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Jacky Winter, or Brown Flycatcher.

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

● OUR FRONT COVER. The Jacky Winter or Brown Flycatcher (*Microeca fascinans*) is by Lilian Medland. It is one of a series of post-cards issued by the Australian Museum.

Amongst the many charming Flycatchers which Australia possesses, none is a greater favourite than this somewhat plainly-coloured little bird. It is confiding and friendly, and has made itself at home in our streets and gardens, where its bright little song—*peter-peter-peter-jacky-jacky-jacky*—may be heard all through the year. It likes to perch on an eminence, whether it be a stump or garden stick, fence post or a telegraph wire, whence it sallies forth to catch its insect prey upon the wing, usually returning to the same spot. After perching, it flirts its tail first to one side, then to the other, in a very pretty way, exposing the white sides.

This species is distributed in open country throughout Australia, but many races which have been sometimes regarded as related species occur. The generic name means "small house", and refers to the tiny nest, about two inches in diameter and very shallow, which is placed on the upper side of a horizontal fork, often at considerable height. Two bluish-white eggs are laid, mottled with brown and slaty markings at the larger end.

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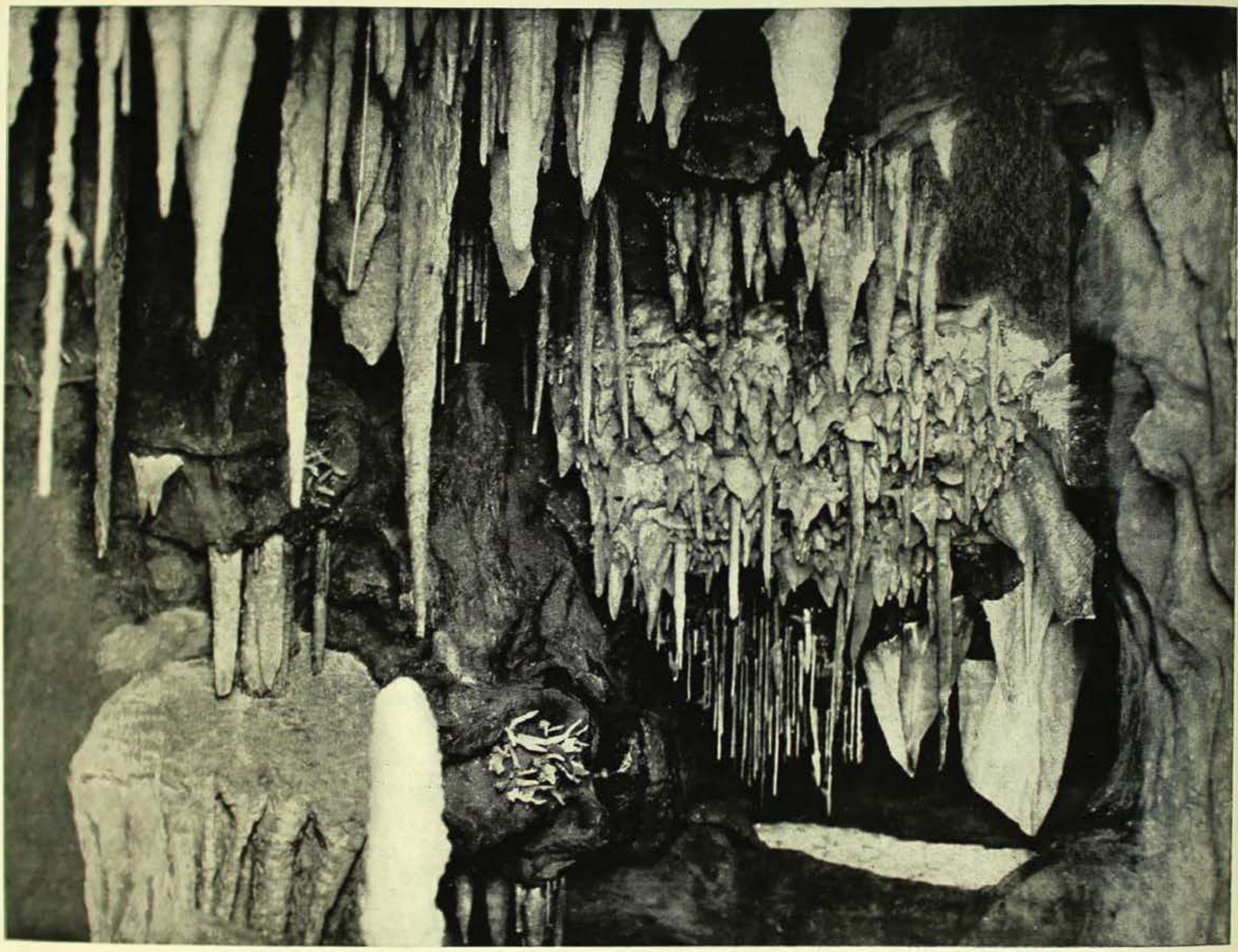

The Limestone Cave Exhibit in the Australian Museum. Good though this general view may be, it fails to reveal the radiant beauty of the various formations as displayed in the group.

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VOL. VI, No. 2. APRIL-JUNE, 1936.

A Limestone Cave in the Museum

By T. HODGE-SMITH

NEW SOUTH WALES is singularly blest with wonderful examples of limestone caves. The Jenolan Caves are perhaps the most famous of all Australian caves, mainly because everything possible has been done for the comfort and convenience of the tourist, and no expense has been spared in showing the marvellous cave formations to their best advantage. The Wellington, Abercrombie, Yarrangobilly and Wombeyan Caves contain a wealth of chambers crowded with formations showing the beauty and mystery of limestone caves to a very marked degree, and these are by no means all the caves to be found in the State.

Often when visiting a cave one felt a strong desire to lift out the cave as a whole and transport it direct to the mineral gallery of the Museum. An absurd thought, no doubt, but today we have at the entrance of the mineral gallery a cave that has in part been transported, and in fact completes the phantasy.

Having selected a somewhat dark space under the stairway at the entrance to the mineral gallery, it was first necessary to make a rough design, and to decide what should be shown in an exhibit such as this.

Beside showing a representative collection of stalactites, stalagmites, shawls, crystals, basins, cascades, "mysteries" or helectites, it would be necessary to show at least two levels of the caves connected by a chimney. In addition, every system of caves has its underground river. To illustrate the movement so common in limestone caves a broken column should be included.

The problem of showing all these features in a space measuring approximately nine feet by ten feet by ten feet presented considerable difficulties. However, with the aid of a suitably placed mirror, and a cunningly concealed cave built upside-down, the observer is able to look up through a chimney into a cave on a higher level and to see stalactites

A start is made with the construction of the Cave Group. The broken column is placed in position, and the laying of eight hundred square feet of wire gauze is commenced on the outer framework.

hanging from the roof sixteen feet above the floor on which he stands.

The underground river is on the floor level, and the illusion of looking some thirty feet along the river has been obtained by the use of parallel or almost parallel mirrors, one of which is entirely concealed. Thus was the difficulty of space overcome.

Having decided on the general layout of the cave group, the next step was to obtain the necessary material and to find someone capable of converting into reality the vision of a dreamer.

Fortunately the Museum is blest with a preparatorial staff whose members are experts at this very work, so that the second problem was readily solved by entrusting the work to Mr. J. Kingsley, Assistant Preparator.

The first problem was made easy through the kindness of Mr. Perrott, who readily gave the Trustees permission to enter his property and collect material from the Cliefden Caves, Belubula River, near Mandurama, New South Wales.

It might not be out of place here to mention very briefly the reason why we find huge caverns in limestone and not in sandstone, shale, or granite. In the first place, limestone is composed of calcium carbonate, or, as it is more commonly called, carbonate of lime. Occasionally limestone is deposited by chemical action, but more commonly it is the result of the accumulation of innumerable sea-shells, or else it marks the position of an ancient coral reef. All rocks contain a great number of cracks, sometimes with a more or less regular arrangement. Rain water naturally finds its way into these cracks, and thus rocks may contain a surprisingly large quantity of water. With sandstone or granite the chemical action of this water is very slight, but with lime-

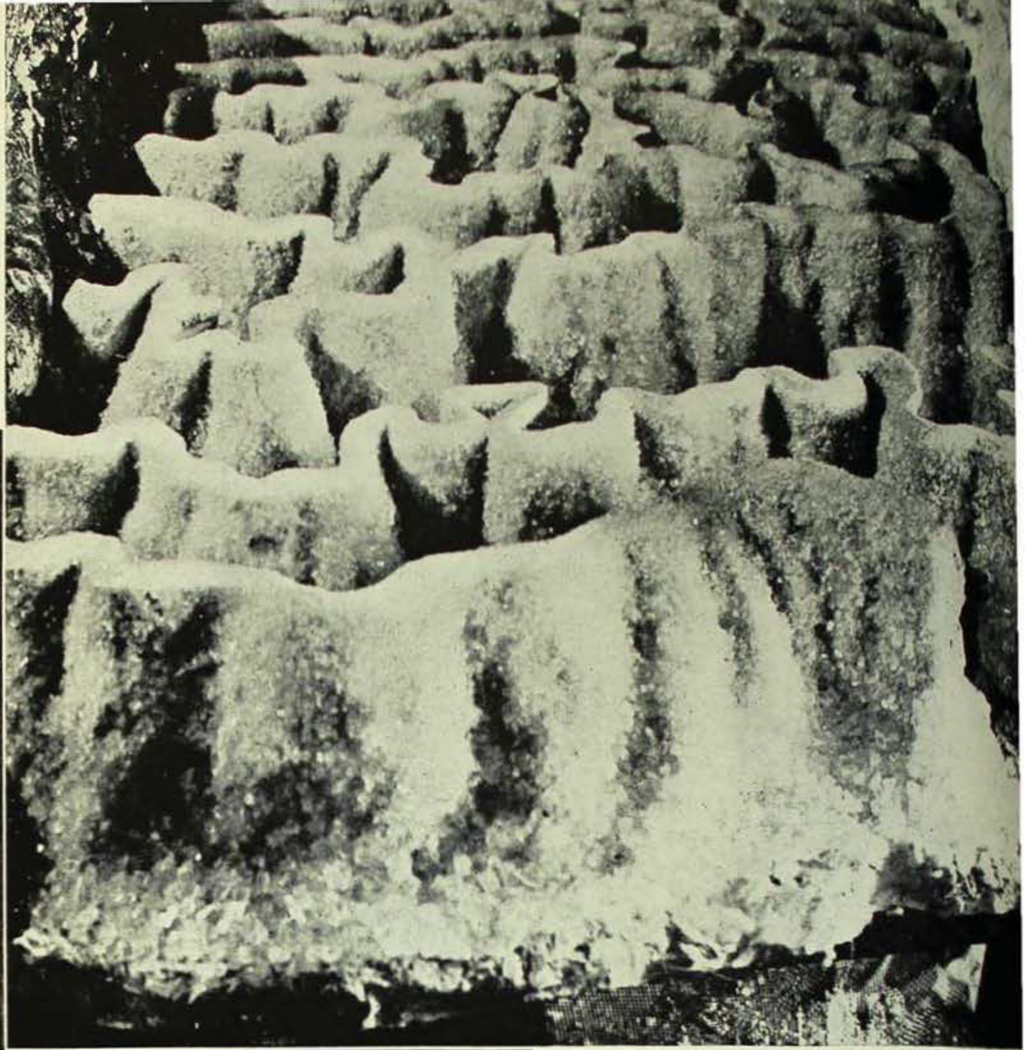
A further stage in the construction; the gauze is here seen in process of being covered with the composition used in making the rock. In the bottom left hand corner is the rock upon which the broken column is to rest.

stone the action is very pronounced. Rain water absorbs carbonic acid gas from the air; incidentally this is the gas we all exhale when we breathe. Charged with this gas, it has the power of dissolving the limestone, and thus we find the system of cracks in the rock converted into more or less vertical "chimneys" and horizontal passages. The falling in of the roof of these passages helps to increase their size and so caves are formed. The upper cave at Cliefden is more than thirty feet high.

The most characteristic features of limestone caves are the stalactites, stalagmites, and various other formations composed of carbonate of lime. The surface water charged with carbonic acid finds its way to the roof of the cave either along cracks or through the porous rock, and during its journey from the surface to the roof it dissolves the calcium carbonate of the limestone. Immediately the drop of water forms on the roof of the cave it commences to evaporate and to lose its carbonic acid gas, in consequence of which it leaves a little ring of calcite adhering to the roof. As each drop becomes replaced by another, more and more calcite is left, until at last there appears the stalactite. Should the supply of carbonated water be sufficient, the drop of water will fall to the floor, still carrying some lime in solution, which will be deposited on the floor in the form of calcite in precisely the same way as was done on the roof, and in the course of time a stalagmite will be built up from the floor. When the stalagmite and the stalactite meet, they will amalgamate to form a solid pillar. Sometimes movement in the cave will cause the floor on which the pillar is resting to sink or move, and then the pillar will break, as is well shown in the Museum Cave. Where the water comes down an overhanging wall a shawl-like formation replaces the ordinary stalactite. The formations known as "mysteries" or helectites have aroused much speculation as to their origin. Unlike the stalactites, they appear to disregard altogether the laws of gravity, and they twist and turn in every conceivable manner, assuming the most fantastic shapes. But why they do this is still a mystery, as their popular name implies.

All these things and many more besides can be seen at the Cliefden Caves, the entrance to which gives no idea of the huge caverns, long passages, and steeply descending chimneys hidden below the surface. This small entrance is marked by two large trees, a kurrajong and a box, growing side by side, and leads to an almost vertical chimney which opens into a large cave more or less dome-shaped. From here passages lead off in a number of directions to other caves at lower levels.

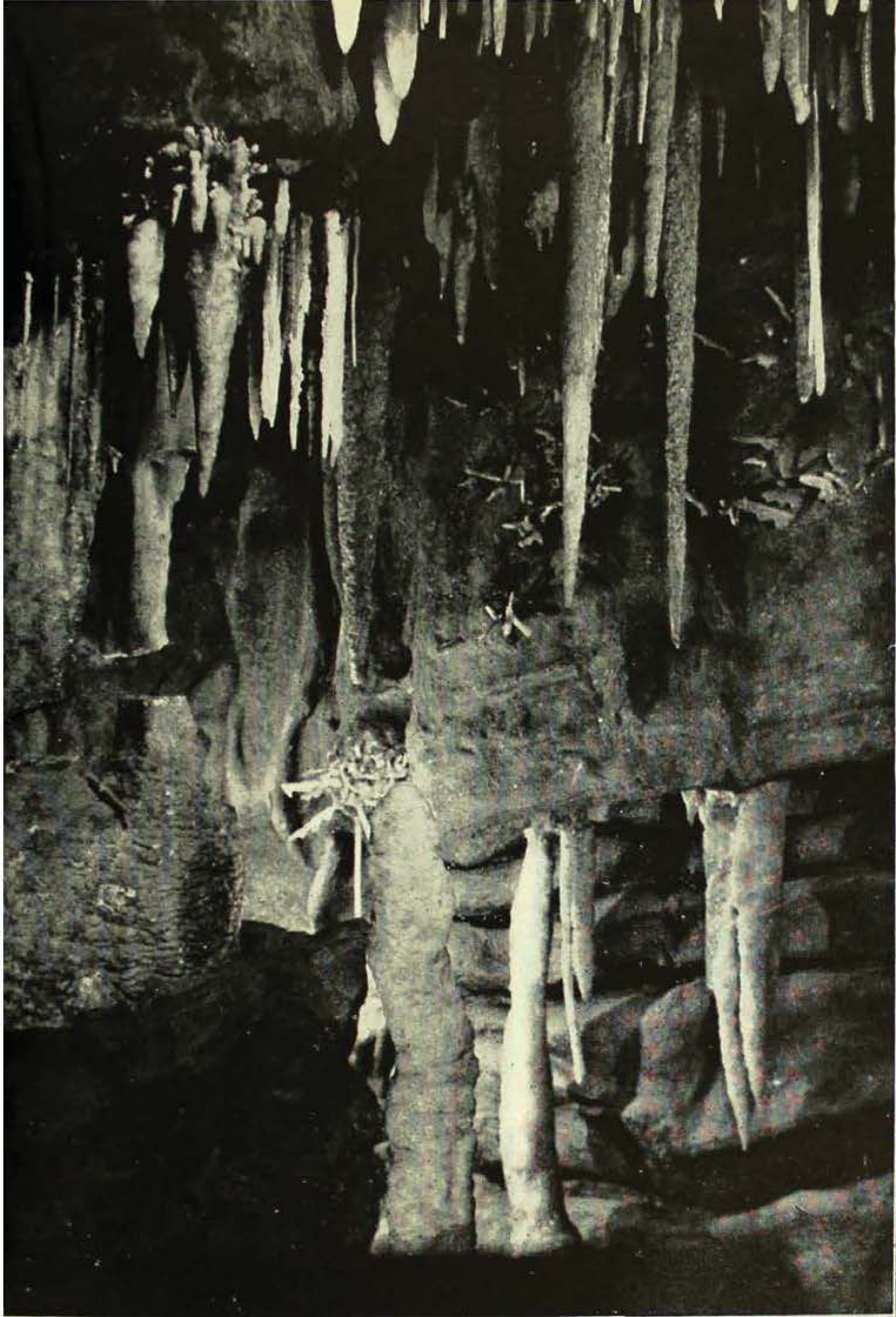
But to return to our story, the real work of the cave group began in earnest when in August, 1932, the Museum party, *The completed basins with their thousands of scintillating calcite crystals placed in position. Compare with lower figure on following page.*



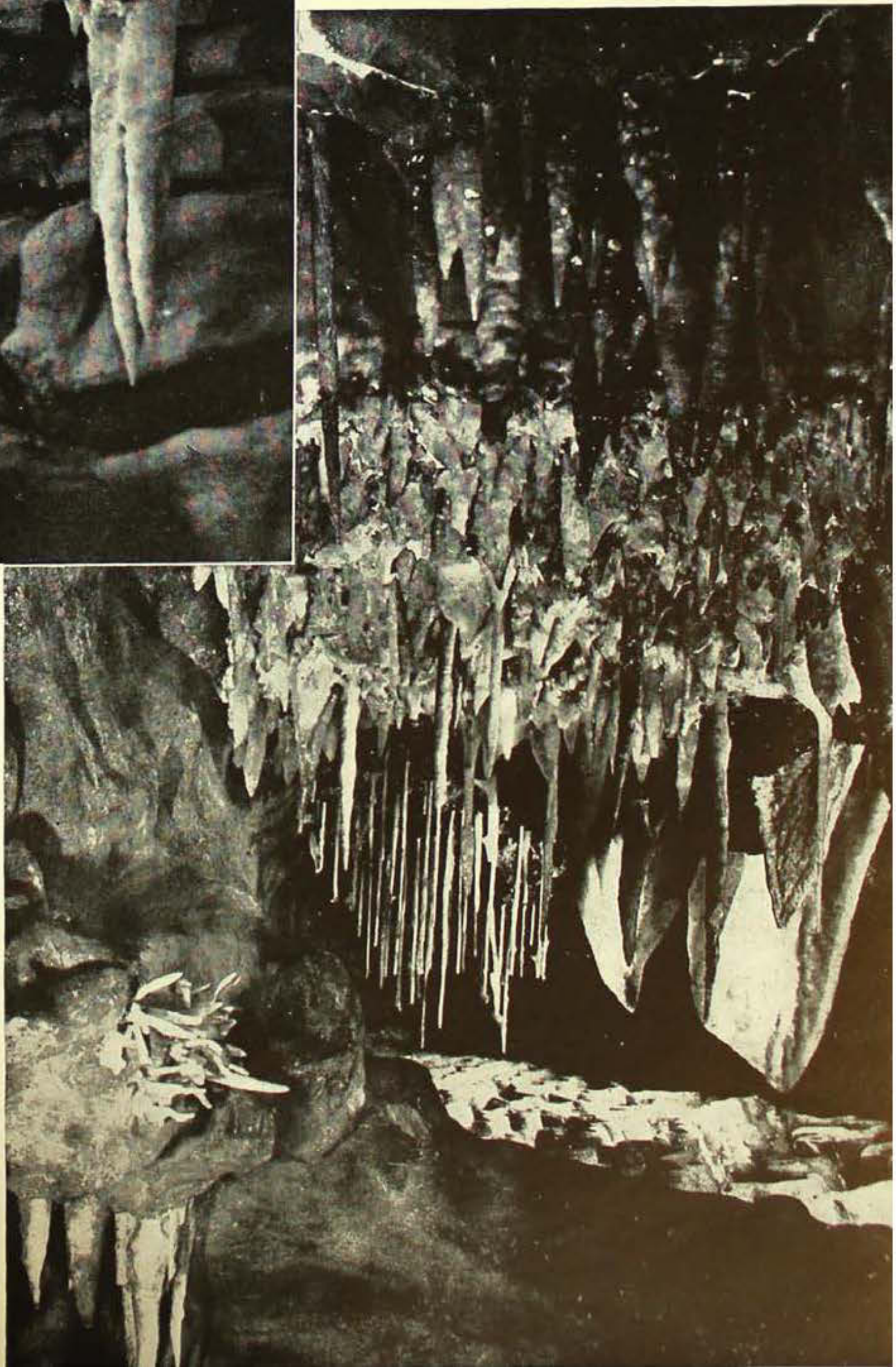
Mr. J. Kingsley breaking away the waste mould, thus revealing the plaster cast of the basins that he had previously modelled in clay.

consisting of Mr. G. C. Clutton, Senior Preparator, Mr. J. Kingsley and myself, visited these caves. We camped in a cottage kindly loaned by Mr. J. Dunhill, who with his wife kept a kindly eye on the party and did everything possible to make our stay comfortable and pleasant.

Most of the chambers of the upper levels of these caves had been ruined by vandals, so that it was necessary to go to the lower levels in order to secure the right material. After much exploration and a careful survey of the suitable specimens the work of collection began. Care was



A view showing the broken columns on the left, and a small column in the lower centre of the picture.



Another view showing the beautiful shawls over the glittering basins. The long slender stalactites, the stoutest no thicker than a pencil, presented difficulties in transport.

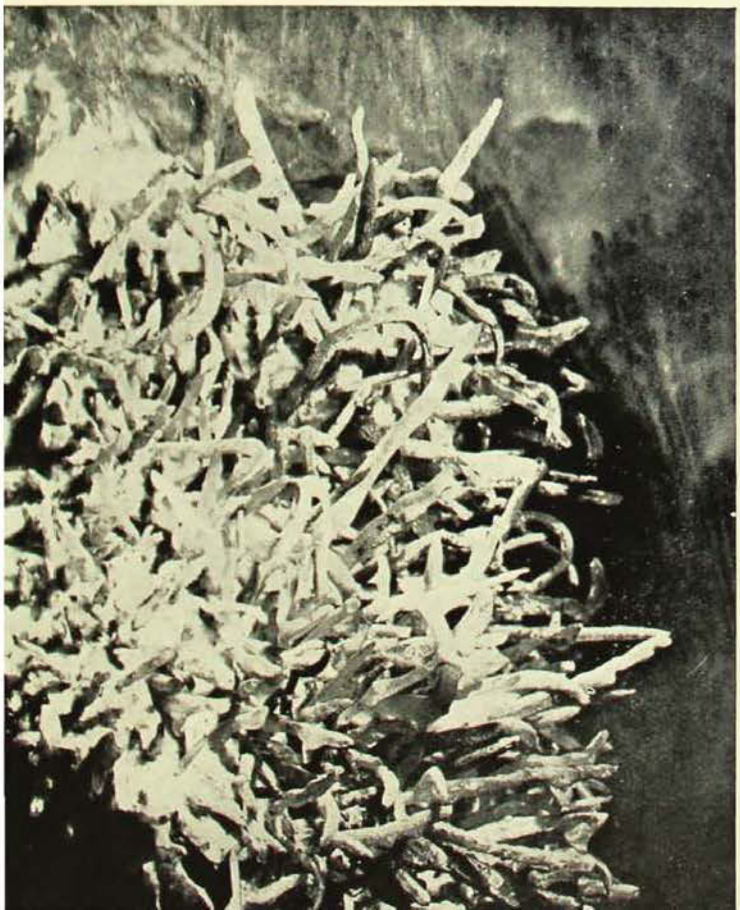
taken to do as little damage as possible, and to select our specimens so as not to destroy the appearance of the caves. Then commenced the work of transporting the material from the depths to the surface. The story of pushing, pulling, and lifting heavy loads of fragile specimens along narrow sinuous passages, through vertical chimneys, and over slippery inclines, is one that had better remain a secret of those caves. We brought back to the Museum over one thousand specimens.

Now the framework could be set up, the disposition of the various formations finally chosen, and construction of the rock commenced. Alas! when Mr. Kingsley placed the stalactites, shawls, etc., in place, he found that the material secured was totally inadequate to produce the effect required, so that in April, 1934, nearly two years after the first expedition, we were again undergoing something akin to a Turkish bath in getting material from below to the surface. This time Mr. H. Jackson, of the Museum staff, took the place of Mr. Clutton, and we returned to the Museum with a further thousand specimens.

The complete reconstruction of a crystal basin before being placed in position. The placing of many individual crystals called for great skill.

It was impossible to bring back the beautiful basins, the marvellous groups of mysteries, the cascades, or the grottoes of scintillating crystals. Accordingly it was necessary for Mr. Kingsley to model these.

The basins were first modelled in clay and then a mould was made from the clay model. One of the pictures shows Mr. Kingsley cutting away the



A group of mysteries. Each individual had to be carefully taken from its position in the Cliefden Caves, and with infinitely greater care placed in its proper position on the artificial wall of the Cave group.

mould, leaving the final cast in plaster. The treatment of this cast with specially selected wax and accurately graded cleavage rhombs of pure calcite brought to light with amazing accuracy the beauty and extraordinary form of these basins, which we so much admired in the Cliefden Caves.

Hundreds of mysteries, those curious twisted forms which appear to defy the laws of gravity, were carefully taken from their position in the real caves. Each specimen had to be put back on the artificial wall of the cave group in their proper position, so that a true repro-

A glimpse of one of the caves at a higher level. The stalactites are seemingly sixteen feet above the observer. A hidden cave and a suitably placed mirror were necessary to achieve this result.

Stately stalactites. This is not a scene in the Cliefden Caves, but in the replica in the Australian Museum.

duction of a mystery group can be seen in all its mysterious glory.

The cascade was modelled and then the delicate tints were painted by Miss Ethel A. King. At this stage the cascade was true in form and colour, but lacked life. The application of very fine cleavage rhombs, specially washed and properly graded, transformed the dead thing into the living cascade, with its glittering surface of a million tiny lights.

At Cliefden Caves we found numerous hollows which originally were pools of water, but are now covered over with a deposit of calcite. On breaking open the top covering of this calcite, marvellous groups of the dog-tooth spar variety of calcite were revealed. It was found impracticable to bring back one of these "jewel caskets" complete. Instead, a large collection of individual crystals and groups of crystals were brought, together with some of the top crust of calcite. With infinite care these were brought together in such a way as to reproduce most faithfully all the sparkling beauty of the "jewel casket" of nature.

In order to create the sense of reality it was decided to add drops of water to the end of a few of the stalactites. The Crown Crystal Glass Company, Limited, Sydney, went to considerable trouble to create drops of water in glass, and the questions already asked about those drops prove the success of their efforts.

One of the most difficult tasks was the construction of the underground river. The ordinary method of indicating the surface of water by a sheet of glass would not do, because no matter what we did it was impossible to eliminate the straight lines of the junction of this glass and the mirrors. Only by skilfully modelling and flat-varnishing the bed of the river to the water line was the desired result achieved.

The Underground River, of which approximately thirty feet can be seen by the observer, was made possible by an arrangement of concealed mirrors.

In the construction of the rock, which of necessity had to be artificial, over half a ton of plaster of Paris and nearly three-quarters of a ton of pulp were used. This mixture was applied to wire gauze, of which eight hundred square feet were used, supported on inch by inch oregon, which in the aggregate measured more than half a mile. The painting of the rock presented difficulties which the British Australian Lead Manufacturers' Proprietary, Limited, were able to solve for us. Incidentally, nearly two and a half gallons of paint were required.

A unique feature of the cave group is that one has actually to pass through the cave to reach the mineral gallery. By this means the museum atmosphere has been entirely eliminated, and the idea of actually being in a cave accentuated. The main exhibits are protected by glass, but so well has the glass window been camouflaged that it has been necessary to place a notice "Beware glass" on the window.

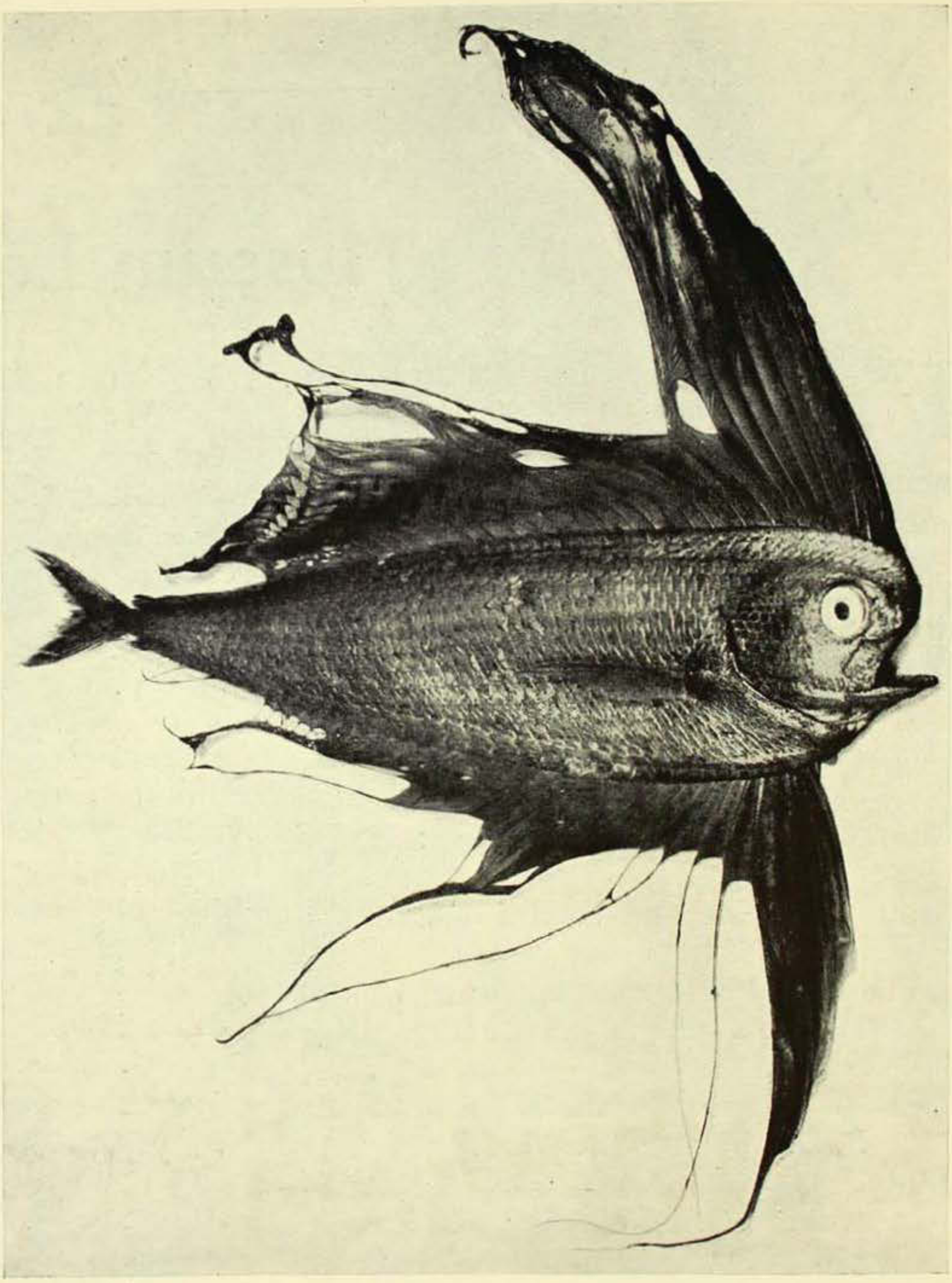
Thus, after three and a half years' work, the Trustees of the Museum present to the public a replica of a limestone cave.

The Wing Fish

By G. P. WHITLEY

MR. HARRY WANN, the well-known illustrator of "Fishy Facts" in the *World's News*, was confronted by a fish as extraordinary as any he had depicted when he found the Wing Fish, here featured, washed ashore on Balmoral Beach, near Sydney, on May 20, 1935. This species had never before been seen in Australian waters, and Mr. Wann presented his find to this Museum, where hitherto only New Zealand specimens had been exhibited. The Balmoral fish was a female, about eighteen inches long, and the dorsal fin was nearly one foot high. The flowing, wing-like dorsal and anal fins are characteristic of the species. Unfortunately, they are easily torn, only their bases being protected by some of the curious, thin, papery scales which cover the body. It is of a frosty silvery colour, said to be luminous in the dark; the fins are dark blue, with a row of circular turquoise spots along the hinder membranes, and the eye is silvery, with a dark blue pupil.

The Wing Fish or Fanlight Fish apparently floats about in open ocean waters, and may feed on jellyfish or salps, because large numbers of these organisms were washed ashore in May last year. However, nothing definite is known of its habits.



The Wing Fish (Pteraclis velifer australiæ) from Balmoral, Port Jackson, N.S.W. The only known Australian specimen.
Photo.—Courtesy Sun Newspapers Ltd., Sydney.

Peter Simon Pallas, who first described a Wing Fish in 1770, thought the fins were used for sustained flights. Baron Cuvier was probably nearer the mark when he suggested they were to maintain equilibrium, but, he asked, might they serve to catch the wind as in the Sailfish? They may act as brakes; they may be purely ornamental; we can only guess until observations on living specimens can be made.

I am indebted to Sun Newspapers Limited, Sydney, for the excellent photograph of Mr. Wann's specimen. It was made from the fresh fish, and originally appeared in *The Sun* of May 30, 1935. Technical accounts of the species, which was named *Pteraclis* (i.e., wings enclosed by double row of scales) *velifer* (a sail-bearer) *australiæ* (of Australia), appeared in the *Records of the Australian Museum*, Vol. xviii, 1931, p. 146, and Vol. xix, 1935, p. 238.

Australian Museum Lectures

THE Popular Science Lectures, to which there is no charge for admission, are as hereunder for the 1936 session. The lectures begin at 8 p.m., but doors are open at 7.30 p.m. They are illustrated by slides and exhibits. In a style free of technicalities, the lecturers will tell nature's story.

April 30—"The Economic Value of Birds": J. R. Kinghorn, C.M.Z.S.

May 14—"Insect Societies": K. C. McKeown.

May 28—"Giants of the Past": H. O. Fletcher.

June 11—"Life and Habits of Shells": Miss J. Allan.

June 25—"Primitive Fishermen of the Pacific": F. D. McCarthy, Dip. Anthr.

July 9—"Ice Ages and Their Effects": R. O. Chalmers, A.S.T.C.

July 23—"Wonder Fishes of Australia": G. P. Whitley, F.R.Z.S.

August 6—"A Naturalist in Strange Places": T. Iredale, F.R.Z.S.

August 27—"Hunger and Harvest in Oceania": Miss E. Bramell, M.A., Dip.Ed.

September 10—"The Early Gold Diggers of New South Wales": T. Hodge-Smith.

September 24—"Darwin's Life and Work": C. Anderson, M.A., D.Sc.

October 8—"Barnacles and Their Story": F. A. McNeill.

For the school children the following lectures, with the approval of the Department of Education, have been arranged. The lectures commence at 2.30 p.m., and occupy forty-five minutes. They are fully illustrated by lantern slides and specimens. Arrangements for attendance of scholars are made by the Department. At the close of lectures opportunity will be given the pupils for questions and discussion.

May 26—"Birds": J. R. Kinghorn, C.M.Z.S.

June 9—"Mammals": E. L. Troughton, C.M.Z.S.

June 23—"Shells": Miss J. Allan.

July 7—"Spiders": A. Musgrave, F.R.E.S.

July 21—"Geology": T. Hodge-Smith.

August 4—"Reptiles": J. R. Kinghorn, C.M.Z.S.

August 18—"Fishes": G. P. Whitley, F.R.Z.S.

September 15—"Shore Life": F. A. McNeill.

September 29—"Insects": K. C. McKeown.

The Feet of Birds

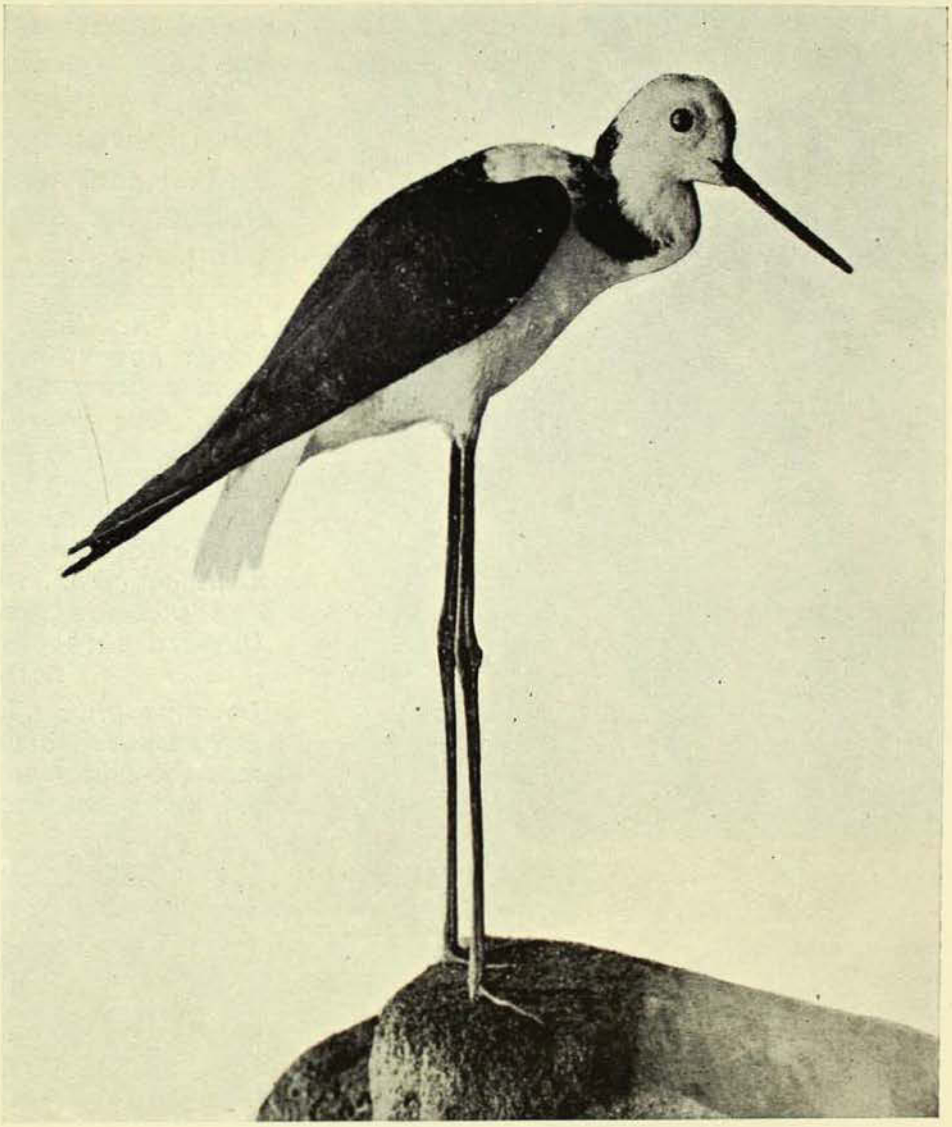
By J. R. KINGHORN, C.M.Z.S.

THE inspiration to write this story arose from inquiries by many children met with during several tours of country districts, and I now wonder just how many young naturalists or field workers give much of their time to the study of the feet of birds and the great variety of structural adaptations to be found among them.

Probably there are a few who delve into the subject, but the great majority of bird lovers pay more attention to colour and song, and behaviour generally, than they do to structural adaptations. If observers were to extend their interests a little they would learn that the foot of a bird plays almost as great a part in the search for daily food and its acquisition as does the beak. A study of feet and beaks leads to a better understanding of the general habits of birds, and in a broad sense should point to the kind of food sought after, and to the type of locality in which the species lives and carries out its daily duties.

In a previous article* it was pointed out that food, the procuring of which is one of the great driving forces in nature, is available only to those birds which are adapted to collect it; therefore the search for food, and the struggle to secure it, plays a big part in evolution, and is a prime factor in bringing about gradual changes in structural adaptations, and eventually the establishment of new species.

Evidence that the type of leg and foot, together with the structure of the beak,

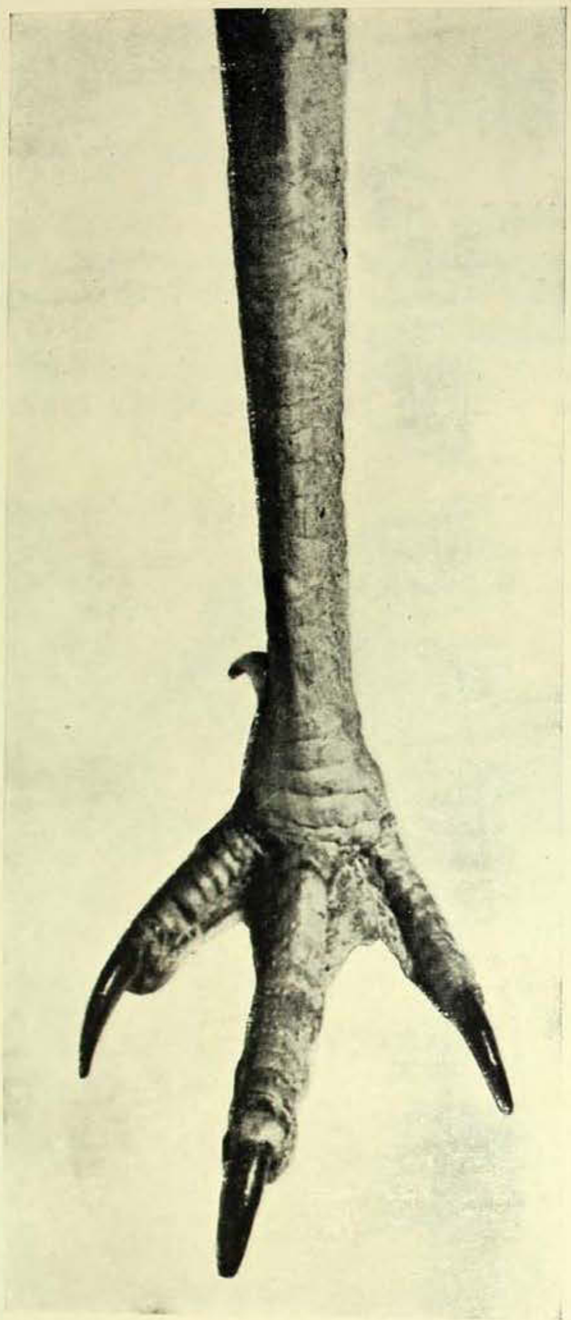


The White-headed Stilt may be regarded as typical of the wading birds. The legs are long, the toes straight and webbed at the base.

would indicate the kind of country inhabited by the bird might be found in the following examples.

Species such as tree creepers have toes with long, curved, and sharp claws for clinging to the branches or bark of a tree, and, as an extreme, totally different from

* "The Beaks of Birds", *Austr. Mus. Mag.*, v, 8, 1934, p. 265.



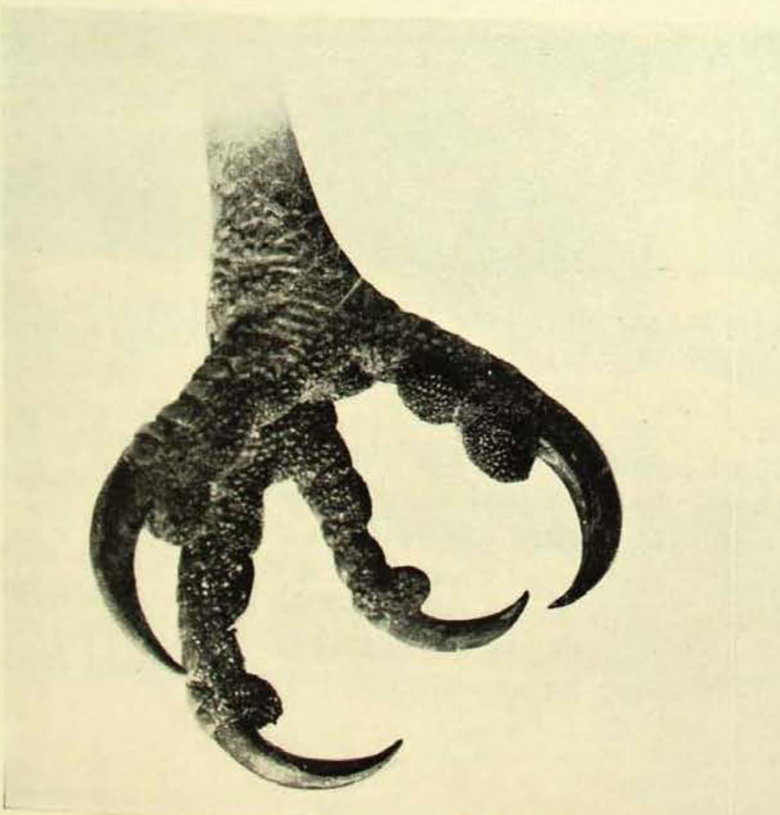
the toes of ostriches, emus, quail, dotterel, etc., which are terrestrial in habits and have no hind toe, or at most a rudimentary one, and which have short, heavy feet, more or less padded for walking or running after food, or away from their enemies. A glance at the foot of almost any ground bird should convince the observer that such a foot most certainly points to the fact that the bird would not be found in the trees, and that a strictly cursorial habit has a tendency to reduce the toes both in number and length.

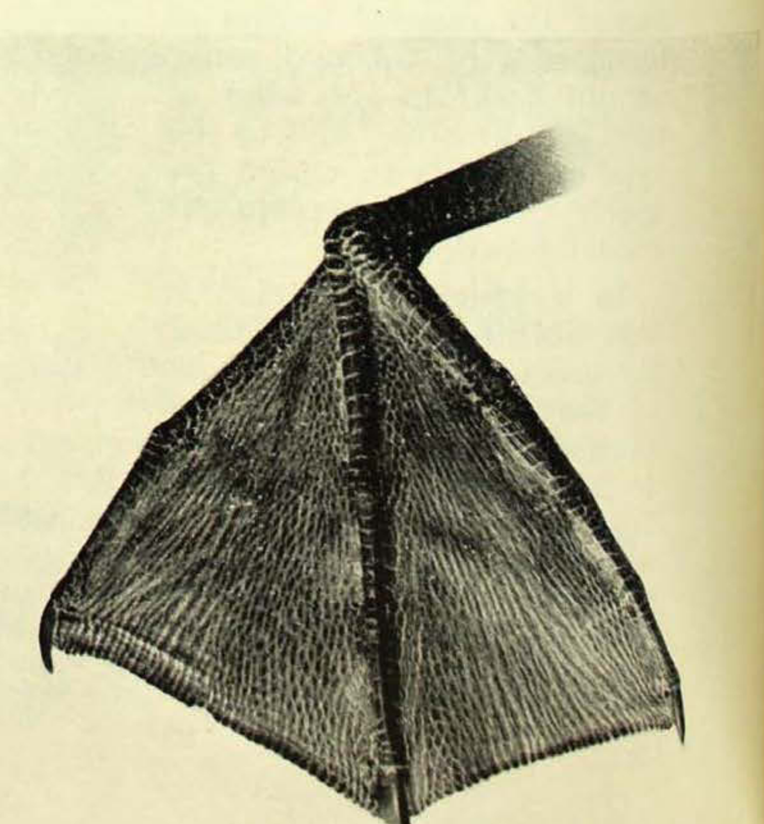
In some birds, such as swallows, which spend most of their time on the wing, the feet are very weak and poorly developed, indicating that they play no part in the search for food; but in swallows and birds of similar habits we find strong wings and broad flat beaks, which enable the owner to catch food while on the wing.

Left: The limbs of the Secretary Bird, a terrestrial eagle, have almost completely changed in structure from a grasping to a terrestrial type. The legs are long, toes short, and claws blunt. Excepting the hind toe, the foot is not unlike that of the Emu.

Lower left: Eagles, kites, hawks, and their allies possess a type of grasping foot, but which is suited to the catching and holding of swiftly moving prey, such as birds, rabbits, and mice. The leg is short and powerful, claws long, curved, and very sharp, the grasping power being further increased by the fleshy bulbs under the toes.

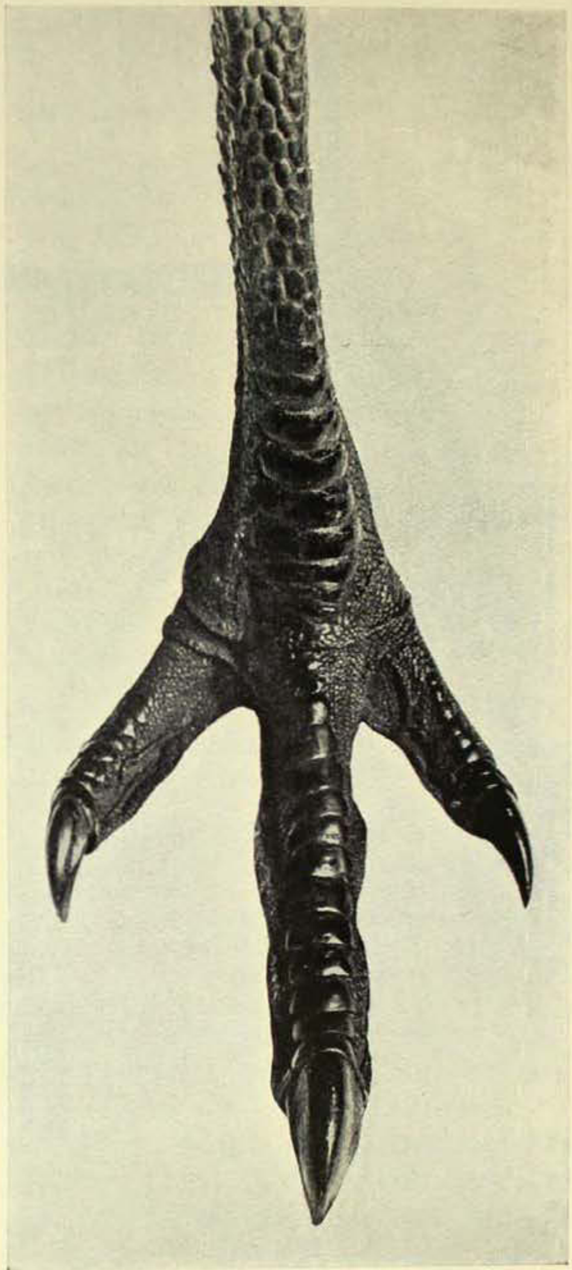
Lower right: The true swimming foot is generally fully webbed between the toes, but some species have more flexible toes and sharper claws for perching on trees or climbing on cliffs and rocky ledges.





Some birds have become adapted more strictly to an arboreal life than others, and have developed feet of a peculiar nature. Such types include the well-known parrot family, in which the middle and inner toes are yoked together and point forwards, while the outer toe is more or less mobile, thereby forming a perfect grasping foot by which food may be held up to the beak to be nibbled at. A somewhat puzzling feature in regard to parrots is that, while the feet have been modified specially for an arboreal life, some species feed almost entirely on the ground; there is no change in the type of foot through this habit, but it is notable that in the ground parrots proper the legs are comparatively longer than they are in the more strictly arboreal species.

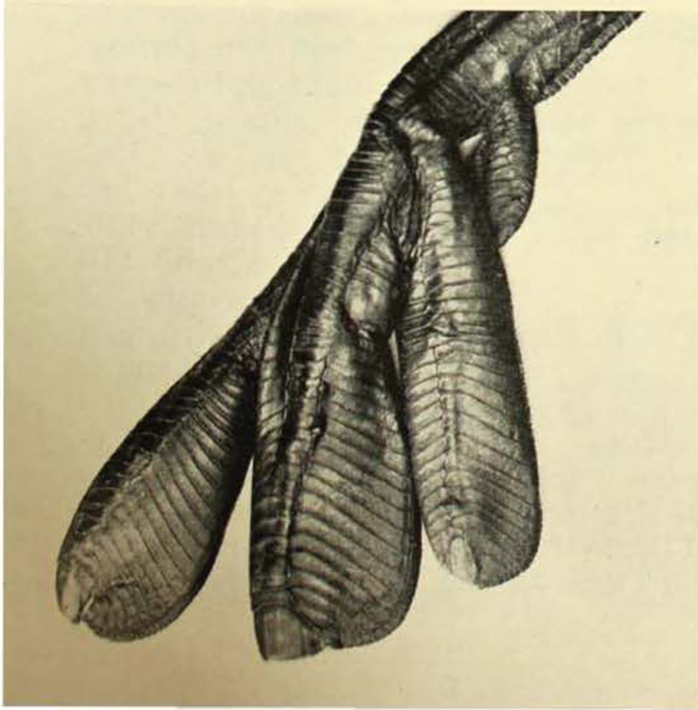
The feet of the great majority of birds, among which we might place robins, wrens, sparrows, and the like, are adapted for perching. The hind toe is well developed and all are fairly long and slender, with sharp

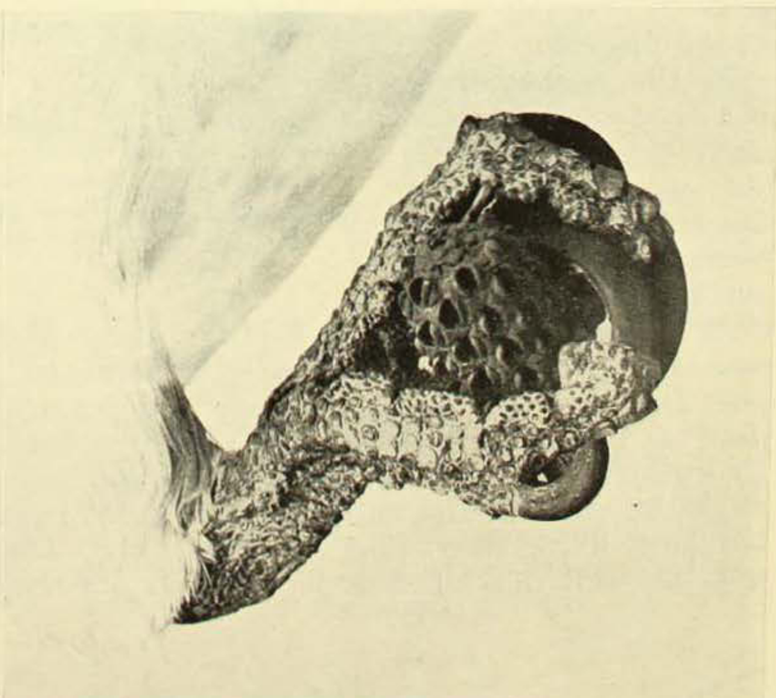


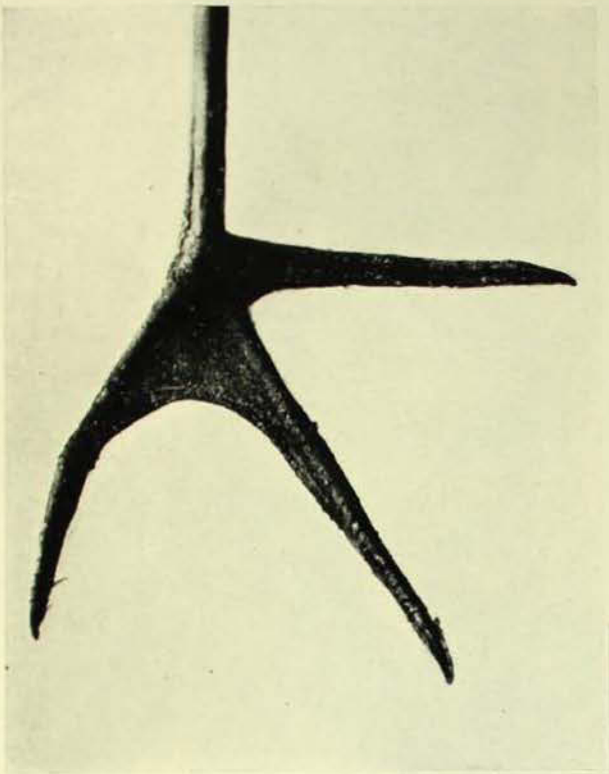
Right: The foot of the Emu is typical for most of the terrestrial birds. It is specially developed for walking or running. The leg is powerful, the toes short, blunt, and straight, the pads under the foot being thick and leathery.

Lower left: A type of swimming foot adapted also for walking. This is the lobed-toe type, common to grebes, coots, and similar birds.

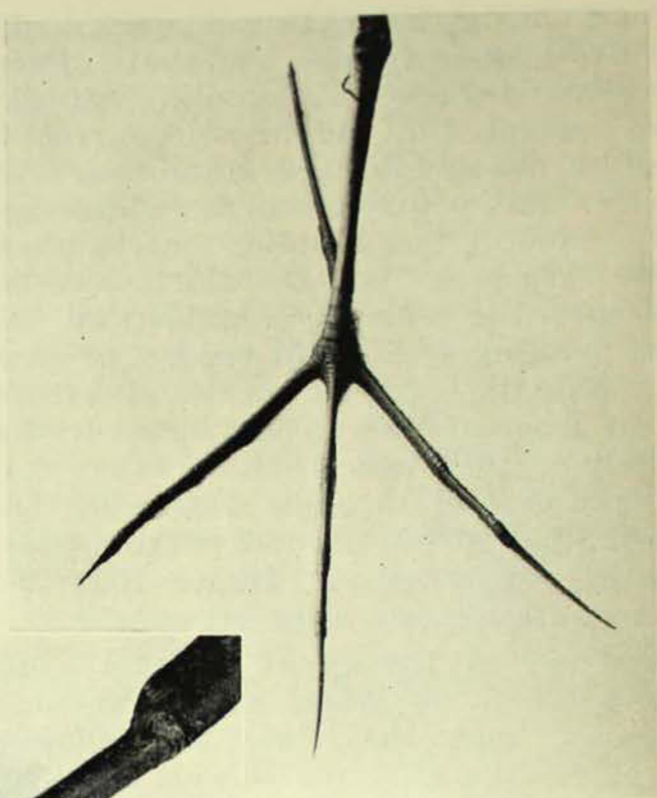
Lower right: The zygodactyle foot of a parrot. The hind and outer toes point backwards, whilst the second and middle toes are directed forwards, thereby forming a true grasping foot which can also be used as a hand.







The foot of a typical wading bird. This foot enables the bird to walk with comparative ease on the soft mud in search of small aquatic creatures which form the principal part of its diet.



The toes of the Jacana or Lotus Bird are enormously developed, thus distributing its weight more evenly over a wide area as it steps from plant to plant on the surface of the water over which the bird moves.

Typical foot of a passerine bird; wrens, robins, sparrows, magpies, crows, and thousands of other perching birds have feet conforming more or less to this plan.

claws; while they enable the birds to grasp the slenderest twig or blade of grass, they are so constructed as not to hinder the birds in hopping about on the ground.

In the eagles, owls, and most other birds of prey, the leg is short but powerfully built, the claws are strongly recurved, and the under surface of the toes bear thick rough pads for grasping purposes, enabling such birds to snatch their prey from tree or ground as they swoop past, and hold it with greater security. Exceptions among the birds of prey might be cited in the vultures, which do not hunt living prey, and therefore have not the well developed grasping feet of eagles, hawks, and the like; vultures are scavengers, and merely wait nearby until their prey dies before they commence to make a meal from the carcass. Their feet are clumsy, with blunt and slightly curved claws, being adapted to standing and taking the full weight of the bird while the heavy, strong bill tears off portions of flesh from whatever carcass the bird may be feeding on. An extreme example among birds of prey is the Secretary Bird of Africa. Here is a species that has adapted itself to a terrestrial life, for, while a good flier, it walks about seeking food in the form of rats, small mammals, snakes, lizards, and ground birds, and so its legs and feet are those of a walker; the legs are very long and strong, the feet short and the claws blunt; the body, head, and beak alone indicate that the Secretary Bird is a cousin to the eagles.

Cranes, stilts, brolgas, ibis, and others of the same general type, are regarded as wading birds, though some species, such as brolgas, search for food mainly on the plains. Most of these birds have small webs at the bases of the toes, which enables them to move freely over the surface of soft mud near the shores of swamps or streams. Waders seldom appear to be in a hurry, their long legs allowing them to take slow and stately steps, and to hasten slowly. In comparison to its size, the stilt has the longest leg of any bird, whilst the frigate bird has the shortest. The latter is a sea bird and therefore a swimmer and diver, though it spends most of its time on the wing. It is generally thought that all swimming birds have webbed feet, but this is not always so, for in the coot and grebe the toes are merely fringed with broad lobes resembling leaves, while waterhens have no webs at all, the toes being long and slender. These birds spend most of their time seeking their food on land, particularly in the mud round the edges of swamps, taking to the water on the approach of enemies, or to get to some island where there is a safe retreat for nesting. Their feet have undergone very little change in the direction of adaptation to the life of a swimmer, yet they are excellent swimmers.

Perhaps the most extraordinary foot of all is that of the Jacana or Lotus Bird. The bird is small and light of body, the legs long and slender, and the toes and claws long, straight, and almost out of all proportion to the rest of its measurements. Here we have a very special adaptation by which the Lotus Bird is able to walk or run about on the large floating leaves of water lilies and other plants, stepping from leaf to leaf with confidence, its large feet distributing the weight evenly, so that the leaf may not be forced below the surface of the water. And so we could go on and on, giving examples of feet and their uses, in a broad and general sort of way. It is only natural that to understand the more intricate details of structural adaptations and their development, one must make a study of anatomical features, more particularly the skeletal ones. For example, in cursorial birds it would be found that with the advance in pedestrian locomotion, the development of the legs and feet is in exact ratio to that of the pelvic girdle, and so on; and, though it is not suggested that a detailed study of this important branch of ornithology be taken up, it is certain that a slight knowledge of the subject will add to the observer's pleasures when rambling through the country.

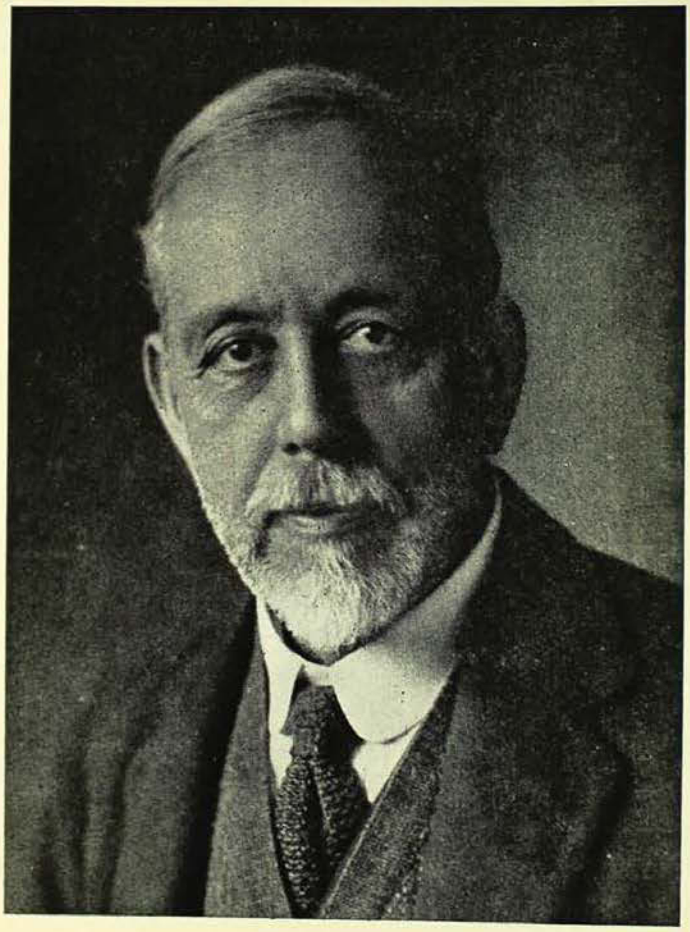
Among recent visitors to the Museum were the following: M. Bader, Trade Commissioner for France; Mr. W. S. Jackson, London; Mr. S. C. Black, Johannesburg; Professor H. C. Richard and Dr. F. W. Whitehouse, University of Queensland; Mr. W. A. McDougall, M.Sc., Bureau of Sugar Experiment Station, Mackay, Queensland; Mr. A. T. Pycroft, President of the Council of the Auckland Institute and Museum.

* * * *

Professor W. J. Dakin, D.Sc., Mr. E. C. Andrews, B.A., Dr. G. A. Waterhouse, B.E., and the Honourable Dr. F. E. Wall, M.L.C., Trustees, have been granted leave of absence, and will be abroad in Europe and America for some months.

An Important Donation to the Museum

IN every natural history collection, no matter how large, there are always many unrepresented species, a number of which may eventually be secured by many years' work, others possibly never. In an institution such as the Australian Museum, where opportunities for field collecting by the staff are meagre and acquisitions consist largely of specimens submitted by the general public, this condition is particularly apparent. The extremely generous donation by Mr. H. J. Carter, B.A., is, therefore, all the more valuable, for he has presented the type material from his collection — a collection known to workers on Coleoptera, or beetles, throughout the world—together with many hundreds of specimens previously unrepresented in the Museum. This has enabled many blanks to be filled, especially in the families Buprestidæ, Tenebrionidæ, Cistellidæ, Elateridæ, and Dryopidæ, in which he has been particularly interested.



H. J. Carter, B.A. (Cantab.).

Mr. Carter, for many years a prominent educational authority in this State, and sometime President of the Linnean Society of New South Wales, has always had a love for his beetles, and he has devoted much time to their study. He is an Honorary Entomologist to the Museum, to which he is a regular visitor, and is widely known as an authority on Australian Coleoptera. His first paper upon beetles was published in 1905, and since that date he has described very many Australian species. These scientific papers are valued by the entomological worker, but are hardly known to students of popular natural history; to these, however, Mr. Carter's name will be familiar as the author of a delightful book, *Gulliver in the Bush*, in which he recounts his collecting experiences in many parts of Australia, on one of which journeys it was the writer's privilege to accompany him; its pages are enlivened with amusing reminiscences of man and insect encountered in his travels. His wide scientific knowledge had ample scope in *The Australian Encyclopædia*, of which he was part editor.

K.C.McK.

The Life History of a Tipulid Fly

By LUKE GALLARD

[The insects which form the family Tipulidæ are commonly known as Crane Flies or Daddy-long-legs, and a general account of the family, by Miss N. B. Adams, will be found in a previous issue (AUSTR. MUS. MAG., v, No. 6, 1934). In the present article Mr. Gallard describes the life history of one member of the family.—EDITOR.]

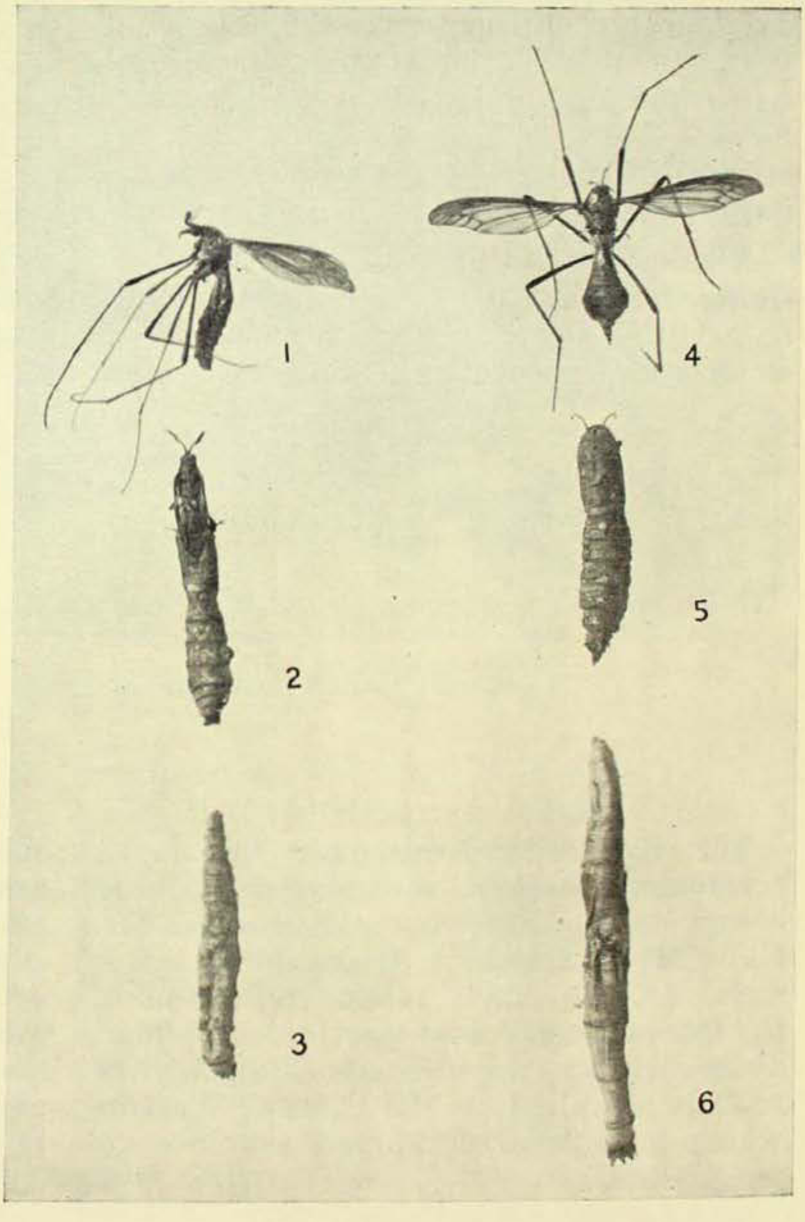
ADULT INSECTS.

THE adult male (Fig. 1) of the Tipulid species, *Ctenogyna bicolor*, is about five-eighths of an inch in length, with a small head and short plumose antennæ. On the dorsal surface the thorax and middle of the abdomen are dark brown; the terminal abdominal segment is surrounded by a dark band. The ventral surface is golden yellow in colour. The legs, which are rather short and stout for a Tipulid, are three-quarters of an inch to one inch in length, and of a golden yellow colour, darkening to dark brown towards the joints. The wings are dark brown but transparent, and have an expanse of slightly under one inch. The adult female (Fig. 4) is larger than the male, but lighter in colour; the abdomen is wider at the base, but terminates in a sharp point.

LARVÆ.

On May 23, 1934, at Epping, near Sydney, I collected from the rotting heart of a dead Apple-tree (*Angophora lanceolata*) about 109 examples of the larvæ. In tunnelling through the rotting wood, which was of the consistency of thick gum, one wondered how such slender and feeble larvæ were able to work their way through such material. They are dirty looking creatures when in this matrix, but after being washed they have quite a different appearance, and are extremely flimsy. Their segmentation is pronounced, and the integument is tough, though so transparent that some of the internal organs are visible.

The larvæ (Figs. 3, 6) are about one inch in length by three-sixteenths of an inch in diameter, and are of the ordinary Tipulid type, having the breathing spiracles hidden in the folding lobes of a



A Tipulid Fly (Ctenogyna bicolor). 1. *Male adult.* 2. *Pupa just emerging.* 3. *Dry larva.* 4. *Adult female.* 5. *Puparium.* 6. *Fresh larva.*

Photo.—L. Gallard.

six-lobed spiracular disk on the anal segment. It is to be noted that, in addition to the spiracular disk, this species has a double pair of long white gill plates, situated ventrally on the anal segment; these turn upwards and are hard to detect when the larvæ are dirty. The spiral folds or flanges are devoid of hairs or spines. The segments seem to work like those of a telescope, and it is this action which enables the larva to work its way through the sticky mass in which it lives.

Some of the larvæ develop and pupate in one year, but others which, perhaps from lack of sufficient nourishment, miss the ordinary brood season, will remain in the larval condition until the following year. In my experiments a number were left in the jars, and these are still perfect larvæ. Thus we may conclude that the larval period is one or two years, according to conditions.

A tabulated account of the 109 larvæ shows that pupation begins in September or early October. Two flies emerged on October 1, and between that date and October 18 fifty-six had emerged, consisting of thirty-one males, nineteen females, and six unsexed individuals. After October 18 no more emerged, but early in March, 1935, it was observed that the experiment jars still contained a number of well grown larvæ. In two of the largest receptacles I found quite a number of small larvæ, half to three-quarters of an inch in length; these had evidently come from eggs laid by adults which had emerged in the jars, or perhaps from eggs which had been in the soil when it was collected.

PUPÆ.

In passing into the pupal form (Figs. 2, 5) the larvæ become slightly shorter, the cuticle hardens, and the extended spiral folds of the segments become chitinized and toothed. The wing pads and legs are folded under the thorax, and a pair of breathing horns, about one-eighth of an inch in length, protrude outwards from the front of the head. The pupal period seems to be thirteen to seventeen days.

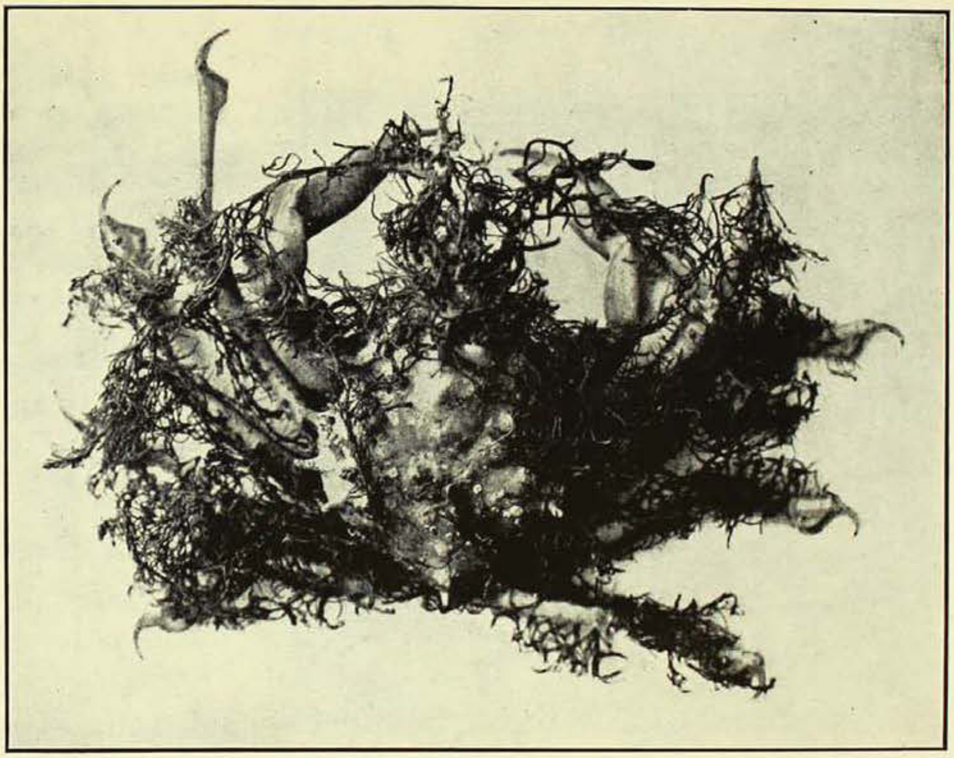
The Australian Museum's important economic research on marine timber borers was advanced a stage when Mr. F. A. McNeill visited Brisbane for a few days early in April at the invitation of the Queensland Forest Service. Considerable work was done in consolidating the reports compiled by Mr. C. J. J. Watson, which have been developed in close co-operation with Sydney authorities, and is now in the press. Opportunity was also afforded Mr. McNeill to make a close inspection of timber-testing stations and wharves in the Brisbane River and Moreton Bay, resulting in the preparation of a special contribution upon crustacean marine borers for inclusion in the Queensland publication.

Seaweed Crabs and Their Camouflage

By F. A. McNEILL

EVERY visitor to the coast has noted the often abundant weed growths which clothe the rocks at the edge of the low tide zone. It is here that the Seaweed Crabs find sanctuary. Except when disturbed by the questing hand of some observant human, the lives of these weed dwellers seem to be singularly placid and free from molestation, for, coupled with their hiding habit, is the adoption of a remarkably clever and efficient method of disguise, and a deliberate sluggishness of movement born of a desire to avoid detection. Even when captured, one of these crabs will remain motionless, so that one could be deceived into believing that life was extinct. It is then that little imagination is required to accept the captive as a mere bundle of seaweed, because of the fragments of growth so cunningly decked over the back and limbs.

In attaching the coverlets of seaweed, the crabs employ their efficient, delicately-fingered nippers to select and prune off suitable sprigs of growth. These are then placed in position with as much precision as is exercised by a woman arranging her coiffure. Anchorage is effected with the aid of numerous, stout, hooked hairs embedded in the substance of the back and limbs, which curl around the growths like the tendrils of a vine. Strangely enough, the weed fragments invariably grow to luxuriant dimensions, and these veritable travelling sea gardens no doubt benefit more than normally from the change of water received when the crabs move from place to place. It is true that a certain cutting back of excessive growth is effected with the nipper hands of the crabs, but it seems that this precaution is at times ineffective. Startling proportions are often assumed by the weed coverlets, and they are so heavy that their bearers could not transport them were it not for the supporting power of the seawater. Release from such a predicament must mercifully come when the periodical casting of the old shell for a new and larger one takes place in the life of the crabs. Upon this happening, suitable sprigs are selected from the old covering with which to deck the new shell.



A Seaweed Crab, Naxia spinosa.

In the selection of coverings the Seaweed Crabs have shown remarkable instinct. Experiments have proved that individuals transferred from one environment to another totally different in its colouring and growths, have methodically removed the late camouflage from their bodies and substituted a covering in keeping with the new surroundings.

At the extremities of the walking legs is a cunningly developed adaptation for clinging to the seaweeds as the crabs move about, and which guards against dislodgement by the waves. Each is armed with a curved claw-like spine capable of being brought back against a hump or protrusion on the joint above so as to form an imperfect nipper. The feature is clearly shown in the accompanying illustration.

The two local forms of Seaweed Crab are known under the technical name *Naxia*. They are rarely seen apart from their weedy environment. The few specimens which fall prey to the fishermen's nets or are cast ashore after heavy gales never fail to excite comment, and are frequently brought to the Australian Museum for explanation and identification.

Review

BIRDS OF CAPE YORK PENINSULA. ECOLOGICAL NOTES, FIELD OBSERVATIONS, AND CATALOGUE OF SPECIMENS COLLECTED ON THREE EXPEDITIONS TO NORTH QUEENSLAND. By DONALD F. THOMSON, D.Sc., Research Fellow, University of Melbourne. Australian National Research Council, Melbourne, 1935. (Angus and Robertson, Limited, Sydney.) Royal 8vo, 82 pages, 10 plates, 2 maps. 1s. 6d.

To the ornithologist the scantiness of reliable and authentic literature dealing with the bird-life of Cape York is a great hindrance. The work under review, even though it be small, is an extremely valuable one, and ornithologists will find it of great assistance.

The sections dealing with the classification of the country, flora-fauna association areas, and affinities with New Guinea, together with the map showing the principal faunal areas, are particularly valuable.

A regrettable omission is the absence of date of observation of certain species, especially in the case of migrants such as *Numenius cyanopus* and *Erolia ruficollis*, and some of the nomadic birds. Dates of observation are always of value, even in instances where specimens are not collected.

The primary object of the author's expeditions into this area was anthropological research, but the publication is distinct evidence of the fact that he availed himself of opportunities in other directions.

The publication is well printed, and is complete with index.

J.R.K.

Some Natural Enemies of the Engineer

By ALBERT E. J. THACKWAY.

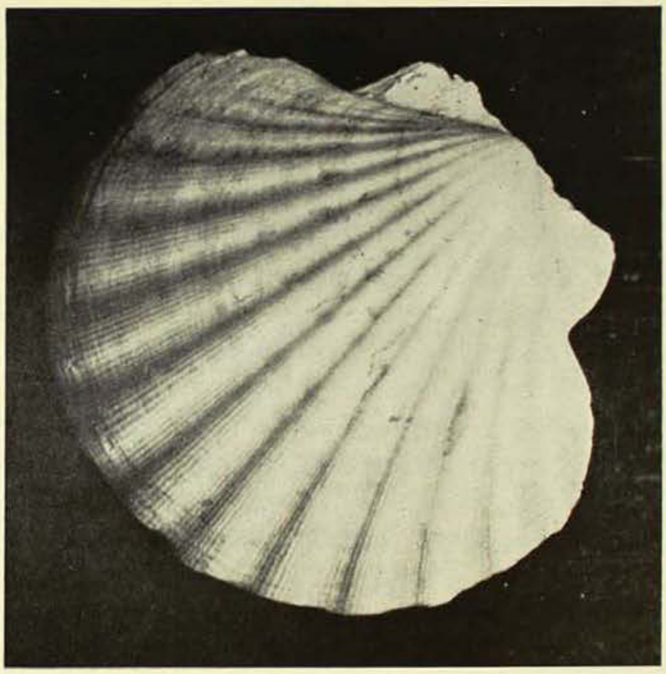
A SOUND working knowledge of many branches of natural history is part of the stock-in-trade of the successful modern civil engineer, as well as of his colleagues engaged in the allied constructional arts and sciences of architecture and building.

Those whose daily vocations embrace these professions require a very deep knowledge of botany in so far as timbers used for constructional purposes are concerned. An intimate acquaintance with the nature, strengths, characteristics, and habitats of all suitable timbers is indispensable to the designing engineer when considering appropriate materials, and when calculating stresses to be imposed upon his fabrications. The life histories, characteristics, habitats, and gastronomical likes and dislikes of various insects, molluscs, mammals and birds must also be included in his storehouse of necessary data.

The engineer in particular, and all of us in general, are deeply indebted to nature for very many of the basic principles of design and applied mechanics, and whilst it does not come within the scope of the title of this article, an illustration of this fact may be of interest to the reader.

Volumes could be written and thousands of examples described, but one typical case must suffice. Take, for instance, corrugated surfaces. The most common form, perhaps, is that of the ubiquitous sheet of galvanized corrugated iron used for fencing, roofing, and scores of other purposes in city and country. Corrugated cardboard for packing bottles and other fragile articles is another excellent application of this principle. These commonplace articles incorporate that wonderful and indispensable aid to engineering, the principle that a flat or curved surface can be reinforced against external pressure to an almost uncanny degree by means of indentations or corrugations.

Now, modern engineering science, so we believe, is indebted to the bivalve (Pelecypod) mollusc commonly called the scallop or fan shell for this, and a common scallop (*Pecten maximus*) of



This Scallop Shell (Pecten maximus), a native of the North Sea, is credited with having given to engineers the idea of corrugating certain of their materials in order to obtain additional strength.
Photo.—A. E. J. Thackway.

the waters of the British Isles is credited with being the progenitor of the idea. Here in New South Wales we have several species of this mollusc, *Pecten medius* being the most plentiful, all of which are corrugated to a greater or less degree, and can thus withstand relatively heavy outside pressures without their frail shells collapsing. There can be found on the Sydney foreshores a whelk (*Thais succincta*) fashioned in a similar manner, but, in this case, the shell is a univalve (Gasteropod); its habitat is the rocky headlands, where, due to its corrugated contours, it can withstand the full force of the Pacific breakers, apparently without inconvenience.

TERMITES.

Probably the most destructive insect in the world is the termite, generally, though erroneously, called a "white ant". The depredations of this representative of the Hexapoda are beyond calculation. In Australia alone the enormous damage directly attributable to the termite costs the country tens of thousands of pounds sterling annually. Around the metropolitan area the milky termite (*Coptotermes lacteus*) is the chief offender. There are, of course, many other equally destructive species extant. In Queensland and the Northern Territory these pests abound in great numbers, and much money is spent on defensive measures. Considerable time and thought have been given to devising ways and means of extermination, but no entirely reliable and commercially practicable scheme or method seems to have been evolved.

Dr. M. Oshima, of the Institute of Science, Formosa, thoroughly investigated* the whole matter some years ago, and suggested that probably the best destructive specific was camphor green oil, obtained from camphor wood (*Cinnamonum camphora*). This substance, so far, has not been obtainable in Australia, so that its effectiveness upon Australian timbers cannot be gauged. The common specific used here is creosote. This substance, when freshly applied, quickly rids timber of the pests, but, unfortunately, its qualities in this direction are not of a lasting nature. Its effectiveness appears to decrease with age, and after a period of some fifteen to eighteen months on Australian hardwoods its value becomes negligible, due to the dense fibre structure making penetration difficult even under pressure.

During recent years some success has been obtained in Australia by scouring and charring timber by means of an oxy-acetylene torch suitably adapted. This process is intended primarily to remove dry rot and other wood-destroying fungi and micro-organisms, but, provided that the wood is not too badly riddled, it is often possible to save the piece from termites and borers by the flame treatment, and, at the same time, render it immune from further attack. The average householder or other person desiring to preserve timber in a small way could obtain quite good results by using a blow-lamp for charring, or even, where practicable, burning the material in an open fire. Charring of wood is one of the best timber preservatives known and also one of the oldest, for it was practised by the ancient Egyptians.

Contrary to general opinion, termites do not confine their activities to timber. They sometimes cause serious damage to brick buildings by penetrating into the walls and dissolving the lime mortar between the bricks. Bricks set in cement mortar appear to be immune. There are many cases on record of these insects causing the failure of electric power, putting large districts into darkness and stopping electric traction. This is due to the "white ants" working their way, as they actually do, through cracks and joints in concrete troughing, and then penetrating through arsenic-impregnated bitumen, lead sheathing, and oil-saturated paper, until they reach the copper conductors of underground electrical power and distribution cables, and thus cause the electrical failure of the cable by short-circuit. It is thought that the termites endeavour to reach the copper conductors for the warmth generated therein. The suburban gardener who has not had the experience should note that "white ants" will attack the potatoes growing in his garden.

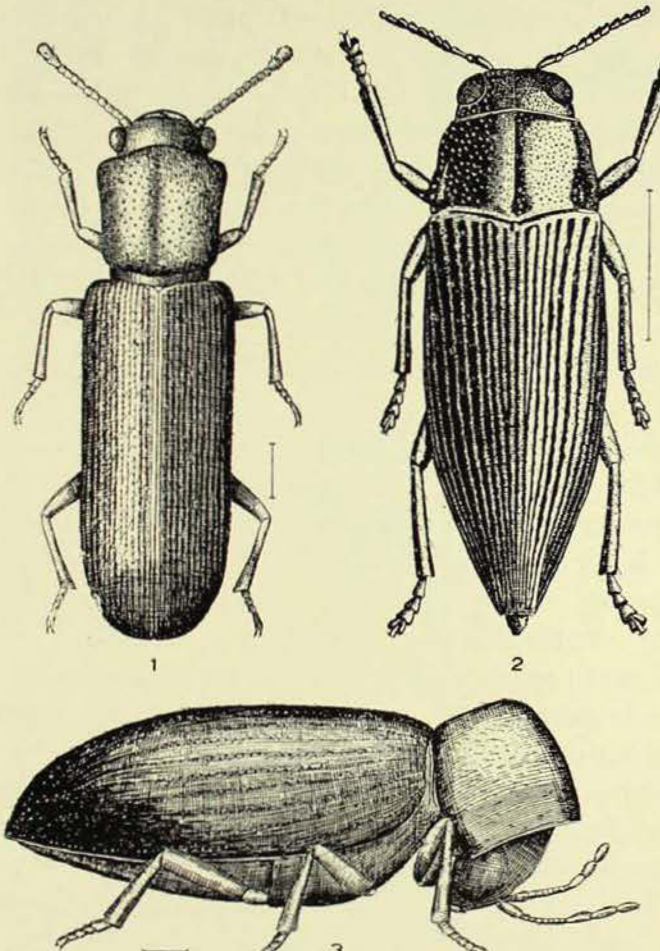
Hardwood timbers, particularly the eucalypts, are the favoured grounds of the pests, although on occasions they will attack some of the softwoods, but coniferous growths appear to be immune. When a number of tests on various commercial "white ant" exterminators were being

* "White Ants Injurious to Wooden Structures and Methods of Preventing their Ravages", by Dr. M. Oshima, *Proc. Pan-Pacific Science Congress*, 1923, Vol. 1, p. 332.

conducted recently in Sydney, ironbark (*Eucalyptus crebra*) posts were buried in ground known to be infested with *Coptotermes lacteus*. An untreated control test specimen, *i.e.*, a post in its natural state, and about twelve inches in diameter, was completely riddled by the insects within four months.

BEETLES.

Timber boring beetles—more popularly known as borers—cause a good deal of concern. There are many species, but the most common and incidentally the most destructive are the Powder Post Beetle (*Lyctus brunneus*) and the Furniture Beetle (*Anobium punctatum*), and to a less degree the pin- and shot-hole borers (*Xyleborus* and *Platypus* spp.).



1. *The Powder Post Beetle* (*Lyctus brunneus*). 2. *The Hoop Pine Buprestia* (*Prospheres moesta*). 3. *The Furniture Beetle* (*Anobium punctatum*).
N. B. Adams, *del.*

Powder Post Beetles attack the sapwoods of our eucalypts, but do not usually extend their depredations into the heart of the wood; therefore, they can be eliminated by removing the sapwood. The Furniture Beetle, however, takes greater toll, as it will attack old and seasoned timber in bridges, buildings, and other engineering structures. It shows preference for the pines, and is the most destructive borer we have to fight.

It is very difficult to rid timber of beetles. Where it is possible, extermination may be regarded as being reasonably certain after saturating the affected wood with kerosene. *In situ* this is sometimes a problem, but quite good penetration can be obtained by spraying kerosene under pressure. A first application usually eliminates the borers, a second is almost invariably successful. Sometimes creosote is used instead of kerosene, but this substance, in practice, does not appear to be any more effective than kerosene, and it has the added disadvantage of staining timber to a considerable extent—a matter of some importance in better class work.

MARINE ANIMALS.

Beetles are not the only wood-boring pests with which the engineer has to contend. Harbour works, such as wharves and jetties, timber bridges over tidal creeks, wooden ships and boats are attacked, chiefly, by not necessarily, between tide marks, by Mollusca and Crustacea, two classes of marine animals. The former is represented by the "shellfish" popularly known as the cobra or ship worm (Teredinidæ family), of which there are a number of species. The cobra bores into the heart of timber piles and other marine structures. The crustaceans comprise three principal forms of marine wood borers, represented by species of the genera *Chelura*, *Sphæroma* and *Limnoria*, all of which attack the sapwood or recent annular rings, frequently obtaining access via the medullary rays. Preventive measures against attack by these pests include sheathing the wood with a nonferrous metal, impregnating the material under heat and pressure with a creosote compound, and, in some instances, by encasing the timber with concrete. Around Sydney, untreated Red Gum

(*Eucalyptus rostrata*), Ironbark (*E. crebra*), and, in particular, Turpentine (*Syncarpia laurifolia*) have given useful lives, under marine conditions, of upwards of 40 years.

In an instructive article dealing with protective measures for the preservation of marine timber piles, contained in an exhaustive treatise* published by the Sydney Harbour Trust in 1932, Mr. R. A. Johnson states, *inter alia*, that "the bark covering of piles is undoubtedly of great importance as a primary and natural means of protection . . . . due to the oils and acids contained therein".

RATS.

Rats (*Rattus rattus*) are a source of considerable trouble to the community in general. In such places as warehouses, ships, stables, and even the humble suburban poultry yard, they are a real pest, and much money and time are spent in an endeavour to secure their extermination. The engineer's chief worry, in so far as these rodents are concerned, is the damage they cause to lead plumbing, such as piping, floors, flashings, and other like details. The initial damage to the lead frequently results in secondary destruction elsewhere due to leakages of water and other fluids. Rats do not attack copper, and for this reason, amongst others, its use is rapidly gaining favour in lieu of lead. Although more expensive in first cost, it will prove to be an economical expenditure where conditions warrant its use.

RABBITS.

Rabbits are popularly regarded as being purely a problem for the man on the land, and the seriousness of that problem as it affects the farmer and the grazier cannot be over-stressed. We are concerned at the moment, however, with the depredations of the rabbit in so far as they concern the engineer. Rabbits undermine earthworks necessary for the construction and stability of bridges, roads, railways, dams, and other engineering works, all of which affect directly or indirectly the safety of the general public.

Where such is warranted, rabbit-proof fences are erected around major works. In many cases the constructions are protected by burying galvanized iron wire mesh a few inches under the ground, or, if convenient, building the earthworks with coarse heavy stones or similar material. Either method is effective, but the latter is the more permanent.

The extermination of this introduced enemy is a matter of national importance, and one in which the knowledge and services of farmers, zoologists, and engineers should be utilized to the fullest possible extent. The rabbit is not only a source of trouble to the engineer, it is a very real menace to the economic stability of Australia.

In addition to the ground pests, electrical transmission line engineers must study the nature and habits of all birds and climbing animals likely to be encountered in the district through which it is proposed to construct a line. In this respect the engineer consults the zoological staff of the museum concerned for expert advice and information regarding such matters as wing spans of birds, overall and reaching lengths of animals, and so on, and upon the data supplied the design of the line as regards spacing of the conductors is based, in conjunction with other necessary technical considerations.

RING-TAILED POSSUMS.

The failure of an electricity supply is not necessarily due to engineering defects or to causes within the control of the electricity supply authorities, as was shown when dealing with the termites. On quite a number of occasions loss of current has been caused by Ring-tailed Possums (*Pseudochirus laniginosus*). These animals climb the supporting poles, get across the power or distribution cables, and thus create what electrical engineers call a short-circuit. The possums, of course, are electrocuted, but their demise

* "Destruction of Timber by Marine Organisms in the Port of Sydney", by Tom Iredale, R. A. Johnson and F. A. McNeill.

does not compensate users for the temporary loss of light or other electrical apparatus.

LACE MONITORS.

A number of reports have been received from country districts to the effect that electrical current supplies had been interrupted through lace monitors

The "goanna" (Varanus varius) gives electrical engineers trouble through climbing wooden poles and short-circuiting electric power and lighting cables.
Photo.—A. E. J. Thackway.

(*Varanus varius*), an adept climbing reptile, making contact between the phases of circuits supported on wooden poles. The lace monitor is known to most Australians as the "goanna".

Barbed wire placed around the poles in helical fashion will stop "goannas" from climbing higher than the wire, but the obstruction apparently does not worry possums. Barbed wire also serves an added purpose: it prevents youthful specimens of the most advanced faunal species—*Homo sapiens*—from giving practical demonstrations in support of Darwin's theory regarding the evolution of man.

BIRDS.

Birds of all kinds, from the smallest to the largest, must be included. The smaller species mainly cause trouble by building their nests in inconvenient places. Some species are a greater nuisance than others in this respect. Post office engineers, particularly, are much harassed at times by the presence of birds' nests on telegraph and telephone lines. Electrical transmission lines maintenance staffs experience annoyance through the larger birds. Steel cross-arms, carrying pin type insulators, fitted on steel transmission line towers, have been replaced in a number of instances by wooden cross-arms, because birds resting on the steel members have caused electrical troubles by pecking at the copper conductors, and thus short-circuiting the current through their bodies. Birds with a large wing span, when flying through the lines, can also cause trouble should they come into contact with the wires and the structure.

The fauna discussed does not by any means exhaust the list of troublesome and destructive birds, mammals, and insects. Only the fringe of the subject has been touched. The genera and species mentioned are some of the principal ones operating in New South Wales, yet, even within the limits of our own State, this list could be greatly enlarged.

Australian Shells

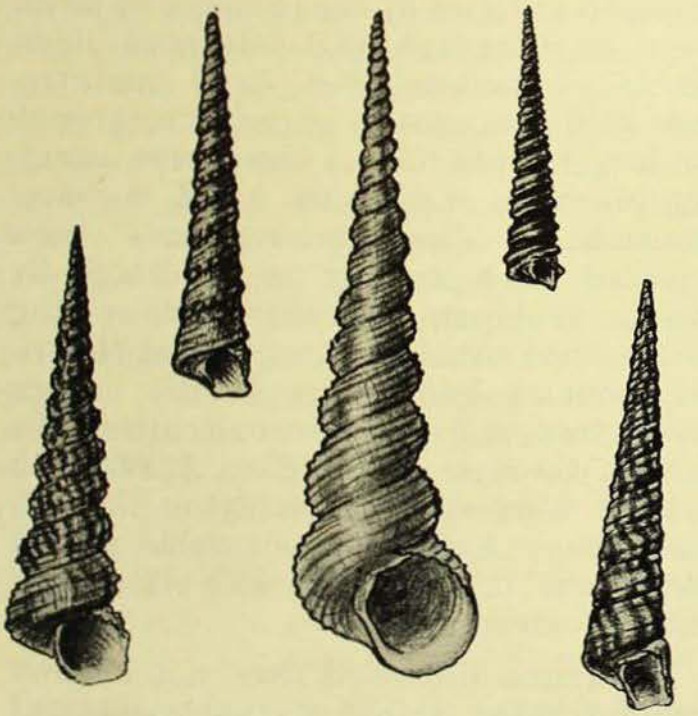
Screw, Blind, Hairy-keeled and Worm Shells, Violet Snails, Carrier Shells and others

By JOYCE ALLAN

SCREW SHELLS.

WITH the Screw Shells we come to a group which is unlike any of those previously dealt with in this series of articles on Australian shells, and which includes many of the more showy and interesting forms.

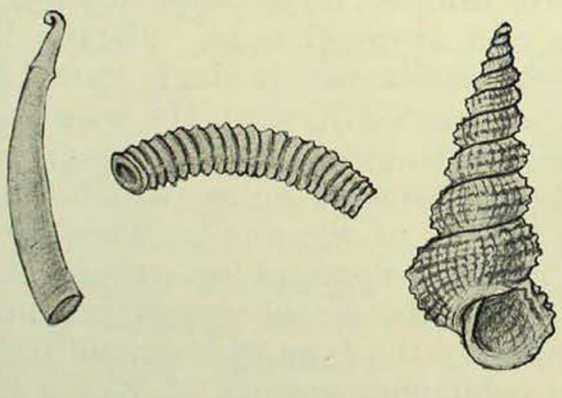
Some of the Screw Shells, or as they are often called Tower Shells, make very handsome exhibits in a collection. Their long slender spires of many whorls, ornamented with fine revolving striæ, display grace and symmetry, and their shape gave rise to their popular name. About one hundred species are known, inhabiting all seas, but principally tropical and subtropical. They range from the laminarian zone to very deep water, and so most of them are obtained only by dredging. Dead or worn shells are often washed up on beaches. Australia has numerous different species in the waters round the coast, but many of them are very similar in shape, and so only a representative number are illustrated here.



Larger Screw Shells. The large one in the centre is Turritella cerea; on the upper left and right of it are Gazameda tasmanica and Stiracolpus iredalei, and on the lower left and right, Turritella terebra and Gazameda gunnii.
Joyce Allan, *del.*

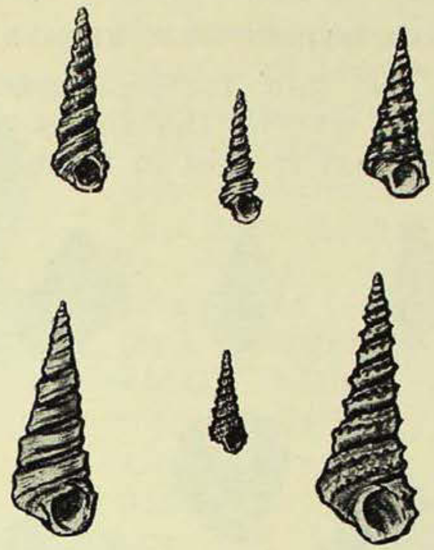
Of these, *Turritella cerea* is probably the handsomest. It is generally white, yellowish-white or light chestnut, sometimes marked with a darker colour, occurs in the Indo-Pacific and north Australia, and measures between four and five inches. It is one of the best known Screw Shells. There is some uncertainty about the specific name of this species, so I have left it under *T. cerea*. A smaller but somewhat similar form, with straighter whorls marked with linear bands of brown and a violet tinged base, is called *Turritella terebra* in the Museum collection, and I will leave it under that name in this article. It comes from north-west Australia, and is about two and a half inches high. A pinkish-white Screw shell, *Gazameda gunnii,* with a white area above and below the sutures, is about two inches high, and is found in New South Wales, Victoria, and Tasmania. A brownish-yellow one, something like this, with coloured irregular spots, and two blunt spirals on the last whorl, is *Colospira accisa*, from the same southern regions. Three small species from southern Australian waters are *Platycolpus quadratus*, light yellow flamed with brown and spotted with dark brown, and found in deep water in New South Wales and South Australia; *Stiracolpus smithianus,* a turreted species having its whorls marked by strong keels, and found also in deep water; and *Glyptozaria opulenta,* a rather solid, glossy, milky shell, marbled with pale brown, and with two strong keels on the upper whorls and three spiral striæ. There is a very common form in South Australia, *Stiracolpus iredalei*, nearly two inches long, with numerous light or dark purple-brown whorls marked with two prominent spiral keels and spiral liræ crossed by very fine striæ; it is also recorded from Tasmania. In that State also, as well as in New South Wales and Victoria, occurs a small species, *Colpospira sinuata*, only about three-quarters of an inch high, devoid of heavy sculpture, and creamy-white coloured, maculated with brown. The small species from Tasmania, which has nodules on the keels crossing its pale yellow whorls, is *Ctenocolpus australis*. Yellow-brown bands of colour encircle the base of the body whorl and the whorls above and below the sutures. *Turritella cingulifera* is a very small form from Queensland, with rather flattened white whorls, encircled with a golden brown line on the periphery of the body whorl and above the suture on the remaining whorls. The sculpture is rather heavy spiral striæ inclined to be nodulose on the upper whorls.

There is a *Turritella*-like shell, *Eglisia tricarinata*, which occurs in the China seas, and on rare occasions is found in



The first figure is the Blind Shell, Strebloceras cygnicollis, the middle one is Caecum lilianum, and the last one, Mathildona euglypta.
Joyce Allan, *del.*

Queensland. It is brown, about two inches high, and differs from true Screw Shells in having deep sutures and much stronger revolving ridges. Among other similarly shaped shells, which are best placed near the Screw Shells, is *Mathildona euglypta*, which grows to about an inch high, and is found on the New South Wales coast. This shell is conspicuously ornamented



Small Screw Shells. The three in the upper row are Turritella cingulifera, Stiracolpus smithianus, and Colpospira sinuata. In the lower row are Platycolpus quadratus, Glyptozaria opulenta, and Ctenocolpus australis.
Joyce Allan, *del.*

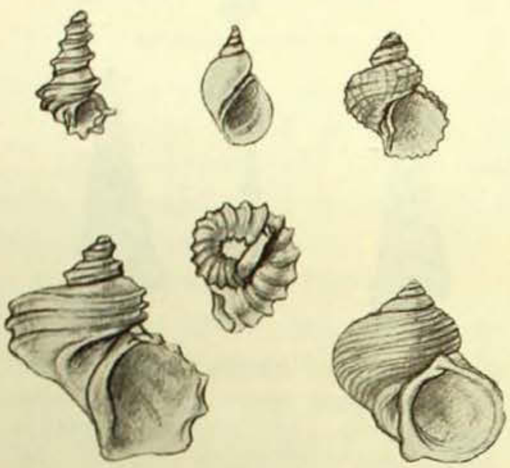
with cross sculpture, and the apex is turned in the opposite direction to that usually adopted by shells.

BLIND SHELLS.

Blind Shells, family Caecidæ, are rather irregular shaped and small, first growing as a spiral, but later their tubular shape becomes elongated and cylindrical. They inhabit temperate and warm seas throughout the world, but appear to be absent in cold waters, and although they show some resemblance to the Worm Shells, they are always free, and the animal, which is not at all shy, crawls about with considerable vivacity. There are usually three stages of growth in Blind Shells. First is the spiral stage, which is soon lost by truncation, the remaining tube closed by a septum; secondly, a curved tube which is also subsequently lost, and, finally, the adult stage, a curved tube closed behind by a septum. Representatives of the two main genera, *Caecum* and *Strebloceras*, figured here are *Caecum lilianum*, a minute brown species, about two millimetres long, which lives along the eastern Australian coast, and *Strebloceras cygnicollis*, another minute shell occurring in the southern waters of Australia.

THE HAIRY-KEELED SHELLS.

These are thin turban-shaped shells, with keeled whorls, the ridges of which bear epidermal fringes in fresh or living



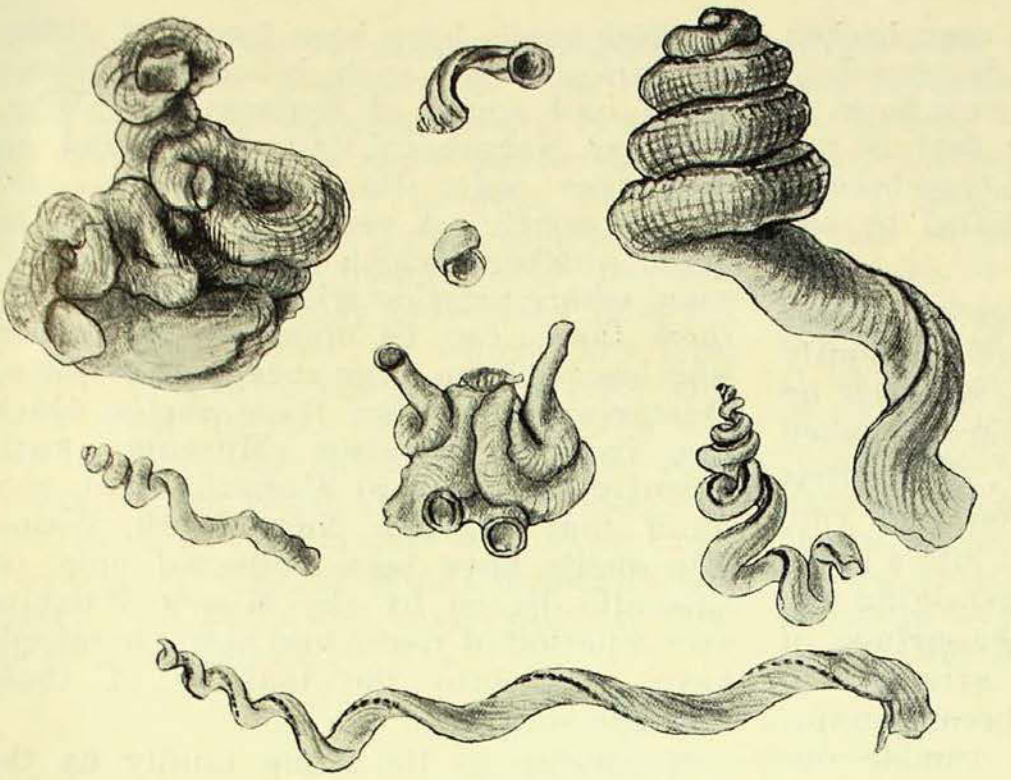
In the upper row are three small Hairy-keeled Shells, Icuncula torcularis, Couthouyia gracilis, and Sirius badius. The figures in the bottom row represent Separatista blainvilleana on the left and Crosseola concinna on the right. Between the two rows is the quaintly shaped species Ctiloceras cyclicum. Joyce Allan, *del.*

specimens, but are without them in dead shells. In Australia the family is represented by only a few genera and species, of which the ones most likely to be found are *Crosseola concinna*, a pretty little species, five millimetres high, from southern Australian waters; *Icuncula torcularis*, an easily recognizable shell of similar size, which occurs in south-east and southern Australia, and *Separatista blainvilleana*, a larger, very pretty brown species, nearly an inch high, which is found in about ten fathoms of water from Queensland to South Australia. Two other shells of this family are *Sirius badius*, which is only a few millimetres high, brownish, and heavily sculptured with revolving ridges, and is found in southern waters, and *Couthouyia gracilis*, a thin, very small, glassy shell, devoid of sculpture, and found in New South Wales. Hairy-keeled Shells form the family Trichotropidæ. An extremely minute, very attractively shaped shell, *Ctiloceras cyclicum*, which occurs in Queensland, is allied to members of this family.

WORM SHELLS.

The peculiar worm-like shape of these shells gives the impression that they are not shells at all. From a close regular spiral, the coils become free and develop in an irregular way when it reaches adult stage. Worm Shells form the family Vermetidæ, and live generally attached to shells, or coral, imbedded in sponges, or congregate together in large colonies. They are exceedingly irregular in growth, sculpture, and colouring, and are difficult to identify because they often reproduce the surface upon which they are stationed. The inside of the shell possesses septa, which, together with the spiral nuclear shell, distinguishes them from certain annelid worms, which many of them resemble.

Main genera of this family found in Australia are *Vermicularia* and *Siliquaria*, and only a few species are figured here, owing to their great similarity. Those of the former genus are regularly coiled when young, but often contorted in adult form, and sometimes form an intricate tangled mass; they inhabit temperate and tropical seas. In the latter genus the shells are similarly spiral when young, elongated irregularly when adult, and are distinguished by a longitudinal groove, or series of holes, which run the whole length of the shell. They live on coral rock or sponges on tropic shores, and the species of the genus are mainly separated by the type of longitudinal slit. Of the commoner species of Worm Shells figured here, the largest is *Siliquaria ponderosa*, a solid yellowish-white species with a deep longitudinal slit, which occurs in north Australia; a graceful, yellowish to pinkish species, *Siliquaria weldii*, very lightly sculptured with longitudinal lines, and having the slit filled below in the first few whorls, but quite open in the remainder, comes from southern Australia, and *Siliquaria bernardi*, another very



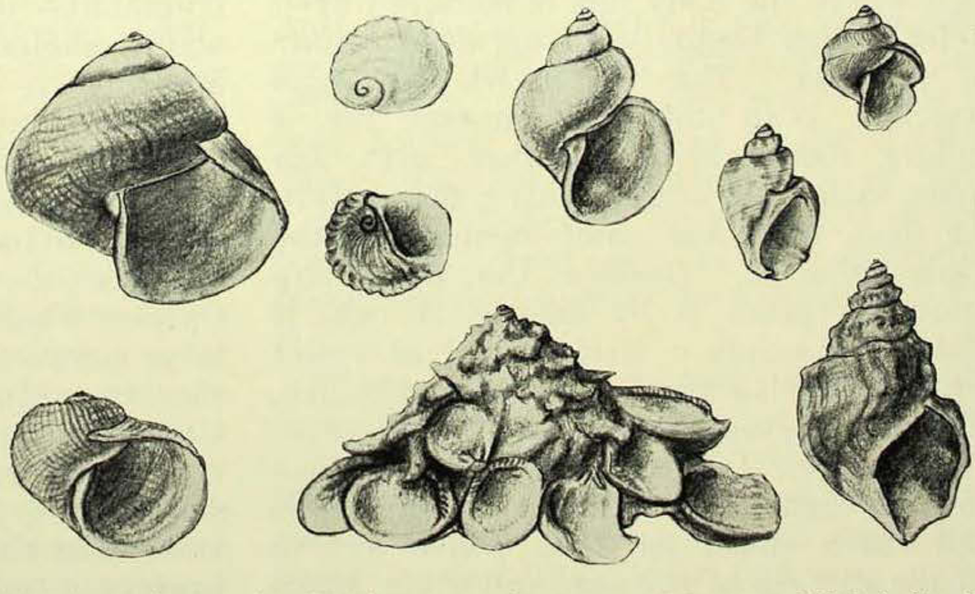
A few Worm Shells. The figures in the upper row represent Vermicularia sipho, with the small coiled Worm Shell, Vermicularia waitei, next to it, and at the right of the row is Siliquaria ponderosa. The three species in the middle row are Stephopoma nucleocostata, Magilina caperata, with a very young form above it, and Siliquaria weldii. The elongated species in the bottom row is Siliquaria bernardi.

Joyce Allan, *del.*

graceful but much more elongated species, is a Queensland shell. A few other Worm Shells are *Vermicularia sipho,* a common shell from New South Wales, Tasmania, and South Australia; a very distinct type, *Vermicularia waitei,* a few millimetres long, with characteristic ridges sculpturing it, which is found in deep water off the New South Wales coast; a South Australian form, *Stephopoma nucleocostata*; and *Magilina caperata*, from southern Australia generally, an adherent, often solitary form, which in its very early stage has a more true shell-like form than other species.

VIOLET SNAILS.

When strong winds blow off the Australian coast, especially along that of New South Wales, bringing into the shore pelagic life which normally lives far out at sea, the beaches are frequently lined with blue masses of Portuguese man-of-war or "blue-bottles". But on close examination of this blue mass there will often be noticed amongst it numbers of very beautiful, frail, violet-blue snails, usually with a delicate, frothy, gelatinous egg-raft attached to the animal within the shells. These are the Violet Snails, *Janthina violacea,* the larger species, and *Janthina capreolata,* the smaller one, and sometimes a more globular species, *globosa,* which form the family Janthinidæ. Known also as Purple Snails, these very beautiful shells are gregarious, and live abundantly on the surface of the ocean where the water is very deep and of a colour similar to themselves. Once driven



The first figure in the top row is the well-known Violet Snail, Janthina violacea, next to it is upper and lower view of Naricava angasi, then comes Recluzia hargravesi, with Zemira australis between it and the small Violet Snail, Janthina capreolata. In the bottom row the three figures illustrate Merria cancellata, Onustus peronianus and Tylospira scutulata.

Joyce Allan, *del.*

ashore, their frail shells are soon broken by the surf, and those not destroyed in this way rarely find their way back to the open sea, because their foot is not adapted for locomotion, and they become the prey of birds, or are killed by the sun.

One of the strangest things about the Violet Snails is the egg-raft—a family trait. This raft or float is secreted by the foot of the animal, and hardens when it comes in contact with the water. Bubbles of air are captured and contained within it, converting it into a pneumatic cushion capable of sustaining the pelagic shell. On the under-surface of this raft egg capsules are attached in neat rows, and later these become punctured and the little snails tumble out and take their chance in the great ocean. Though the raft is present in both male and female animals (in fact, if separated from its raft, or if its vesicles are punctured and the air escapes, the animal sinks to the bottom and perishes), eggs are attached only to that belonging to the female Violet Snail. In some species the female is viviparous. The distinct light and dark tone of the violet colour of the shells is probably a protective measure. The shells float with the mouth turned upwards, and the exposed part of the shell where the body lies is coloured deep violet, which blends with the deep colour of the sea. The raft with its eggs attached is a tempting morsel for a hungry fish, which, together with sea birds, skimming and scanning the surface for food, form the chief enemies of the Violet Snails. Besides the protective colouring given it by nature, it can, if disturbed, exude a little cloud of violet ink, which, like the ink of the cuttle-fish, probably serves to facilitate its escape. For its own food the Violet Snail has only to thrust out a prehensile proboscis and catch small jelly-fish which swarm on the surface of the sea, and other small organisms, such as barnacles, which are frequently of the same colour as themselves. A little blue crustacean lives on the float of these shells, obtaining free lodging and transportation. Large masses of these snails have been found at different times along such beaches as those north and south of Sydney, Dee Why, Collaroy, Narrabeen, Palm Beach, and, on the other side, Bondi, Cronulla, and further south. A very good idea of the great numbers which segregate and so come ashore together when the wind blows them there, can be obtained by anyone who has seen the large sprays of artificial Wistaria made from these shells which are in the Windsor Museum, until recently exhibited at Cronulla, but now on a tour through New South Wales. The shells have been collected only on Cronulla Beach by the Misses Wilshire over a period of years, and many hundreds have gone into the making of these realistic sprays.

Belonging to the same family as the Violet Snails is a slightly different shaped shell, of a pale creamy yellow colour. This is *Recluzia hargravesi*, a pelagic form found along the shore of New South Wales and Queensland.

THE CARRIER SHELL.

One of the most remarkable cases of camouflage amongst shells is that exhibited by the Carrier Shells. To deceive their enemies, and to serve as a protection against them, it is their habit to glue to their growing shell pebbles, fragments of rock or dead shells, or whole shells. The usual type of shell attached is a bivalve, of which several different kinds may be found on one specimen, although spiral shells are also frequently used. The material added is restricted to that which is found in the vicinity of the place inhabited by the Carrier Shell. In some species, the shell is so completely hidden under this debris that its natural top shape cannot be distinguished, and the whole mass looks like a pile of fragments of stones and broken shells—a typical sea-bottom conglomeration. The sharp edges of the jagged mass present a particularly uninviting appearance to any creature venturing near the shell with a view to making a meal of its inhabitant. In some of the species, however, the protection is not so apparent, and the shape and sculpture of the shell can be easily distinguished. In all species, however, the base of the shell is left free of impedimenta, to enable the animal to move about unencumbered.

Carrier Shells live in deep water in tropical seas, where they scramble about in a very jerky manner over the sea bottom, their clumsy gait being adapted to suit the surface on which they live, which is usually composed of rock and dead shell debris. Boats trawling for fish on the continental shelf off the New South Wales coast frequently bring up specimens of *Onustus peronianus* in their trawl nets. Carrier Shells belong to the family Xenophoridæ, and only a few species are known.

Two other shells figured in this article each represent a different family. These are *Zemira australis*, from south-eastern Australia, marked with deeply cut sutures and a furrow forming a tooth-like projection on the outer lip, and *Tylospira scutulata*, a rather large shell, which lives in deep water off the New South Wales coast. The former shell belongs to the family Zemiridæ, and the latter, which has less smooth relatives living in New Zealand, represents the family Struthiolariidæ. Two other species, *Merria cancellata* from Queensland, and a very small southern Australian shell, *Naricava angasi*, are both members of the family Merriidæ.

A New Mineral Display

Fluorescence of Minerals in Ultra-Violet Rays

By T. HODGE-SMITH

SOMETIMES when viewing a display of wonderfully coloured minerals the thought will flash across the mind that a great wealth of beauty must be hidden below the surface of the earth. It is the sunlight that frees the beauty that has been hidden away for countless centuries in the darkness below.

Without the sunlight there is no beauty, and the sunlight after all is only wave motion of certain limited wave-lengths that have the power of affecting our sense of vision. The minerals by absorbing some wave-lengths and reflecting others give to us the sense of colour that is so pleasing to our eyes.

It was in 1690 that the Dutch astronomer and physicist Huygens first suggested that light was due to wave motion. Since then tremendous advances have been made in our knowledge of wave motion. Today we speak of many different kinds of waves—sound waves, wireless waves, and so on.

The wave-lengths that produce light are extremely small, and yet can be measured with amazing accuracy. For convenience, a unit of length, known as the Ångström unit (Å.U.), has been adopted, measuring one two-hundred-and-fifty-millionth part of an inch. The ordinary spectrum is so well known as to need no description here. The longest wave-length of light (7,600 Å.U.) creates the sensation of red, while the violet end of the spectrum possesses the shortest wave-length (3,800 Å.U.).

There are, of course, wave-lengths immediately above and below these limits which do not affect our visual organs. Those which lie beyond the red end of the spectrum are called *infra-red rays*, and those beyond the violet end are called *ultra-violet rays*.

It is only the ultra-violet rays with which we are concerned. Their wave-lengths vary from approximately 1,600 ÅU. to 3,800 Å.U. The effect of the ultra-violet rays on minerals and other substances was first investigated in 1834 by Sir David Brewster, though it was not until 1852 that Sir George Stokes coined the word "fluorescence", from the fact that the phenomenon was best shown by the mineral fluorite, just as opalescence is best shown by the opal. Although more than one hundred years have elapsed since Brewster's first experiments, no explanation of the mechanism of fluorescence has been forthcoming. In fact, experiment has only achieved seemingly contradictory and conflicting results.

The new case in the mineral gallery of the Museum contains an apparatus for producing ultra-violet rays. The essential part of the apparatus consists of a mercury-vapour arc in a tube made of lead glass containing small quantities of nickel and cobalt salts. The tube is coated with opaque material, so that only the ultra-violet rays, "dark light" as it is sometimes called, are allowed to reach the specimens on display. No one source of light will provide the whole range of the ultra-violet rays, and the arc used in this case covers slightly more than one-quarter of the range, that is from about 3,100 Å.U. to 3,800 Å.U. When a fluorescent mineral is placed under the violet rays its appearance is entirely altered. For instance, colourless fluorite from the famous Weardale locality, England, appears to glow with a bright blue colour. However, another specimen of the same mineral from the same locality gives no response whatever. Why this should be no one can say. All that can be said is that some substances, both artificial and natural, have the mysterious power of absorbing the invisible ultra-violet rays and emitting in their stead rays of longer wave-length. The colour exhibited by the specimen under these conditions depends on the wave-length of the emitted ray.

So it is that the hidden beauty of a specimen revealed by the sun's rays may even be transcended by the rich glow of colour that is revealed only by the ultra-violet rays.

Our first thought is replaced by a query: Can science reveal any further hidden beauties in the now prosaic specimen that only saw the light of day because of man's search for wealth?

Mr. E. le G. Troughton, mammalogist of this Museum, has recently had the distinction of being elected a Corresponding Member of the Zoological Society of London.

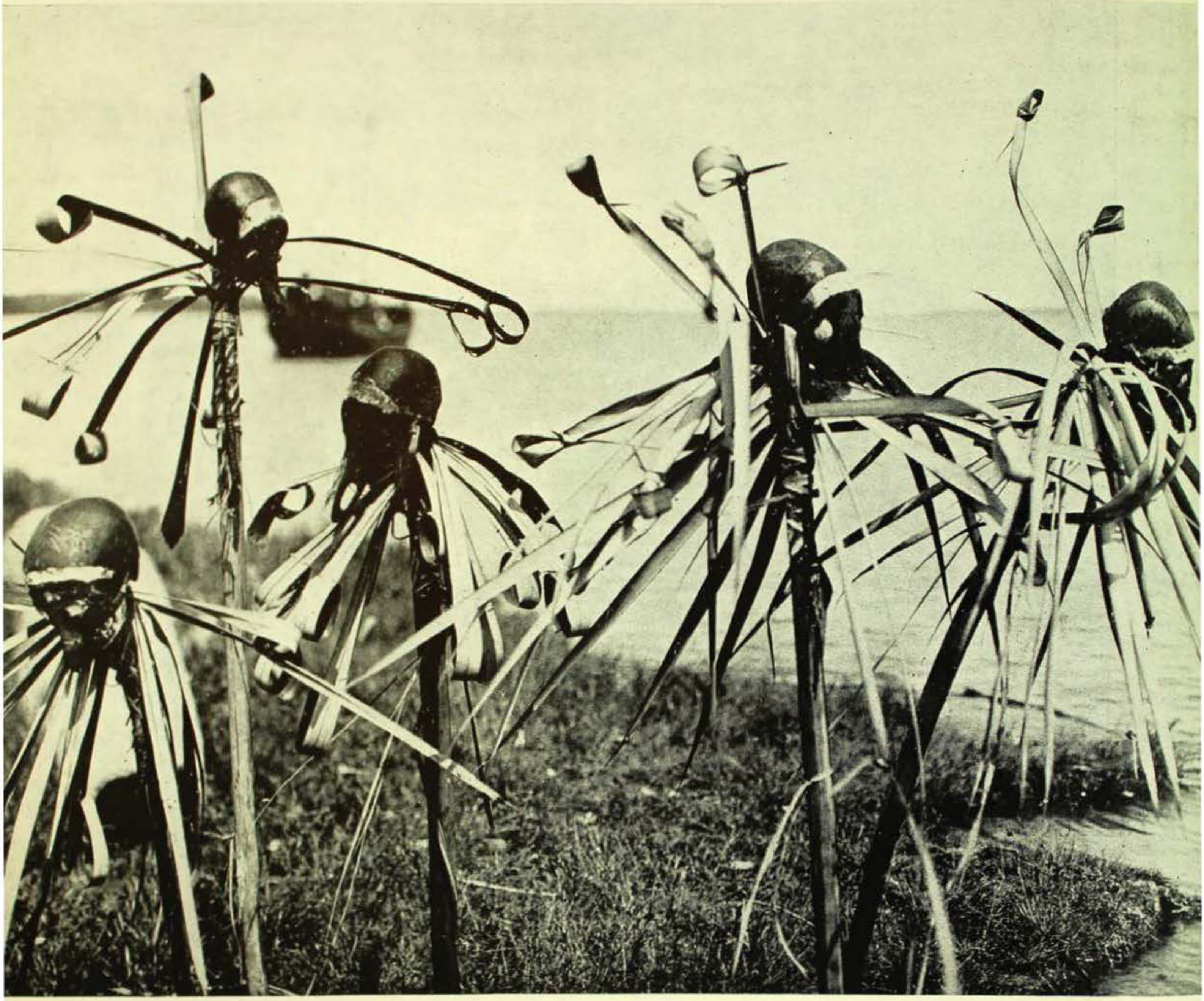
Mr. Troughton has carried out many important researches upon the unique mammalian fauna of Australia and the Pacific, our knowledge being considerably advanced thereby. The collection of the necessary data involved considerable travelling, Mr. Troughton journeying many thousands of miles. Upon these expeditions he also collected important natural history material apart from his special interest, the mammals. The results of his researches have been published in various scientific journals, here and abroad.

A few years ago, whilst on long leave and at no cost to the State, he visited the museums of Europe and America, studying the types of many Australasian species in their collections. The housing of these types in foreign collections frequently hinders research workers in Australia and Mr. Troughton spent a considerable time in examining them and making copious notes. Apart from these investigations, he studied modern methods of museum technique.

CANOEMEN OF THE PURARI.

The natives of the Purari Delta, Papua, have long, narrow, dug-out canoes which enable them to move swiftly along the tortuous waterways of their territory. They stand to propel their vessel with perfect balance and rhythm; their skill is indicative of a life spent largely on the water. Several river canoes of this type are on exhibit in the New Guinea Hall of the Australian Museum.

Photo.—Captain Frank Hurley.



HEADHUNTERS' TROPHIES.

The Goaribari people of the Delta Division, Papua, are renowned man-eaters. Along the waterfront of Kerowa village these decorated heads stand upon stakes to impress the visitor with the head-hunting prowess of the inhabitants. A thirst for revenge, excitement or a reputation for skill in war motivated head-hunting raids now forbidden by the government. After the head has been brought back to the village it is denuded of flesh, and a great wooden nose and protruding eyes, inset with Job's tear seeds, are attached to the skull, changing it from a thing of human semblance to a grotesque horror. Preserved heads of many types may be seen in the Australian Museum galleries.

Photo.—Captain Frank Hurley.