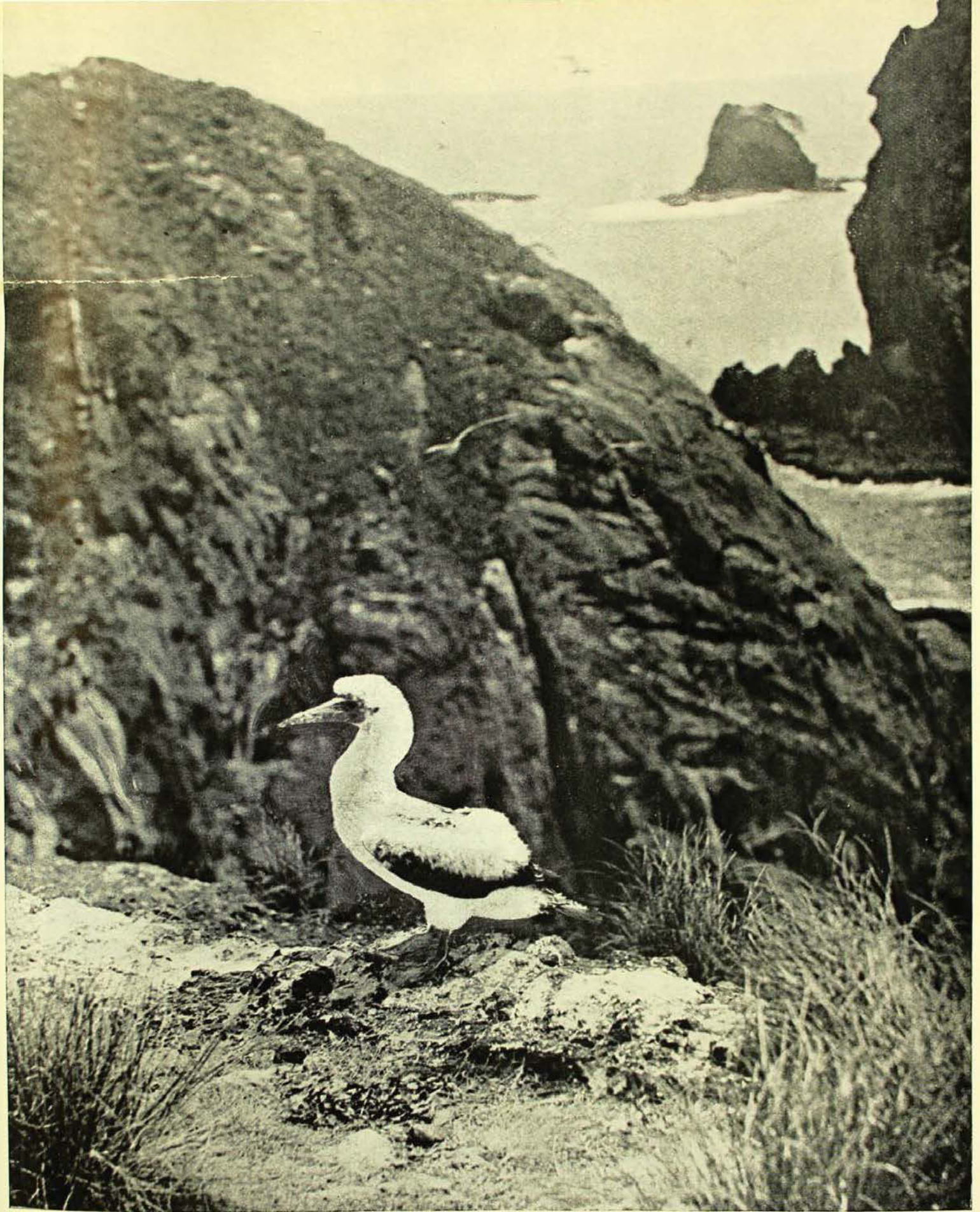


*The Gannet, the most notable of diving birds, lives on fish and other creatures of the sea. A thickened frontal bone in the skull enables it to withstand the impact with the water when diving from a height of one hundred feet or more.*

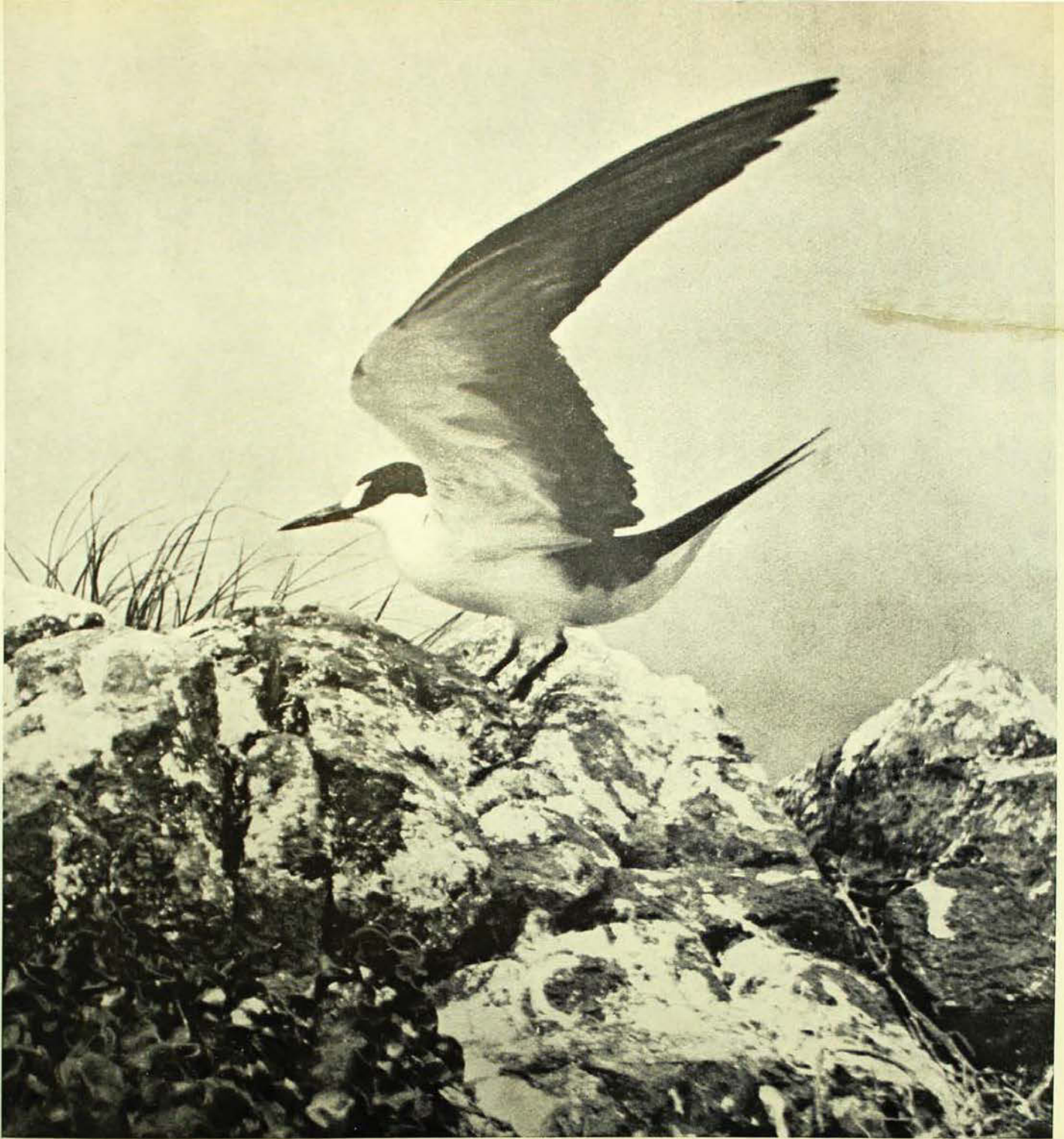
glistening white plumage, relieved by black wing tips, it is one of the conspicuous birds of the sea, and it frequently visits estuaries, for it likes to feed in quiet waters where its prey may be more easily obtained. As a high diver, it stands supreme. No other bird has attained to anything approaching its accomplishments, and no bird but the gannet could withstand the great impact with the water which occurs when dives are made from a height of a hundred feet or more.

Swerving suddenly when catching sight of a fish, the gannet drops headlong, with its wings open until a moment before entering the sea; the stout bill parts the water and the head and body enter with a splash that disperses spray for yards around, and the bird goes to a considerable depth. Once gripped with the serrated bill, a fish has little chance of escape, and it is almost invariably swallowed before the buoyancy of the diver causes it to shoot to the surface. A school of fish will





*A young Gannet, just before it begins to fly, is covered with a coat of down that gives it an attractive appearance and makes it look larger than its sleek-coated parents. This one was reared on a ledge overlooking the sea.*



*Most terns derive their living by diving, though they seldom go so deep as the gannet. This picture of the Sooty Tern shows the sharp bill and great length of wings. Their long wings can sustain them in extended flights.*

attract gannets from far and near. They dive at frequent intervals, but not always from a great height, and sometimes are so heavily gorged that only regurgitation of part of the meal enables them to rise from the water.

Almost any day the fishing habits of the gannets and terns may be watched from the coast. They are frequently in company of innumerable shearwaters, or mutton birds, which skim the water in their ceaseless, undulating flight. Gannets

and terns are those birds which dive from some height above the water. Cormorants, ducks, penguins and grebes are among those which dive while floating or swimming on the surface. All are well adapted to their particular mode of living.

#### TERNs.

Terns are clever fishers. They drop as fast and straight as a stone. With their rapier-like bills pointed to the water, they hover above a school of small fish, and,



*Fairy Penguin. The Penguins frequent the Australian coast and are clever swimmers. Their modified "wings" serve as paddles.*

if one should approach the surface, the birds are upon it without a moment's hesitation. Large fish, however, are not attacked, for the terns are comparatively small, and they can manage only sprats. There are a great many kinds of terns, and they are distributed over all the seas. In Australian waters we have them ranging from the powerful and strikingly handsome Caspian Tern, a bird with bright orange bill and red legs, to the diminutive Fairy Tern, a delightful little inhabitant of islands off the southern coast. In Sydney Harbour, the Crested Terns may be seen at any time, and it is possible to distinguish them by their black caps from the Silver Gulls, which, in flight, they somewhat resemble. In addition, their contour is different from that of a gull. They are much finer "cut", equipped with long narrow wings to support them in extended flight, long bills to catch fish, and rather short legs, which

have the appearance when the birds are at rest of being telescoped into the body. In general outline, a tern is not unlike a common House Swallow, having the same short legs and the swift and erratic flight, so that, with some justification, they are known to fishermen and others as "sea swallows". Terns may sometimes be seen hundreds of miles from the sea on large freshwater lakes, and some species are known to inhabit the centre of Australia and other inland areas, feeding on lizards and insects when their natural food is not available. Probably generations of those inland birds never see the ocean.

#### UNDER-WATER MOVEMENT.

Only recently has the subject of bird swimming been studied thoroughly. There has been much speculation on the relative movements of cormorants and penguins while fishing, and naturalists have not

been in agreement as to the way they swim. Observations which have been made in glass tanks by ornithologists in England show that the penguin, which depends absolutely on a diet of fish, progresses under water by means of its modified wings, each of which moves independently of the other, and the bird is

thus enabled to accomplish amazing turns in the water, these sudden changes in direction being necessary in order to facilitate the capture of speedy fish. During fast movements in a straight line, the penguin's feet are held out behind in order that they may not interfere with the stream-line of the body, but the feet

are used as a kind of rudder during turning movements, and are brought forward to act as a brake against the water whenever the bird wishes to stop its forward progress.

The cormorant, according to Mr. Neville Kingston, the English naturalist, progresses by movements carried out by the webbed feet, its wings being held tightly against its body; and during a great number of observations, he states, there has never been an attempt to use these wings in conjunction with the feet in the pursuit of food. During the bird's hunt for prey, both of the feet are kicked out at the same time in a way that resembles the action of a swimming frog, and this forward propulsion rarely varies as long as the cormorant is advancing directly towards its victim, but deviation from a straight line is accomplished by using each foot alternately. Unlike the penguin, which



*Little Grebe on its floating nest of reeds. All the Grebes are fine exponents of the diving art, though they are not plungers like the gannet and terns; they seek security under water rather than in flight.*

*The Sacred Kingfisher at the entrance to its nesting tunnel. Kingfishers nest in hollow trees or river banks, but they do not all live on fish.*

is able to consume its food under the water, the cormorant is obliged to swim to the surface before each fish can be swallowed.

As with the cormorant, the darter of inland streams swims only with its feet, the tail being sometimes used for steering purposes, the wings being held tightly against the body while the bird is submerged. The darter, according to Kingston, does not appear to be so fast under water as the cormorant, possibly because it does not have to catch its prey by speed alone, like the cormorant and the penguin, but can saunter towards its victim and suddenly dart out its beak on a flexible neck like an arrow from a bow.



There is at present no certain evidence of a diving bird having gone down below ten fathoms. Such evidence is, naturally, difficult to procure. The richest life of the sea is near the surface, where sunlight penetrates most freely. Though the cormorant has the credit of being one of the deepest divers, it finds much of its food close to the surface.

Among the ducks there are certain species which derive their living by diving, and they are readily distinguished from the surface-feeders, for they float heavily on the water compared with the others; as a rule, they drag their tails behind them, whereas the tail of the surface-feeder is usually held clear of the water, and in this respect the two types differ as distinctly as a motor boat does from a yacht. The Musk Duck is the most characteristic member of the diving duck group. It swims low in the water, and, in seeking food or security, disappears neatly below the surface, preferring submersion rather than flight. It dives both far and well, and with closed wings.

The grebes, of which there are three species in Australia—the Crested, Black-throated, and Hoary-headed—are highly specialized for diving and swimming, and these birds also rarely seek safety in flight. The whole structure of the body has become profoundly changed. They have lost their tails, their wings are no longer suitable for prolonged flight, the thigh has become so shortened as to bring the legs to the extreme end of the body, adding immensely to their efficiency as propellers, but making it extremely difficult for them to progress on land, which, indeed, they rarely attempt. We are apt to regard a webbed foot as essential to a water bird, but the grebes have dispensed with the web, and in its place have developed fleshy lobes along the toes, which serve the same purpose. On the other hand, bald coots, moor-hens

and other gallinules, which can swim well, have neither webs nor lobes. The grebes, however, are full of adaptations, and the rapidity with which they can disappear from the surface of the water has long been a source of astonishment and wonder.

Our list of diving birds is nearly complete. We have seen how diving has reached its highest form in the gannet and developed in different stages in the terns, and birds which have brought it down to the range of mere submersion. There are other birds which derive their food from below the water without either complete submersion or diving. The neck of the swan has become elongated to enable its beak to reach the bottom of shallow water, while the surface-feeding ducks stand on their heads, so to speak, with their tails out of the water, as they fossick among the roots of reeds and other aquatic growth. We would expect to see diving employed more widely by the kingfishers, but, in Australia, where there are ten species of these birds, fish form relatively a small part of their diet. Indeed, the kookaburras and forest-haunting kingfishers feed on insects, reptiles, and other inhabitants of dry land. It is chiefly the Azure Kingfisher that breaks the calm of quiet reaches along our rivers and estuaries, by plunging from an overhanging branch when a small fish swims within striking range, and sometimes the Sacred Kingfisher will revert to the habit; but in other countries, kingfishers are typical diving birds. In their habit of frequenting the bush in preference to water and consuming insects and reptiles rather than fish, the kingfishers of this continent afford an example of but one of the many evolutionary adaptations which have characterized the lives of birds in the past, and are still in operation.

# The Tuross River-

## An Entomological Paradise.



By Keith McKeown.

*Valley of the Tuross. View from the camp looking towards the coastal ranges.\**

DR. CHAS. ANDERSON has written inimitably of the delights of luring the wily trout from its watery haunts,† and the writer has related some of the mysteries of their diet.‡

The examination of the contents of hundreds of stomachs of trout under laboratory conditions in connection with the investigation of their feeding habits, has brought about the realization that, to secure the utmost value from the results obtained, it must be correlated with work carried out in the field, in order that some light might be cast upon a number of problems that had presented themselves in the course of the work. We knew fairly conclusively upon what insects and other creatures the fish were feeding, but from time to time remarkable changes would occur in their diet—changes for which we had no satisfactory explanation. It became necessary, therefore, to check up on the conditions in the streams themselves, and the insect fauna both of their waters and the vegetation fringing their banks.

An opportunity to carry out work in this direction occurred when, thanks to the kindness of Dr. A. J. Spiller Brandon, I was invited to visit his fishing camp on the Tuross River. It was owing to Dr. Brandon's keenness and industry that we had more complete information regarding the food of the fish in this stream than that of any other, so that the locality was eminently satisfactory for the purpose of the investigation.

All arrangements having been completed, and the appointed day having arrived, Dr. Brandon and the writer set out, the car heavily laden with what seemed an amazing assemblage of collecting and other gear.

The journey was without incident, and we arrived in the little town of Cooma in the darkness through a penetrating drizzle of light rain. Our night's stay in the town was not enlivened by the constant splash of rain upon the roof, which made one feel far from optimistic with regard to the prospects for the following day. Day dawned wet and unpromising, but saw us early on the move and further burdening the sturdy little car with supplies. This very necessary work com-

\* Photographs by the author.

† AUSTR. MUS. MAG., IV, 6, p. 185.

‡ AUSTR. MUS. MAG., V, 7, p. 233.

pleted, a start was made for the Tuross through scudding showers, but the day showed promise of clearing.

The road, in many places little more than a rough track, climbed steadily over the ranges until the divide was crossed, and finally the last ridge was behind us and the valley of the Tuross lay spread before our eyes. The "camp", a comfortable four-roomed cottage, stood upon the rising ground, with the river flowing among the trees at its foot; here we were welcomed by the two daughters of my host, Miss Bowman and Mr. J. Harnett, an ardent angler also attracted by the charms of the Tuross.

After lunch a start was made on collecting, for on such occasions there is no time to lose, as each day brings with it changing conditions, and with them insects which may not be encountered again. Due to the rains, the river was too high for work on the aquatic fauna, and remained so until a couple of days before my departure a week later. Such is the luck of the game, but it gave no excuse for idleness.

The district in the vicinity of the Tuross River had been practically unworked from the point of view of scientific collecting, and among the insects which abounded everywhere were many interesting, and possibly new, forms which found their way into my collecting bottles.

The banks of the Tuross River in the vicinity of the camp are fringed with tall gums, with a close undergrowth of seedling eucalypts and tea-tree. Christmas beetles (*Anoplognathus*) were swarm-

ing in the gums and flying lazily about in the sunshine, or falling ever and anon with a faint "plop" into the water below, to struggle for a few minutes before they disappeared, and an ever widening circle of ripples would show where some hungry trout had secured another trifle for its meal. The tea-trees, too, were filled with a buzzing population of smaller fry, metallic green *Diphucephala*, brown and black *Phyllotocus* of several species, a beautiful green click beetle, possibly new; but to give even a partial catalogue would exceed the limits of this article. Examples of almost all these insects were continually losing their footing, to fall into the water below to perish, seldom by drowning, but generally in the gaping maw of some brown or rainbow trout lurking in the cool green waters in the shadow of the bank for just such an opportunity. This activity was especially noticeable on a stretch of water known as "Nosey Bobs"—named after some great fish of the past, but now long since gathered to his forefathers, or into the



Dr. A. J. Spiller Brandon practising the "vertuous" art on a sheltered reach of the Tuross River.



bag of some patient angler. Who knows?

At Dyballs, where the stream turns almost at a right angle from Nosey Bobs, are quite extensive sand beds which lie shining and warm to the touch in the sunshine. Here were remarkably interesting Apiocerid flies resting on the hot sand or whirling madly in the air in ever recurring chases and excursions, which

The young gums on the river bank, too, had their special inhabitants—beetles, moths, leaf-hoppers, and others. Particularly worthy of note were the curious red longicorn beetles (*Macrones rufus*), with their elongated and slender bodies. These insects are so exceedingly wasp-like that one is inclined to pause before securing them; there is a feeling that one must not be precipitate in effecting their capture.

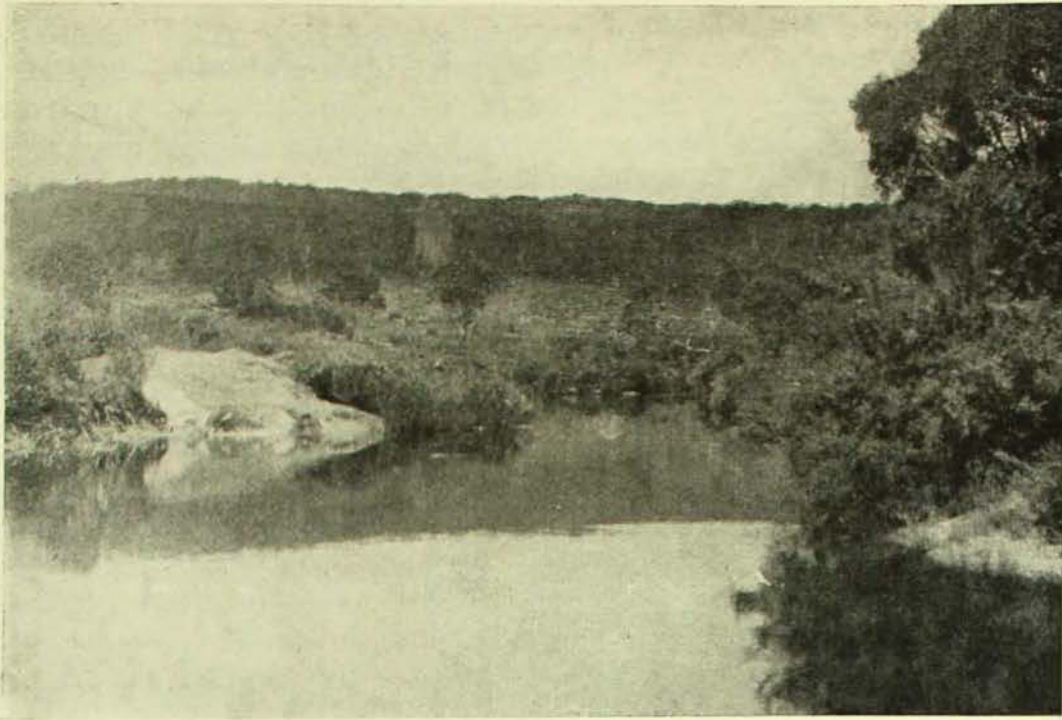
Warning coloration is not without its effect even upon man. Perhaps the most interesting of the denizens of the bushes was Lewis's Sawfly (*Perga lewisi*).

*Left: Part of "Nosey Bobs", showing the gums frequented by the Christmas Beetles, and from which they drop into the still water.*

*Below: A view of the Tuross River, showing the fringing tea-tree bushes frequented by many insects.*

were evidently part of an elaborate courtship. These sand beds, with their scattered patches of wiry reeds, were always of unfailing interest to the watcher, for here was a little world where life was lived at a feverish pace, with love, hunger, and warfare all in evidence. Robberflies (*Asilidæ*) of several species rested on the reeds awaiting their opportunity to impale some unfortunate beetle or Apiocerid fly with their sharp beaks and suck its juices. Sand wasps dug their burrows in the heaped mounds, sending jets of the clean white sand flying behind them as they dug, and when the burrow was prepared they stocked it with the paralysed bodies of spiders snatched from their webs among the tangled undergrowth. Foraging ants prowled everywhere on the search for unconsidered trifles.





*One of the deep pools on the Tuross River, the haunt of big trout.*

Upon almost every gum seedling were one or more of these curious wasps, each resting motionless upon the surface of a leaf, firmly braced over the long swollen scar where its eggs had been deposited in the leaf-tissue, or, when the eggs had hatched, and the tiny brownish-black larvæ were feeding upon the surface of the leaf, the mother still stood guard over them like a hen over her chickens. She would staunchly resist all efforts to frighten her from her vigil; at most she would only raise her wings, buzz, and open her jaws menacingly — but it was all bluff. Pick one up in the fingers; she could do no harm; replace her upon the leaf, and

broken down their resolution and devotion. Along the river banks and in swampy low-lying areas dragonflies were

she would at once hasten to resume her interrupted guard—nothing mattered but the safety of her brood. So staunch were these little mothers that, when a number of them were secured and packed in a tin with their accompanying leaves and brought to Sydney for the purpose of making colour sketches of the living insects, each on arrival was found to be still holding her post; darkness, confinement and the jolting of their prison had not



*The old house whose surroundings formed an "island" in the surrounding country.*

exceedingly numerous, flitting over the surface of the water with quick jerky movements, dipping the tip of the abdomen beneath the surface as they deposited their eggs, while other species accomplished the establishment of their families by crawling down the stems of the reeds or other aquatic plants and depositing their eggs in slits cut in their soft tissue—an occupation which ended fatally for many, since the opportunity was too tempting to be missed by the voracious fish. The stout brown nymphs of the bulky Agrionid dragonflies, known as “mud-eyes” to the angler, crawled and hid in the rotting leaves and vegetable matter in the backwaters of the stream, while the slender Zygopterid nymphs frequented the more open and gravelly stretches.

As soon as the level of the river had fallen sufficiently to permit the work, dredging and netting were carried out in different sections of the stream. As mentioned above, the nymphs of the dragonflies were found in different situations, and such was also the case with the curious little caddis-worms, which crawled laboriously among the weed, or dragged their cases over the gravelly bottom; the conditions that suited one species were apparently quite unfavourable to another, so that the stream was portioned out between the different species with little overlapping, so avoiding excessive competition among them. During the course of the investigation of trout food in previous years, caddis-worms had occurred in the fish stomachs from the Tuross, often in really astounding numbers, but the 1935-36 season was marked, with few exceptions, by their almost complete absence. In the laboratory the reason for this change was puzzling, but on the spot the cause became apparent. During the early month of 1935 the Tuross River had been swept by a series of severe floods; the effect of these had been to scour the massed weed-growth from its bed, but now, here and there, the weed was beginning to recover, and it was only among this growth that the caddis-worms were

present in any numbers—the loss of the weed had meant the disappearance of the caddis, depriving the fish of this valuable and esteemed delicacy. Weed is hated by anglers, but it must not be overlooked that its presence is responsible for a rich and almost inexhaustible supply of one of the most valuable of trout foods, and contributes in no small degree to their well-being. Much was learned in the course of this work as to the habits and distribution of many curious aquatic insects, together with other creatures.

The open grassland and the damp depths of the gullies provided yet other types of insect life, even mention of which is impossible here, but one particular collecting ground cannot be omitted, since it formed what might be termed an “island” with an insect population of its own, surrounded by, yet seldom entering, the areas around it. This “island” was formed by an old and abandoned home-stead, a place with all the picturesque, though melancholy, beauty of age and dilapidation as the sun cast shadows through the broken shingles of the roof upon the weathered slab walls and the rotting verandah floor. In these patches of sunlight, butterflies slowly opened and closed their colour-blotched wings as they rested in the warmth, while mole crickets (*Gryllotalpa*) burrowed and chirped among the roots of the tangle of black-berry canes and the relics of cultivated plants in what had once been the garden. Here, too, were old and gnarled lichen-covered pear, apple and cherry trees that formed harbour for the birds. Even the most casual observer could not fail to notice how the denizens of this area kept themselves in almost complete seclusion from the world about them.

Each type of country on the Tuross is worthy of the closest investigation, for I have seldom found a district in which the areas are so clearly defined, and differ so widely in their insect inhabitants. Their distribution would form the basis for an extremely interesting field study; then, again, among the specimens brought back there is much material which, when

worked upon by specialists, will yield many new species.

There is very much in this little paradise which it has been quite impossible even to touch upon: the many birds that filled the valley with song as the sun tipped the eastern mountains at dawn; the park-like grasslands across the river with their kangaroos; the wombats that burrowed in the river banks, and the platypus in the calm stretch of Nosey Bobs; and, above all, the ever-changing face of the valley, which varied every hour from dawn to dusk.

It was with keen regret that I rose before dawn on the morning of our departure, and looked out over the valley

which lay covered with a white blanket of mist through which the sheep were lazily beginning to move, calling to one another as they went. Above all, from a clear sky, gleamed the moon and the morning star; there was time for one last glance before the car turned to ascend the mountains on the long return journey to Sydney.

\* \* \* \*

In conclusion, I wish to express my sincere thanks to my host, Dr. Brandon, and his daughters for making this collecting trip not only possible, but, by their hospitality such a happy one.

MEMOIR ON FOSSILS OF THE LATE PRE-CAMBRIAN (NEWER PROTEROZOIC) FROM THE ADALAIDE SERIES, SOUTH AUSTRALIA. By SIR T. W. EDGEWORTH DAVID, K.B.E., C.M.G., D.S.O., M.A., D.Sc., F.R.S., and R. J. TILLYARD, M.A., D.Sc., F.R.S. (Angus and Robertson, Ltd., Sydney, 1936.) Pp. 122, with 13 plates. Price: 7s. 6d.

The comparatively high organization of the oldest fossil animals known to us indicates that they were preceded by a long series of forms of which no record is preserved in the rocks. The search for still more primitive types is therefore being eagerly prosecuted in various parts of the world, and the quest for organic remains in the Pre-Cambrian rocks of Australia, which was carried on with such energy and enthusiasm by the late Sir Edgeworth David, is of outstanding interest and importance.

The work contains ten chapters, and gives full particulars regarding the geological succession in the area, the discovery and mode of occurrence of the fossils, and a discussion of the specimens on which the main conclusions are based. These are described by Dr. Tillyard, who places them in a new class (Arthrocephala) of the Arthropoda, distinguishing two species of one genus, *Protadelaidia*, and discussing their relationships to other forms. As might be expected,

the preservation of the fossils leaves much to be desired. The disjointed and distorted fragments present few features by which their structure and affinities can be determined, but prolonged study has convinced the two distinguished authors that their conclusions are well established. Dr. Tillyard considers that the Arthrocephala belonged to the arachnoid line of evolution, and had their nearest relatives in the Eurypterida, although they were far more primitive than any known type of Arthropoda. The structure and appearance of this new form of life are shown in two fine drawings by Mr. E. H. Zeck, giving the supposed appearance in life of *Protadelaidia howchini*, which, it is estimated, reached a total length of about six inches.

There are, no doubt, sceptics who are still unconvinced that these specimens are actually the remains of animals, and, granting that they are organic, much discussion will probably take place concerning their zoological position. But no one can withhold admiration for the patience and skill displayed by the authors in interpreting such unpromising material, and in setting forth the arguments on which their conclusions are based.

The work has been splendidly produced by the publishers, and forms an heroic and praiseworthy attempt to grapple with a difficult but exceedingly important problem.

C.A.

# Victoria's Pink Lakes

By CHARLES BARRETT, C.M.Z.S.\*

**M**ORE than three hundred miles from Melbourne, in the north-west of Victoria, is a group of salt lakes which were not even named a generation ago, and still are unknown to the tourist. We call them the Pink Lakes of the Mallee; the few among us who have followed the sandy ways from Linga or Underbool to their shores, lonely as the desert itself until salt harvesting became profitable. Now there are small homes and outbuildings among the trees around the larger lakes; salt-crushing machines beside mounds of salt that resemble flattened icebergs; and tracks over which sedan cars and motor trucks travel. The picturesque camel teams have made their last journey up here; tons of bagged salt, crushed to nearly the fineness of flour, are transported to the railway in the modern manner.

But my theme is not the salt industry. Twice I have visited the Pink Lakes, each time as a naturalist. The first trip was made in 1922, with Mr. F. E. Wilson, the well-known Victorian entomologist; the second in April of this year, with two Dutch scientists, Professor Baas Becking and Dr. John Reuter. There have been many changes in our Mallee lakeland in the years between these visits. Wilson and I, though the salt industry had begun, saw neither men nor habitations at the lakes. Our water-bag was empty on a broiling day; and here was only rain-water an inch or two deep on the salt crust, water more briny than that of the sea. Pink and purple reflections were mocking as a mirage; but, not being new chums in the Mallee, we soon found liquid to drink. Around the lakes needle bushes (a species of *Hakea*) grow, and water is obtainable from their root system. And, by the way, a needle bush

yielded to us specimens of a nice Longicorn beetle, *Syllitus parryi*.

Bird life in the timber around the Pink Lakes and the porcupine-grass and scrub on the sandhills is fairly abundant, and, taking the Sunset Track, which ends in the wilderness, one meets with most of the Mallee species—Lowan, Scrub Robin, and others. Wide tracts of unsettled country lie almost within cooe of the lakes, and, leaving track or roadway, a visitor may easily become bushed. Indeed, we met a farmer on the Sunset Road who had tried a short-cut home and lost direction. He was "mighty glad" to be on the sandy old road again. And yet, one night two real bushmen took Dr. Reuter out kangaroo chasing (not hunting, mind you), driving the car far into the "porky" country. They steered by the stars coming back to Lakeland. Five kangaroos were seen, and went pounding away in the glare of the headlights. It was a thrilling experience for the young Hollander, whose eyes shone as he told me about it. I was a stay-at-home, taking notes while Professor Becking, reluctant to speak of his own work, gave me an outline of salt lake knowledge. His researches have taken him to many countries. From Australia he has gone to the Dutch East Indies again; then his long trail leads to Egypt, and to Palestine, where the Dead Sea lies in the world's deepest depression, an inland sea or lake of brine. I have looked down upon it from the hills between Jerusalem and the Jordan Valley—a glorious deep-blue sheet of water, which the Turks made "out of bounds" to Australians when I was in the Valley. Annoying to a naturalist who longed to go looking for birds and things—and a pillar of salt.

One of the salt-harvesters up at the lakes had been a light horseman and suffered, none too gladly, the heat and dust and flies of Jordan Valley. Much

\* Photographs by the author.

*One of the huge mounds of salt ready for the crusher.*



*Professor Becking "looks over" the lake named in his honour.*

better in the Mallee, though the heat is burdensome, reflected from the salt-crust, in summer time, and flies are not lacking. We remembered those old soldiering days, as we crunched the pink salt underfoot now, and compared Lake Crosbie with the Dea Sea, to the former's advantage. It's a better lake, at least for Australians. Dr. Becking assures me that these Victorian salt lakes are among the most interesting he has seen, and rank high for beauty. Their charm lies not in coloration only, but partly in their setting. They are encircled by sparsely forested sand-dunes—vast mirrors with sunset colours, reflected or in the salt itself, contrasting with those of the dunes and their vegetation, tawny and many shades of green.

Three lakes of the group near Underbool are included in a public reserve; they are Lake Kenyon (311 acres), Lake Crosbie (394 acres) and Lake Becking (207 acres). The smallest one was named in honour of the professor from Leyden, whose visit to our Pink Lakes has helped

to put them on the map for people who had not even heard of them before, or had but a vague idea of their situation.

Results of the researches carried out by the professor and his assistant will not be published perhaps for a year or two, but their importance is already indicated. Some notable finds were made, including a purple bacterium (first record for Australia, I believe) and the larvæ of a fly living in brine. The pink colour of the salt we believed to be due to chemical impurity in the crust, algæ contributing the green hue of other portions. Dr. Becking proved that the salt is pink owing to the presence of microscopic organisms—flagellates. As regards the green, we were right. Mr. A. D. Hardy, Victoria's leading algologist, a member of our little expedition, had visited the lakes more than twenty years ago, and again in February of this year, and collected material for study. He found in the salt-crust samples two colonial forms of algæ, and several others. Black mud underlies

the crust of rose-tinged salt, and this evil-smelling stuff Mr. Hardy found to contain five species of algæ, the two most abundant being also tenants of the salt.

The colour bands of the old stratified salt crust are very pretty. In several places we dug out chunks with five different colours, ranging from purple to dainty shell-pink. "Rainbow cake", the professor named these samples, which under the microscope revealed a world of infinitely little lives—plant and animal. Crystals, too, were collected, some of great size—for crystals—and beauty.

I am out of my depth rather, dealing with microscopic organisms, and this is the place to quote what Dr. Becking wrote for me:

"A few decades before Darwin set out on his voyage, the German zoologist Ehrenberg had demonstrated that many microscopic animals were, apparently, universally distributed over the earth. Ehrenberg assumed that these organisms

travelled in the form of spores (in which life is latent) with the high winds, after the spores got into this high altitude by ascending air currents. We know now that Ehrenberg was right and that Darwin was aware of it, although the proof for the omnipresence of living things came later; it was left to the genius of Louis Pasteur, in the 'sixties, to demonstrate the presence of microbes in the air.

"There are, therefore, two principles governing the distribution of organisms. One is concerned with the specific position of a given area—and this specificity is brought out in the nature of its higher plants and higher animals—while, according to the other principle, lower forms that may be carried (in latent or active form) by the wind, might be universally distributed.

"Dust from storms in Central Australia is found deposited in New Zealand. Volcanic dust from Krakatoa (a volcano west of the island of Java) travelled



*Lake Tyrrell—one of the most acid lakes in the world.*

*Dr. Reuter collecting samples of the pink salt crust. Lake Crosbie.*



several times round the earth, and caused remarkable sunsets all over the world. The crystals of volcanic minerals could be wiped from window-panes in Holland more than a year after the eruption. Small particles may, therefore, travel enormous distances, and that living 'particles' travel such distances has been demonstrated by several investigations, under which an experiment of Charles Lindberg deserves special mention.

"How far goes the 'universal element' in the distribution of plants and animals? What have continents in common apart from the plants (like prickly pear) and animals (like foxes and rabbits) that are distributed by man? Deductions can be made from experiments such as Lindberg's, but also a trip to an isolated spot could be made, and this time looking for similarity rather than difference. And it was with such an idea in mind that our trip to Australia was planned.

"Now the latent universally distributed 'germs' are not the only simple things, like bacteria and one-celled animals, or microscopic moulds and algæ. Eggs of small Crustacea, of insects, of worms, spores of ferns and mosses, and even small seeds, may be transported across oceans. Thousands of germs are brought down on the earth by rain, by snow, or by settling in still air. In order to make them develop we have to give them a suitable environment.

"The earth holds only a limited number of environments. As a rule, it would be an exceedingly conservative one. It possesses fresh water and salt water, and a few weird cocktails like the concentrated brines, like the acid volcanic lakes, like the acid alinite pond in Western Australia. In its coldest liquid environment, equally as in its hottest, life is present in quantities, and it is very questionable if ever terrestrial environment devoid of life (apart from the hot larva) will be found. Thousands of feet deep, in the oil wells, living beings have been found; even liquid kerosene and the asphalt pits of California may boast their own flora and fauna. Apparently life is able to 'swallow' everything that the earth can produce.

"It is in the laboratory, however, that the full powers of life become apparent. There we can make combinations of salts that never occur in nature; we make things to grow in the most improbable environments. Every living form has its own prescribed environment—a counter-mould, so to say, of its own intrinsic character. If this character is peculiar the environment will be unusual, and *vice versa*. In unusual environments comparatively few organisms persist. An intensive study of these environments is therefore possible because the organisms living in it, being few in number, may be, for the largest part, recognized at a glance.

"For the organisms living in concentrated salt solutions present many unusual peculiarities. According to the classical theory of physiology they should not be able to persist, both by reason of the high concentration and chemical compositions of this environment. Still, we find many plants and animals living, apparently happily, in thirty per cent. brine. Thus far we have found them, the world over. A small shrimp, described from Staffordshire in 1776, has been found to occur in North America, Africa, Asia and Australia—wherever solar salt-works are. The same may be said about a fly, and about curious minute animals and plants. As many of these organisms have never been found outside this saline environment, one must assume that they are, in some form, of universal distribution, but that they appear, in active form, only in solutions of high salinity. They are cosmopolitans. It has been our luck to find almost every one of them in Australia as well, and this search in an isolated country has proved to us just as exciting as the search for the dissimilar and the unexpected for which this country is justly famous."

The professor is writing a "Book of Salt", in which will be summarized and explained the results of his researches, extending over more than ten years. The Pink Lakes of the Mallee will receive "honourable mention" in that work. Another Victorian Lake, Tyrrell, also in the Mallee, will perhaps be given more



space than its allies out from Underbool. For Tyrell is one of the most acid lakes in the world—a fact quite new to us. Until Professor Becking's visit to this, the second largest lake in Victoria, it was not regarded as notable, excepting for size, and no one, so far as I know, had troubled to take samples of its salt for the "acid test" and identification of organisms.

Some youngsters living less than ten miles away, could not give us directions how to reach Lake Tyrell; perhaps they had never been so far from home! Had we questioned them concerning the Sea of Galilee or Lake Ontario, perhaps answers would have come promptly. Why are young Australians not taught more about their own country and the geography of their own and neighbouring districts? Some day even educationalists may become educated.

Pink Lakes are not always pink. The colour of the salt crust varies with the season and rainfall. After rain in summer time the colour may be purplish-pink, though, as a rule, the surface hue is rose- or shell-pink. Heavy rain means a heavier layer of salt and the pink tint deepens. Sunset reflections are enchanting; these salt mirrors of the Mallee have then quick-changing beauty. Only colour photographs, which are to be taken, can make the lakes alluring to folk who have not seen them. An artist might fail to capture a charm that is so elusive.

To wild life these lakes have little to offer; apart from emus, which sometimes appear on the shore, the only birds to visit them are ducks, which alight on the surface to rest after a long flight, and dottrels, which I have seen twinkling around the margin of Lake Crosbie.

Beetles of several species thrive in this strange environment. Beneath planks embedded in crystallized salt a tiger beetle (*Megacephala australis*) is at home in channels excavated by itself. We found dozens of the handsome insects, like elongated emeralds set in rose-pink crystal. These beetles have metallic-green wing-covers. Our expedition added another species to the Pink Lakes' scanty insect fauna—a very rare, prettily marked, little tiger beetle (*Cicindela jungi*), not previously recorded from Victoria.

Tiger beetles are associated with salt, or many species are. Large brackish lakes of the inland, salt-pans too, are the habitat of tiger beetles, those of Western Australia being especially rich in beautiful forms. I doubt not that undescribed species exist, perhaps at the Pink Lakes; and were I more active, a tiger beetle expedition might have me as its leader. But these long-legged insects are speedy and clever at dodging the eager hand! I have lost many a race with tiger beetles on tropic beaches and inland plains—and the Pink Lakes of the Mallee.

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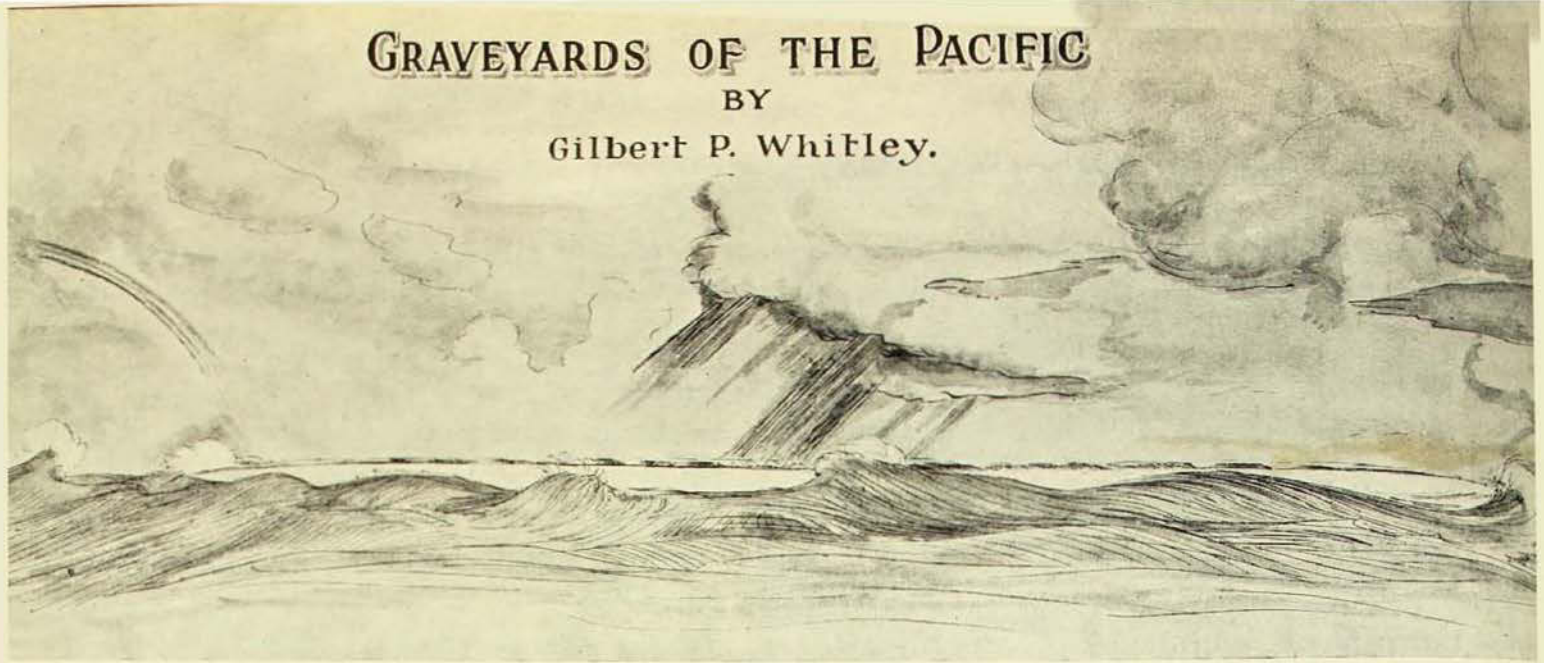
Among recent visitors to the Museum may be mentioned the following: Mr. H. A. Longman, F.L.S., C.M.Z.S., Director of the Queensland Museum; Mr. L. Glauert, B.A., Curator of the Western Australian Museum; Mr. Gilbert Archey, O.B.E., M.A., Director of the War Memorial Museum, Auckland, New Zealand; Dr. W. R. B. Oliver, Director of

the Dominion Museum, Wellington, New Zealand; Dr. F. J. Kirschbaum, Alexishafen, Territory of New Guinea; Dr. G. Hoelker, Editor of *Anthropos*; Dr. Weston A. Price, Director of the Dental Research Laboratories, Cleveland, Ohio, and Mrs. Price; Mr. William Owen, F.R.S.E., of the Australian Institute of Anatomy, Canberra.

# GRAVEYARDS OF THE PACIFIC

BY

Gilbert P. Whitley.



*Elizabeth Reef.*

## The Elizabeth and Middleton Reefs

**S**URROUNDED by unbroken leagues of open sea, some three hundred miles east of the northern coast of New South Wales, lie the Middleton and Elizabeth Reefs, the loneliest islets in the whole world. Even the term islets is perhaps a misnomer, since the storm-lashed Tasman Sea may break entirely over the tiny sand or shingle banks which rise from their coral ramparts, to wash the battered wrecks which alone afford meagre lodging for the rare visitors to these desolate atolls. Not a tree or a shrub can here exist, for there is no soil and no fresh water, and the only inhabitants are a few sea-birds resting awhile after their long ocean flights. Flocks of ocean-skimming birds such as these suggested to La Perouse, as he proceeded from Samoa to Botany Bay in 1788, the idea that land might exist in the vicinity of Lord Howe Island and its satellite reefs and islets, whose existence it remained for the Englishmen of the First Fleet to prove a little later in the same year.

Middleton Reef was discovered by Lieutenant John Shortland (1736-1803), who, after a varied naval career, had come to Australia in the transport *Alexander*. On his return to England, *via* Batavia, he sighted many unknown islands and reefs, and in an account of his voyage\* is

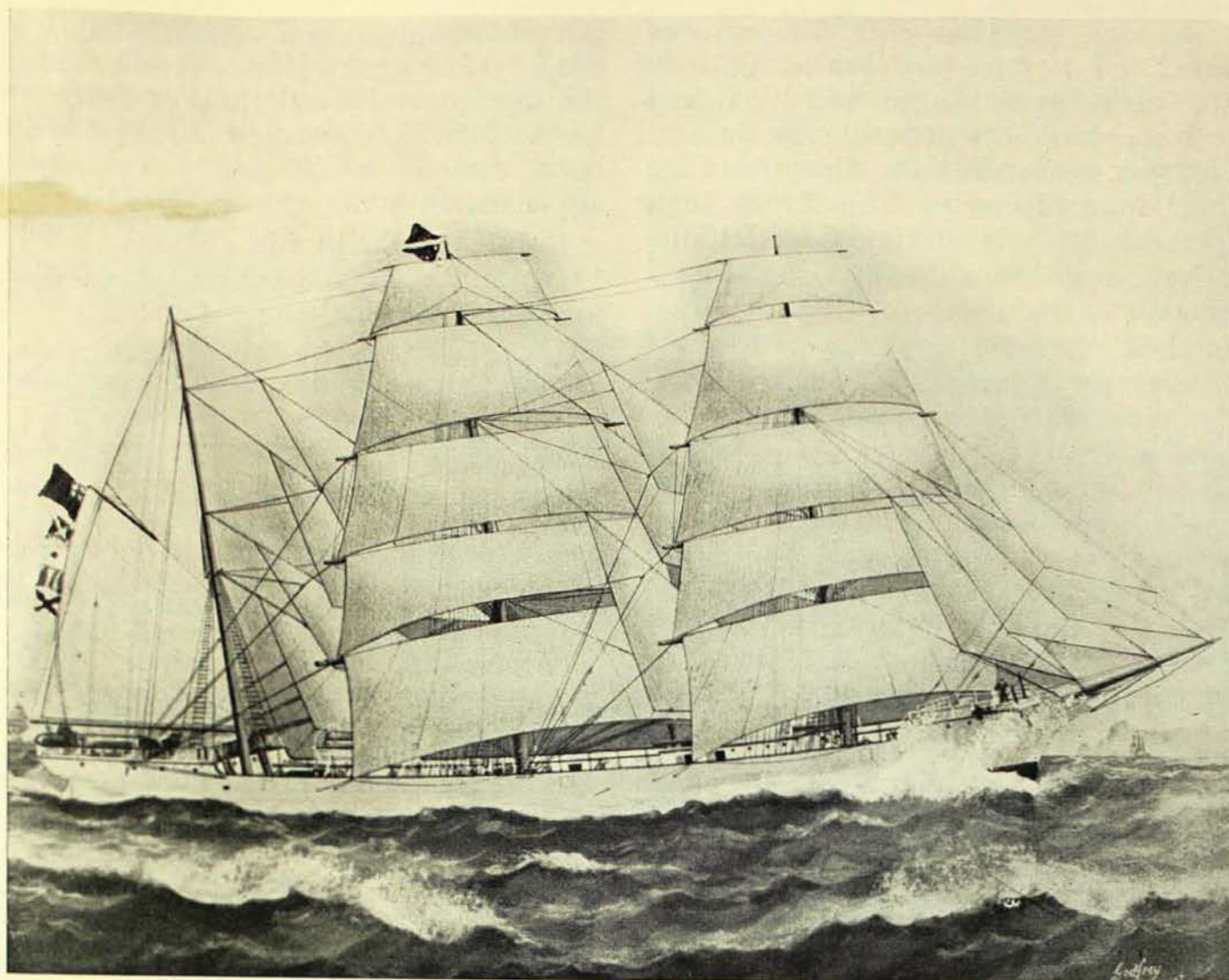
recorded the following, under date July 20, 1788:

About noon this day, the men at the mast head discovered a very extensive shoal on the larboard beam, bearing from north by west to west by south, distant between two and three leagues. It trended north by east and south by west, and was judged to be in length about three leagues and a half. The breadth could not be ascertained, for, while the ship ran along it, the sand bank was seen to extend as far as the eye could discern. It lies in latitude  $29^{\circ} 20'$  south, and in longitude  $158^{\circ} 48'$  east, and was named by Lieutenant Shortland, *Middleton Shoals*.

Sir Charles Middleton (1721-1813) was Comptroller of the Navy at the time. When Shortland returned to London he urged the Admiralty to have the seas east of Australia thoroughly surveyed and charted, and thus was partly responsible for the famous voyage of Matthew Flinders.

Elizabeth Reef is some thirty miles southward of Middleton Shoals, and, since both places were incorrectly recorded as to their latitude and longitude in the early days, they appear in different situations on old maps, and under various names, such as Seringapatam, Clark, or Eliza Reef. The wreck of the brig *Elizabeth* in 1831 was responsible for the naming of Elizabeth Reef, though the spot was evidently first discovered by the whaler *Britannia*, which was wrecked there in 1806. Both it and the Middleton Reef became notorious as

\* "The Voyage of Governor Phillip to Botany Bay", 3rd ed., 1790, p. 259.



*The "Annasona" as she was. From a painting in the possession of Gerald Kirby, Esq., Lord Howe Island.*

graveyards of the Pacific, when wreck after wreck was piled upon their coral, or derelict vessels from miles away were converged by currents upon their treacherous shoals. Captain J. H. Watson, in the *Scottish Australasian* for October, 1916, and in the *Australian Encyclopædia*, listed all the known wrecks, a score in all, but doubtless many ships perished there without record of their fate.

The most prominent wreck on Middleton Reef was (and still is) that of the *Annasona*, a barque of 1,400 tons, which, on a voyage from Peru to Australia, crashed on top of the reef early in the morning of January 18, 1907. The master (Captain G. H. Blackstock) threatened to shoot anyone who tried to put over any boat until daylight came and they could review their situation. His action enabled all his crew and himself to reach Lord

Howe Island safely in a few days, and some of the islanders still remember his advent. Meanwhile the wreck of his steel ship remained, peopled only by huge rats which thrived for a short while on resting seabirds. Later in the year, the *Young Rock*, a schooner belonging to Mr. Stanley Spain, of Sydney, who had purchased the wreck, visited Middleton Reef and salvaged a number of useful articles from her.

The most terrible disaster in the doleful history of Middleton Reef was the wreck of the Norwegian barque *Errol*, which was on her way from Chimbote, Peru, to Newcastle, New South Wales, when she struck Middleton Reef at midnight, 18th June, 1909. She broke into three sections and several of her crew were drowned; others tried to get across to the *Annasona*, where they suffered agonies from hunger and thirst, and their mascot, a black cat,

did not long survive. The master was drowned and devoured by sharks, his wife became mentally deranged and died, and there were dark whispers of cannibalism and murder concerning the disappearance of their four children. The *Tofua* took five persons, the sole survivors, off Middleton Reef, and brought them, aged and exhausted, to Sydney.

The last recorded wreck was that of the *Askoy* on Elizabeth Reef, December 27, 1911, a 1,600 ton vessel, which was caught by treacherous currents, perhaps caused by submerged mountains about the reefs, and drifted onto the coral.

Apart from the wrecks and rescuing vessels, there were a few trips made to survey the reefs, but little in the way of data seems to have been published as a result, and the modern mariner still uses

the charts prepared in 1853 and 1878. Some years ago, a lifeboat was moored in the lagoon at Elizabeth Reef, with stores for shipwrecked seamen, but either it has been stolen or it most probably disappeared in some storm.

Ralph Stock, in his *Chequered Cruise*, 1916, published a photograph of Middleton Reef, of which he wrote:

It was worth seeing. Anything more desolate and sinister than this gigantic horseshoe of coral out in the open sea, a menace to every storm-driven ship in a radius of a hundred miles, it would be difficult to imagine. Some day, perhaps, it will be an island, as fair as any in the South Pacific, but at present the wonderful little coral polyp has not finished its work, and Middleton Reef constitutes a death-trap. A white circle of breakers, clear cut against the blue of deep waters outside, and the opalescent green of the lagoon within, and here and there perched on the reef's jagged teeth, like marine scarecrows, wrecks in every stage of dissolution.

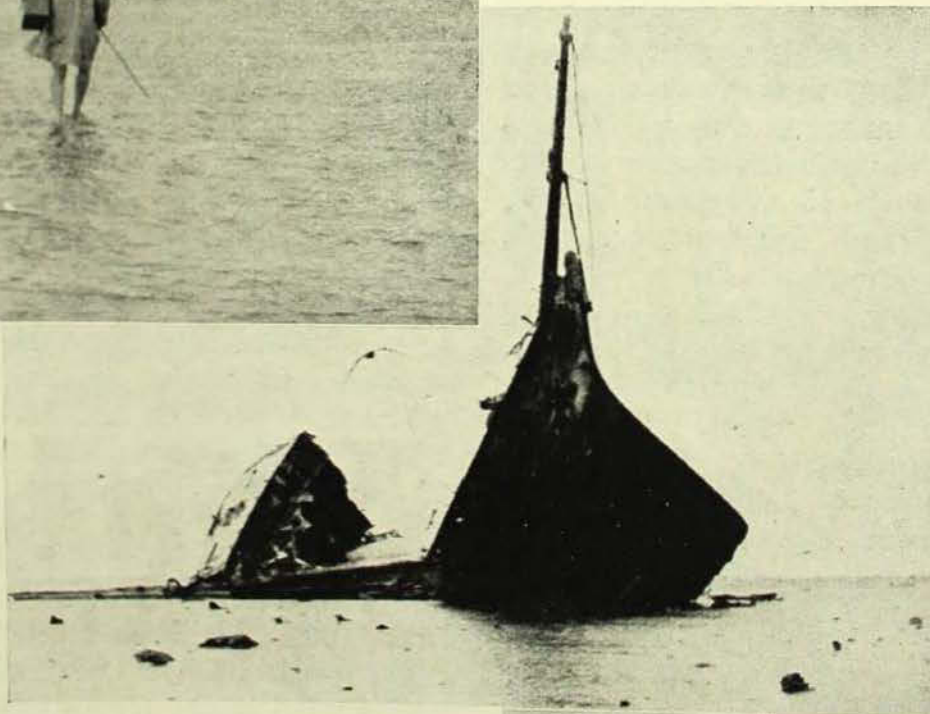
At the time of the *Firm's* passing there were five, and never a year goes by without adding to their number.

Again, in his *Cruise of the Dream Ship*, 1921, Ralph Stock reproduced his picture of the *Annasona* wreck, but since he calls it "The Wreck of Tragedy", he evidently mistook it for the *Errol*.

From time to time, steamers on the run from Fiji or New Caledonia would look in at the reefs in case of further shipwrecks.



The "*Annasona*" as she is, on Middleton Reef.



Photos.—N. K. Wallis and J. Powell.



When, returning from Noumea in a 20,000-ton liner some years ago, the present writer passed the vicinity of Middleton Reef, he little thought he would some day be landing thereon from a yacht in the interests of the Museum. It happened in this wise.

Early in 1936, Mr. Norman Wallis, a well-known Sydney yachtsman, purchased the *Annasona* wreck for the nominal sum of five shillings, and organized an expedition to visit the Middleton and Elizabeth Reefs to obtain salvage from her, to study the life of the reefs, especially the fishes, and trace the currents in the vicinity. The present writer was deputed by the Trustees of the Australian Museum to accompany the expedition as naturalist, and so, accompanied by preservatives, collecting gear and notebooks, he boarded Mr. Wallis's yacht *Wanderer* early in April for the reefs.

The schooner yacht *Wanderer* is nearly fifty feet long and fitted with an auxiliary engine. She was named after the *Wanderer* in Masefield's poems, but her name is also the same as that of Ben Boyd's famous yacht, whose moorings she now occupies. On this, the third of her trips to Lord Howe Island, the crew consisted of Messrs. Norman Wallis, H.



Figurehead of the "*Annasona*".

Newton Scott (navigator), J. Forsyth, and the writer, who had had no previous yachting experience, as naturalist. We

sailed from Neutral Bay at noon on Saturday, April 4, 1936, and struck a rough sea and strong south-east wind on leaving the Heads. That very afternoon an accident occurred which might well have terminated the expedition: the main sheet parted and Wallis and Scott were washed overboard. Fortunately, they both managed to grab ends of rope trailing in the water, and then a heavy wave swept Forsyth into the sea, leaving a very seasick naturalist for a short while in sole possession of the ship. Then the skipper hauled himself aboard, whilst Scott was aquaplaning below the end of the swinging thirty-foot boom, and Forsyth had managed to grasp the counter. Finally, all were got safely aboard, and we hove to for the night. The next few days were marked by rough weather, and dolphins and seabirds were about the only creatures seen. The yacht was blown or drifted well off her course, and suffered a good deal of damage, even the bowsprit being carried away one night during a cyclone. A flying fish (*Exocoetus volitans*) was washed up on deck, and was the first specimen secured for the Museum. Two days after the storm, a gannet visited us, although we were over one hundred miles from Lord Howe Island, and we saw a large waterspout, which later disappeared. Very early on the morning of April 11 the ship's course had to be altered to avoid striking two large whales, and later in the day we sighted the mountains of Lord Howe Island, and managed to reach an anchorage there the same night.

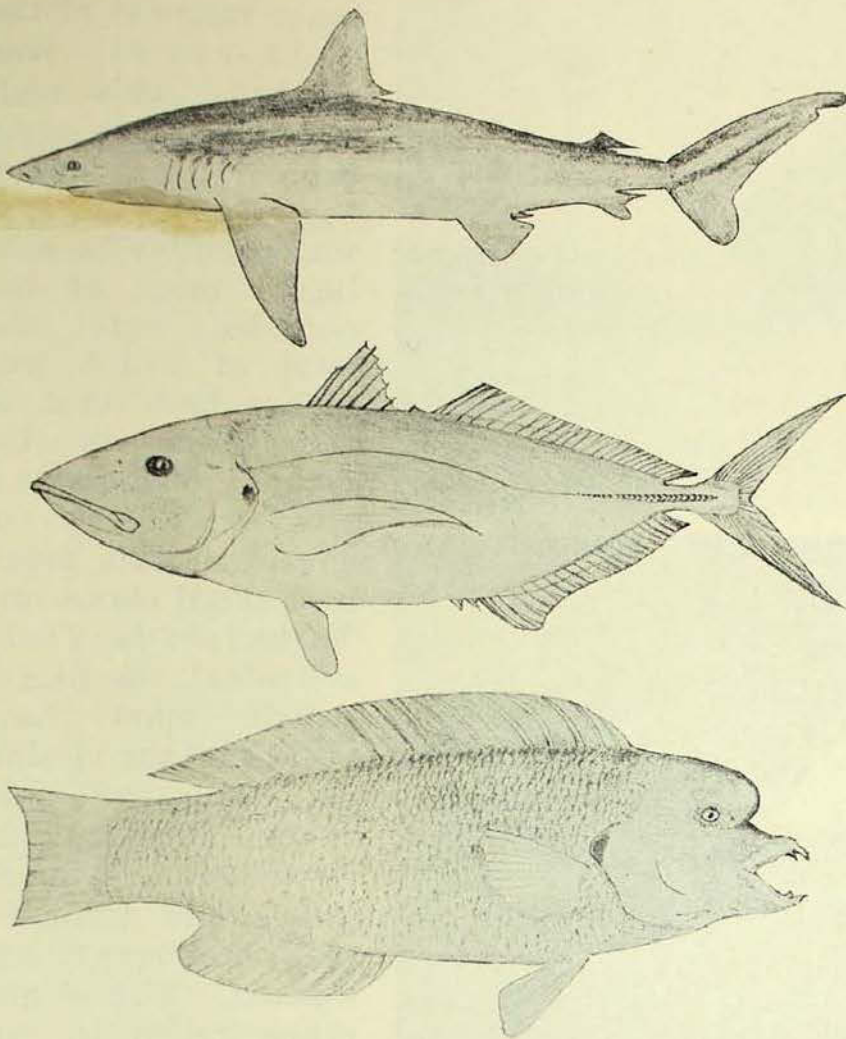
Here our little crew was augmented by three of the islanders, Messrs. Frank Payten, Tom Payten, and Maurice Wilson, and we left for our main objective, the Elizabeth and Middleton Reefs.

After two days' sailing through a curious criss-cross sea, we sighted Elizabeth Reef on the afternoon of the 14th, and, as we approached it, huge green waves were seen and heard crashing upon the ring of submerged coral which encircled the smooth lagoon, some five by four sea miles in extent. From the appear-



*The Schooner Yacht "Wanderer" in Sydney Harbour.*

Photo.—Hall and Company.



Whaler Shark and new species of Trevally from Elizabeth Reef, and Doublehead from Middleton Reef.

G. P. Whitley, del.

ance of the surf, it seemed impossible to approach such a reef, but Wallis and a couple of others went off in the dinghy to test the anchorage in an opening marked on the chart, taking with them a compass, some food and drink, lights, etc., in case they became stranded. Those who remained on the yacht were relieved when the dinghy returned, reporting safe anchorage, and at sunset we moved slowly through the opening and, for the first time in the whole voyage, kept an even keel. The water was alive with sharks and everybody caught at least one. They were Whalers (*Galeolamnoides macrurus*), five to six feet long, but immature; their bodies were suspended around the yacht to form most unusual fenders.

On Wednesday, April 15, we were all up early as the reefs were being uncovered

by the ebb-tide, and we landed upon parts of them. Since there is a permanently exposed sand cay here and the reef was not known to have been annexed, the expedition took possession of Elizabeth Reef in the name of His Majesty King Edward VIII. In the short time available I collected all I could whilst the tide allowed, and obtained a new species of clam, various shells and crabs, a new sea-slug, and some marine worms. By fishing, we obtained several different species, all identical with Lord Howe Island forms, except a Red Bass (*Lutjanus coatesi*), which was the same as a Queensland fish which has the reputation of being poisonous as food. The fishes and sharks here had never known the presence of anglers and took baits eagerly, so that we had enough for both scientific and gastronomic purposes. Our navigator, trolling for sporting fish, caught a Lizard Fish (*Synodus houlti*) which, being only about six inches long, was hardly larger than the automatic striker it had so gamely taken! We also caught a specimen of a new species of Trevally. Gannets and noddies were

the only avian inhabitants of the sand cay, where Frank Payten distinguished himself by catching a shark by the tail as it came into shallow water after Bluefish.

We rose at dawn the next day and prepared to leave Elizabeth Reef. There was some anxiety when getting the anchors up, as we were very near coral, but we finally got away and plunged into a terrific sea. The trip to Middleton Reef was very rough, the yacht rolling considerably and often shooting breakers. Mutton birds, gannets, and a Fluttering Petrel were the only living things in view.

At about noon the wreck of the *Annasona* was espied, her bowsprit raised to the squally heavens like some titanic forefinger uplifted in admonition. Here,



*Noddies perched on the wrecks on Middleton Reef.*

Photos.—N. K. Wallis.

then, was Middleton Reef, quite invisible from a distance, and indicated only by this tragic relic. We approached the reef from the lee shore, and saw numerous small niggerheads on the coral. The surf was not so strong as that at Elizabeth Reef, although the lagoon was of about the same area, and in the afternoon we made our way into Herald Haven, where we anchored. Tom Payten immediately caught a Tiger Shark, and the water around the yacht was soon thick with Whalers and an occasional Kingfish or Tiger Shark. One or two turtles were also seen.

The next day, April 17, we all visited the wreck of the *Annasona*, crossing the lagoon, whose floor consisted of coral sand, with sparse coral patches, until the

inner rampart of the reef-crest was reached. This reef-crest, upon the outer rampart of which the *Annasona* lay, was peculiar in having a moat of impounded water the level of which was higher than that of the water in the lagoon. There was a rich variety of corals in this moat, also small clams and Turban shells (*Turbo cepoides*), the like of which must have sustained the victims of shipwreck in other days. The *Annasona* yielded much fine timber—teak, mahogany, and *lignum vitae*—and other relics to our crew, but I was surprised to find no coral growth nor animal life whatever attached to her hull, with the ex-

ception of three Black Periwinkles (*Nerita melanotragus*); possibly rust had fouled the water. Fishes in the vicinity of the wreck all belonged to Lord Howe Island species: Bluefish, Doubleheads, Parrotfishes, Demoiselles, and others. Some ballast stones, probably brought from Callao, had formed a bank occupied by swiftly running crabs, but the only bird inhabitants were noddies (*Anous stolidus*). In the lagoon, bêche-de-mer were common, browsing over the bottom. We took possession of the reef in the name of the King, thus having made the first additions (inconspicuous though they be) to the Empire during his reign.

We also visited a smaller wreck, thought to be the remains of the ill-fated *Errol*, but were unable to land and join





to stand on deck, and we dragged our anchors and looked, for a while, like being blown onto the reefs. However, the anchors were got aboard, polished by grating along the coral sand, and, forced to postpone all shore activities, we made out to sea. After beating through rough seas all day, we hove to, and, being short of petrol, which was being conserved for emergencies, drifted helplessly in the treacherous currents around Elizabeth Reef. More by good luck than anything else, we missed the reef, and proceeded laboriously, through lack of wind this time, in the direction of Lord Howe Island. Eventually, on the 21st, a good wing sprang up, and we sped forth through rough seas, but helped by a southerly drift. The bilge water, always unpopular, had slopped up through bunks and lockers, spoiling notebooks, cameras, clothes, and gear, but finally that evening we reached Lord Howe Island, exhausted and bearded. The hillsides were swarming with anxious islanders, who gave us a wonderful welcome, for we were several days overdue. Here we stayed for about

a week, mending sails, refitting and recuperating, and I secured some more specimens for comparison with those from the reefs we had left behind. The weather was very unsettled, but on the 29th we decided to sail for the mainland, and a convoy of gannets accompanied us for the first part of our homeward journey. Land was sighted on May 2, and proved to be the North Brother Mountain, New South Wales. A Horse Mackerel and a new species of Little Tunny were caught by trolling, and, the next day, we witnessed a grand display of sporting and leaping by innumerable dolphins, pairs of which would sometimes jump twelve feet into the air. Slowly and pleasantly we sailed down the coast, in calm water at last after our 25 stormy days out of 29, and a total of 117 hours hove to in rough seas: passing Newcastle, Norah Head, and then Barrenjoey lighthouse as darkness fell; past the jewelled lights of Manly to enter the Heads at 11 p.m. At eight bells, exactly midnight, the *Wanderer* had returned to Ben Boyd's old moorings at Neutral Bay.

In the last issue of THE AUSTRALIAN MUSEUM MAGAZINE an account was given of the very generous donation by Mr. H. J. Carter, by which the reference collection of Australian Coleoptera or beetles in the Museum was considerably augmented.

It is now highly satisfactory to be able to report that, largely owing to the generosity of Messrs. Orwell Phillips, William Dixon, Robert Dixon, Anthony Hordern, T. E. Rofe, and Sir Hugh Denison, it has been possible to acquire the collection of Mr. A. H. Elston, of Aldgate, South Australia. Mr. Elston has built up this collection over a number of years, specializing in the families Elateridæ (Click-beetles) and Cleridæ, in both of which he has described a number of species; these families are difficult, and have formerly been somewhat neglected by workers. The collection

contains some 6,000 named species, inclusive of about 250 type specimens, and in addition there are a large number of extra-Australian members—identified by specialists—of the groups in which Mr. Elston has been particularly interested.

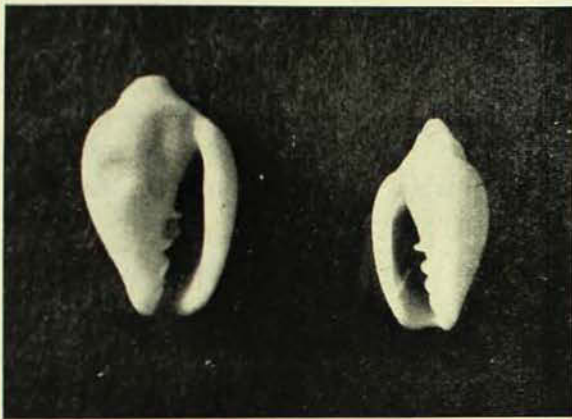
The value of such a collection will be apparent at once to coleopterists and other workers in Australian entomology. It is by the acquisition of such large private collections, which far too often are permitted to leave the country, that the value and scope of Museum collections are enhanced. The material, so obtained and housed in a scientific institution, is available for study by specialists for all time. It has been the fate of many fine collections to find their way into the museums of Europe and America, where they are inaccessible to workers in this country.

# Abnormalities Among Shells

By HAROLD S. MORT, B.Sc., B.E.

THESE are several types of abnormal growth constantly occurring amongst shells. Some of these are extremely rare, while others are liable to take place whenever the normal environ-

shell are spirally coiled in the opposite direction to the usual type, and the mouth opening is on the left side of the axis instead of on the right.

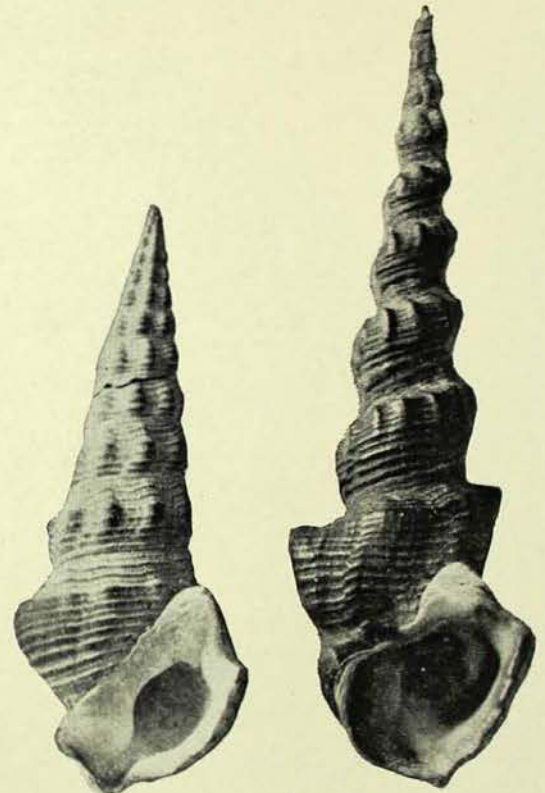


An example of sinistral or left-handed abnormality. The specimen of the Margin Shell on the right, *Marginella muscaria*, from Balmoral Beach, Sydney Harbour, has the whorls coiling to the left instead of to the right, and the mouth of the shell is on the left hand side. A normal specimen with the mouth on the right hand side is shown next it.

ment is altered. Monstrosities sometimes occur in which the whorls become entirely disjointed from one another, this type of abnormal growth being known as scalariform; or they become carinated, that is, they develop a keel on a normally smooth whorl. In others the spire may be produced to an extreme length and becomes in this case acuminated, or, if its point is lost through disuse or other reasons, the shell is said to be decollated. Dwarf and giant specimens of otherwise normal species also frequently occur. Another rare form of monstrosity is a shell with a double mouth opening, caused by the fusion of two shells in the embryonic stage; but possibly the most unique abnormality is the sinistral or left-handed shell, in which the whorls of the

## SINISTRAL SHELLS.

By no means are all sinistral or left-handed shells considered monstrosities. Many genera are normally built this way, for example, those of the genera *Clausilia*



Interference by foreign bodies during growth has possibly caused the unwound appearance of the Mud Whelk or Hercules' Club, *Pyrasus ebeninus*, on the left. This abnormality is known as the scalariform type. Mud whelks are very common round Sydney, and are sometimes found with the mouth of the shell very expanded through irregular growth.

and *Triforis*; in other cases the genus is typically right-handed or dextral, but certain species are sinistral, such as *Fulgur perversus*. Sometimes a species is indifferently dextral or sinistral, especially several of the genus *Achati-*



The animal of the common Sydney Red Rock Whelk, *Charonia rubicunda*, in repairing an injury to the back of its shell, formed a conspicuous double mouth. The shell was collected at Bottle and Glass Rocks, Sydney Harbour.

*nella*, while many species of the family Eulimidae have a sinistral shell only in the embryo stage. This becomes dextral in the adult, but the first shell formed, which always remains at the tip of an adult shell, and is known as the proto-

conch, retains its sinistral form, and the adult shell, therefore, is coiled in the opposite direction to that part of the shell developed earlier. All these forms may be considered normal, and it is only when a shell of a dextral genus and species is reversed that it becomes a monstrosity. This reversal occurs in the early stages of embryonic development, and is caused through the visceral hump of the animal coiling in an opposite direction to the normal coiling, the coil of the shell naturally following this arrangement.

This left-handed condition occurs much more frequently among land shells than among marine ones, and in England sinistral forms of fifteen different species of snail have been reported. Among sea-shells may be mentioned the common English Whelk (*Buccinum undatum*) and the Indian Chank Shell (*Turbinella pyrum*). A sinistral example of *Marginella muscaria*, the small Margin Shell, has been found at Balmoral, Port Jackson. It is interesting to note that in *Twenty Thousand Leagues Under the Sea*, Jules Verne relates an incident in Torres Strait where the discovery and subsequent loss of a sinistral specimen of an Olive Shell (*Oliva*) led to trouble with the natives.

#### SCALARIFORM MONSTROSITIES.

These are much less common than sinistral abnormalities. They have been reported in five different species of English snails and in several others, both land and marine, and may be due to the presence of a foreign body preventing the proper fusion of the early whorls of the shell, and the inability to

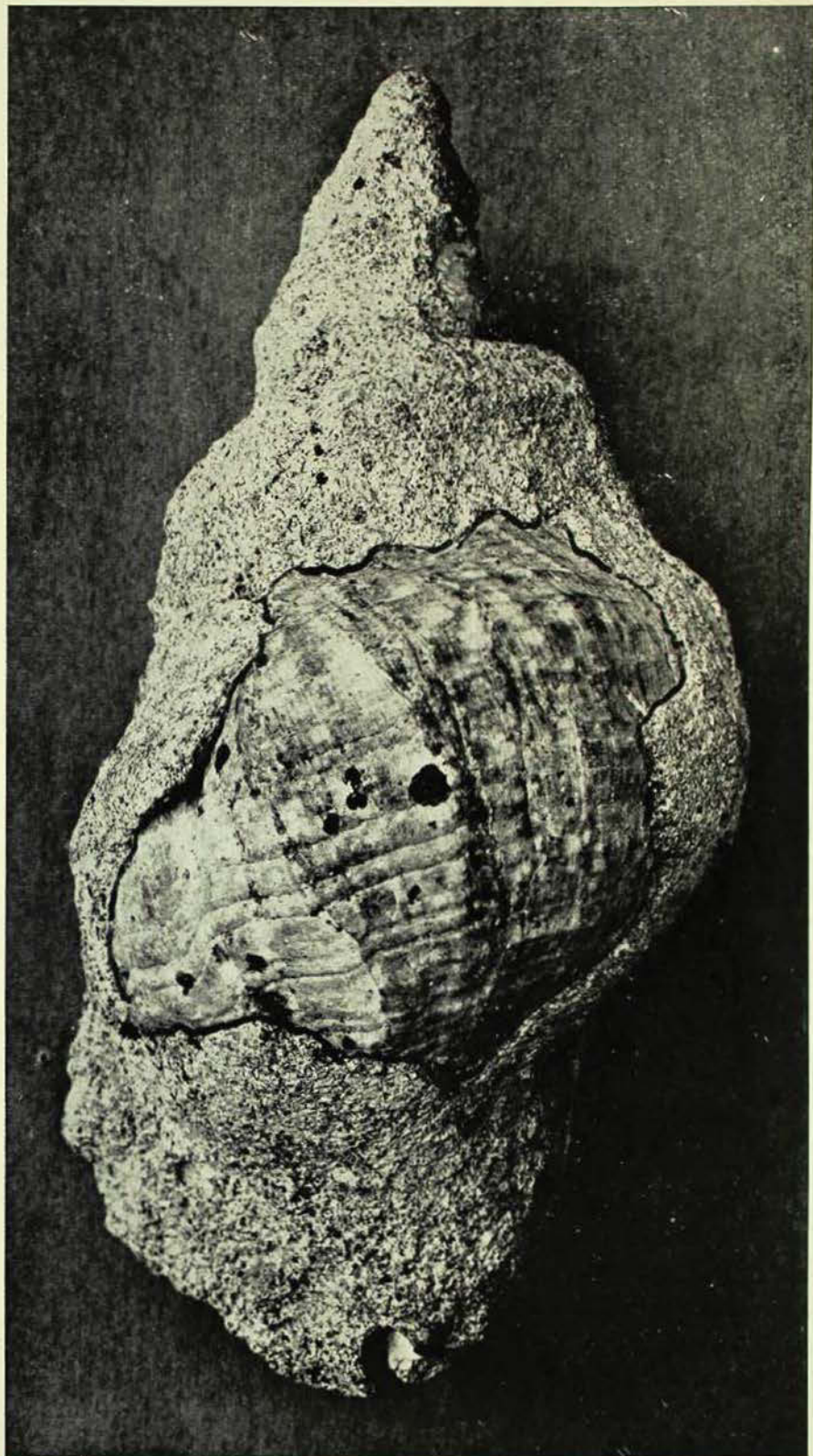
join them up again once the connection is broken. The common mud whelk, or Hercules' Club Shell (*Pyrazus ebeninus*), is sometimes found in this form.

#### DECOLLATED SHELLS.

Decollated shells may be the result of damage to the spire, but in some cases it appears that for some unknown reason the animal has either dropped or absorbed a portion of the shell. As the shell becomes adult its animal may cease to occupy the upper part of the cavity, and the space thus left unoccupied is sometimes filled with shelly matter, or is simply partitioned off. The deserted apex becomes dead and brittle and breaks away, leaving the shell with a truncated appearance. Some molluscs regularly truncate or decollate their shells during growth, so that there is little resemblance between the adult and young shell. Numbers of American terrestrial species uniformly decollate their shells, and five species possessing this abnormality are recorded among English snails.

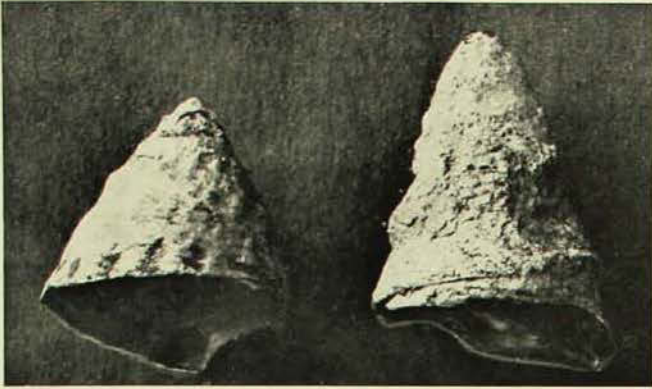
#### ACUMINATED SHELLS.

Acuminated shells are perhaps the commonest abnormal forms, and are usually caused through living in a restricted space, such as a narrow cleft in a rock, where there is no room for lateral expansion, and so the shell grows to an extreme length. All shells living in restricted areas are liable to interference in their growth. The specimen of *Cymatilesta spengleri* illustrated in this article was collected alive at North Harbour, Port Jackson, and is only one and five-eighths inches in diameter as against two and five-eighths inches in a



*The repaired back on the last whorl of the Red Rock Whelk. The original sculpture and colouring have been maintained. The specimen is heavily encrusted with foreign growth.*

normal specimen of the same length. It had apparently been liberated late in life from its restricted environment, as the last whorl is normal except that there is a well defined umbilicus on the columella or inner lip of the mouth of the shell. The Tent Shell, a very common species on



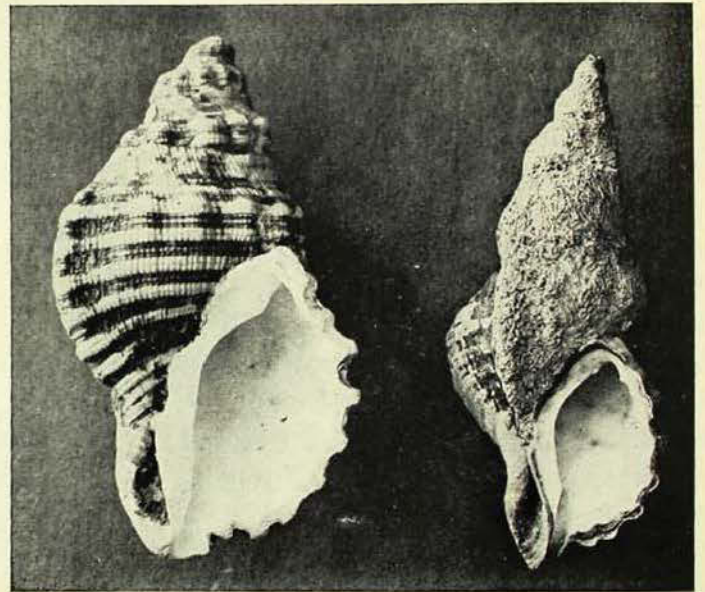
*Tent Shells, owing to their exposed habitat on the rocky shore-line, often show variation in growth. A specimen of *Bellastraea sirius* from Sydney Harbour is much more elongated than its normal form on the left.*

the rocks round Sydney, is frequently found with its height increased considerably, sometimes to as much as twice normal height.

Closely connected with abnormalities of growth are the changes made in shells by damage or disease. One often finds a shell which does not look quite normal, to discover on closer inspection that there has been a break at some point of its growth, or that it has been attacked by a parasite. Some specimens of the large Ear Shell (*Haliotis nevosum*), recently found at Gerringong, were so altered by disease that they were hardly distinguishable from the South Australian species of Ear Shell (*Haliotis cyclobates*), a species quite unlike it in its normal form.

The amount of injury a mollusc can survive and repair is well illustrated in the case of a specimen of the rock whelk (*Charonia rubicunda*) collected alive at

Bottle and Glass Rocks, Port Jackson, last October. This was a particularly fine specimen, seven and a half inches by four inches, and had had a hole three and a half inches by two and a half inches knocked in it. This had been repaired by a deposit of shell covering the hole and extending to the mouth of the shell, where both the old lip and the new may be now seen. A case is on record in which a Paper Nautilus (*Argonauta*) not only repaired a hole, but used the broken piece to do it; the piece had been broken right out, but the animal had managed to keep hold of it, and, in replacing it, got it turned wrong side out and at right angles to its former position.



*Through being wedged tightly in a rock crevice, the specimen of the Rock Whelk, *Cymatillesta spengleri*, on the right has only been able to grow lengthwise, and therefore has a more elongate and narrower shape than the normal type on the left.*

The articles on Australian shells by Miss Joyce Allan, which have been a regular feature in THE AUSTRALIAN MUSEUM MAGAZINE for some time past, have been of great interest to collectors

throughout Australia, and to many visitors to the Commonwealth. This feature has been replaced in this issue by an article by Mr. Harold S. Mort, the well-known conchologist, but in the next issue the series will be resumed.