

The
AUSTRALIAN
MUSEUM
MAGAZINE

Vol. X, No. 4.

Price—TWO SHILLINGS.



The Glossy Black Cockatoo.

THE AUSTRALIAN MUSEUM

HYDE PARK, SYDNEY

BOARD OF TRUSTEES

PRESIDENT:

H. B. MATHEWS, B.A.

CROWN TRUSTEE:

H. B. MATHEWS, B.A.

OFFICIAL TRUSTEES:

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

ELECTIVE TRUSTEES:

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

FRANK B. SPENCER.

O. G. VICKERY, B.E., M.I.E. (Aust.).

WALLACE C. WURTH, C.M.G., LL.B.

PROF. A. P. ELKIN, M.A., Ph.D.

F. McDOWELL.

R. J. NOBLE, M.Sc., B.Sc (Agr.), Ph.D.

E. J. KENNY, M.Aust. I.M.M.

F. L. S. BELL, M.A., F.R.A.I.

FRANK W. HILL.

G. A. JOHNSON.

PROF. P. D. F. MURRAY, M.A., D.Sc.

DIRECTOR:

A. B. WALKOM, D.Sc.

Assistant to the Director:

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

SCIENTIFIC STAFF:

Birds, Reptiles and Amphibians: J. R. KINGHORN, C.M.Z.S., Curator.

Mammals and Skeletons: E. Le G. TROUGHTON, F.R.Z.S., C.M.Z.S., Curator.

Fishes: G. P. WHITLEY, F.R.Z.S., Curator.

Insects and Arachnids: A. MUSGRAVE, F.R.Z.S., F.R.E.S., Curator; K. C. McKEOWN, F.R.Z.S., Assistant Curator.

Molluscs: JOYCE ALLAN, F.R.Z.S., Curator.

Crustacea and Other Groups: F. A. McNEILL, Curator; ELIZABETH C. POPE, M.Sc., Assistant Curator.

Minerals and Rocks: R. O. CHALMERS, A.S.T.C., Curator.

Fossils: H. O. FLETCHER, Curator.

Anthropology: F. D. McCARTHY, Dip.Anthr., Curator.

LIBRARY AND PUBLICATIONS.

W. A. RAINBOW.

JASMINE M. McKECHNIE, B.A.

DEPARTMENT OF PREPARATION:

J. KINGSLEY.

HONORARY SCIENTIFIC STAFF:

Zoologists.

Prof. T. HARVEY JOHNSTON, M.A., D.Sc.

Asst. Prof. E. A. BRIGGS, D.Sc.

H. LEIGHTON KESTEVEN, D.Sc., M.D.

MELBOURNE WARD, F.R.Z.S., F.Z.S.

TOM IREDALE.

Entomologist.

T. H. GUTHRIE.

Ornithologist.

K. A. HINDWOOD, C.F.A.O.U., F.R.Z.S.

Archaeologist.

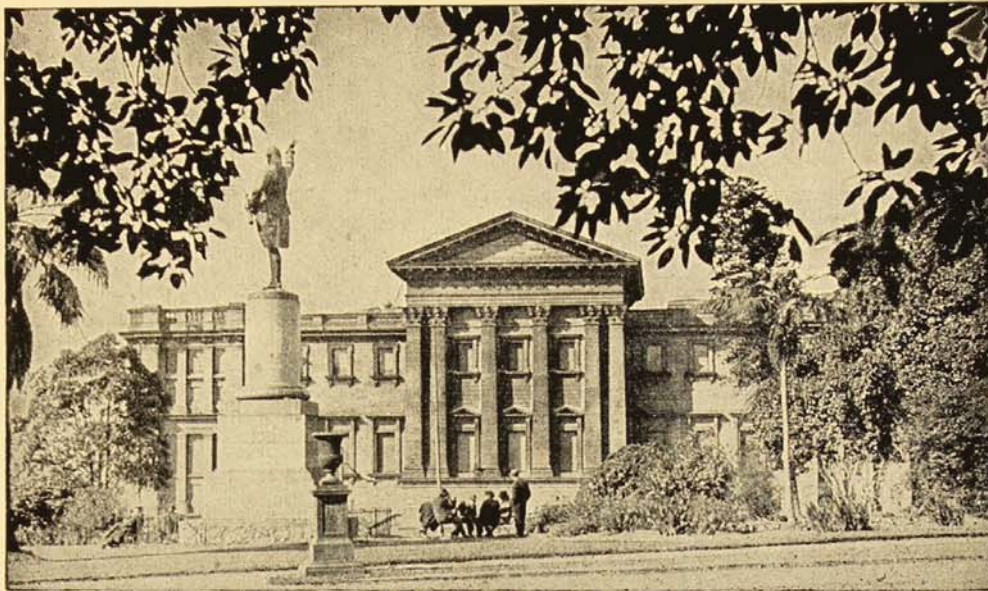
Prof. J. L. SHELLSHEAR, M.B., Ch.M.

Numismatist.

G. C. HEYDE, A.S.T.C., F.R.N.S.

Philatelist.

FRANK W. HILL.



THE AUSTRALIAN MUSEUM MAGAZINE

BLACK COCKATOO GROUP	<i>Frontispiece</i>
A NEW EXHIBIT—THE BLACK COCKATOO GROUP— <i>J. R. Kinghorn, C.M.Z.S.</i>	105
AUSTRALIA'S OLDEST FOSSILS— <i>H. O. Fletcher</i>	107
BANDICOOTS—RARE AND OTHERWISE, PART II— <i>Ellis Troughton</i>	113
SPIDER AERONAUTS AND GOSSAMER WEB— <i>A. Musgrave</i>	118
CLINGFISHES— <i>G. P. Whitley</i>	124
GEOLOGICAL CURIOSITIES, PART II— <i>R. O. Chalmers, A.S.T.C.</i>	129
AUSTRALIAN INSECTS—XLI—COLEOPTERA, 18—BYRRHIDS, HISTERIDS, AND SILPHIDS— <i>Keith C. McKeown</i>	132
A LARGE STARGAZER— <i>G. P. Whitley</i>	135
REVIEWS	106, 136

(Photography, unless otherwise stated, is by Howard Hughes.)

● OUR FRONT COVER. These Glossy Black Cockatoos (*Calyptorhynchus lathami* Temminck) are part of the Black Cockatoo Group described on page 105. The species feeds almost entirely on the tiny seeds of Casuarinas.



Black Cockatoo group in the Australian Museum. Three species are shown, the Red-tailed, the Yellow-tailed and the Glossy. Upper Allyn district on the Allyn River, Main Dividing Range, is the scene.

THE AUSTRALIAN MUSEUM MAGAZINE

Published by the Australian Museum
Editor: A. B. WALKOM, D.Sc.

College Street, Sydney
Annual Subscription, Post Free, 8/6

VOL. X, No. 4.

DECEMBER 15, 1950.

A New Exhibit— The Black Cockatoo Group

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

A habitat group, recently completed at the Australian Museum, shows Black Cockatoos in their natural environment. The scene is at Upper Allyn, a small bustling saw-milling centre on the Allyn River, somewhere beneath the Barrington Tops on the Main Dividing Range. Most of the material for the group was collected by a field party during the month of January. In the exhibit the large tree has the bark which has actually been torn by the birds in their search for food. Many of the bush plants, leaves, flowers, and rocks were made by the museum preparatorial staff—copied from the material collected in the field.

There are four species of Black Cockatoo—a bird found only in Australia—three of which, the Red-tailed, the Yellow-tailed and the Glossy, are included in the exhibit.

The Yellow-tailed Black Cockatoo, a large bird with a very powerful beak, is perhaps the best known and most widely distributed and is the species once commonly seen or heard, even now to a lesser degree, in the bushlands a few miles from the City of Sydney. In the group it is shown in the act of tearing the bark from a tree in search of wood-boring grubs which form a very large portion of its diet. Not only does it tear away bark, but it also cuts out large pieces of the toughest of our hardwoods in search of these insects. An

extraordinary feature of this performance is that the bird at first appears to be listening, not always close to the tree, but often from a distance of several feet, after which it flies to the trunk and commences work, almost invariably at the spot where a grub is working. A first glance at trees so cut about may suggest that the bird is very destructive to the forest areas, but that is not so, for the black cockatoo, by searching out and destroying the borers and perhaps an occasional tree in so doing, helps to save our forests from considerable damage by the grubs.

The Glossy Black Cockatoo, often confused with the Red-tailed or Banksian, because of an almost identical red tail-band, at one time was thought to be a juvenile of that species. However, the Glossy is not completely black but has a brown head, neck and mantle which distinguishes it from the all black Banksian. Unlike the Yellow-tailed species it prefers a diet of small seeds, its favourite appearing to be the tiny ones found in the cones of the casuarina; it seldom eats grubs.

Black cockatoos nest high up in the hollow branches or the trunks of trees, and the single egg of the Glossy or the two eggs of the Yellow-tailed may be deposited on such bark or fallen chips of wood as may be in the nest site. The entire duties of



Red-tailed Black Cockatoos (*Calyptorhynchus banksi* Latham)—a portion of the group.

incubation are carried out by the female, for observation has shown that the male seldom approaches anywhere near the nest site.

The group was constructed at the suggestion of Mr. E. J. L. Hallstrom, F.R.Z.S., who made a generous donation towards the

cost and who, during the course of construction, made available labour and material at a time when both were difficult to obtain. The Trustees of the Museum appreciate his generosity in making possible the addition of this fine educational exhibit to the Museum galleries.

Review

MAROONED IN DU-BU COVE.—By Evelyn Cheesman. Illustrated by Jack Matthew. (London: G. Bell and Sons Ltd.) 8vo. Pp. 190. English price 8s. 6d.

This book for younger readers describes the adventures of some children, their grown-up friend Boom, and Socks, the dog, who after being caught in a tropical storm are eventually wrecked in an outrigger canoe in a lonely cove on the coast of New Guinea. Here, marooned, they are forced to fend for themselves and lead a Robinson Crusoe existence until eventually rescued.

An interesting feature of the book are the drawings of tropical plants and animals which occur on the New Guinea coast.

Nobody is better qualified than Miss Cheesman to write such a tale of adventure in New Guinea, that Land of the Spear. She has collected insects and plants in the Owen Stanleys, travelled along the coast, and collected at Hollandia and other places at the western end of the great island. She has also written books of travel, in which she describes her collecting activities in this still little-known part of the world.

The present adventure book should certainly appeal to those children who live in New Guinea, or who, like the reviewer, have spent their early childhood's days there.

A. MUSGRAVE.

Australia's Oldest Fossils

The Winged-Snail, Biconulites, and the Archaeocyathinae Sponges*

By H. O. FLETCHER.

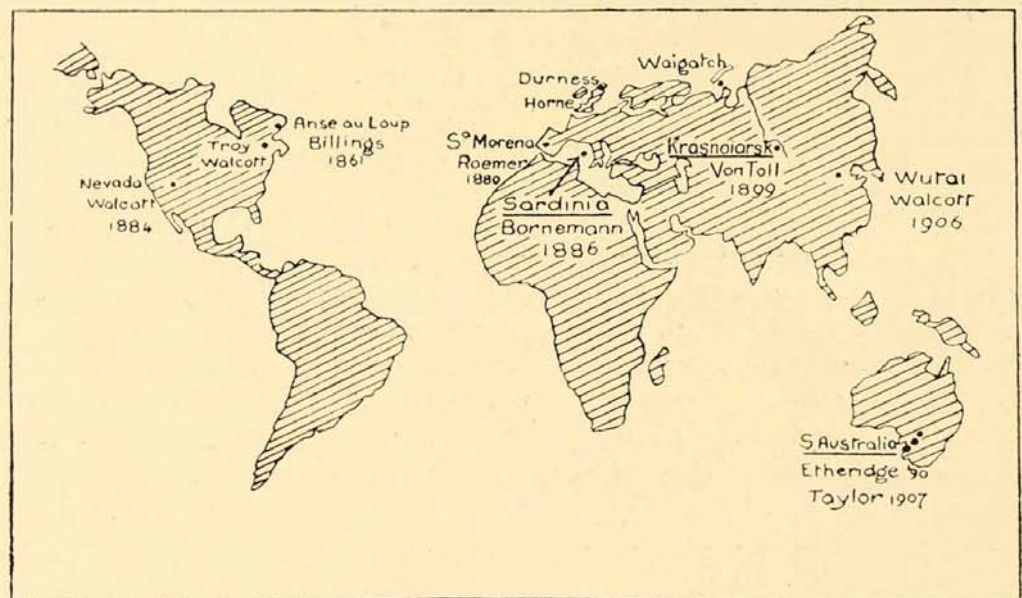
THE earliest well preserved and recognizable fossil life in the world is found in the sedimentary rocks of Lower Cambrian age. This does not indicate that life originated in Lower Cambrian times but simply means that any fossil evidence of earlier forms of life ceases abruptly as we pass backward into the older Proterozoic and Archaeozoic rocks of the pre-Cambrian. It is generally accepted that the high state of development and variety of types exhibited by these first-known fossils indicate very strongly that they are the descendants of a more primitive ancestral stock which came into existence long before the start of Lower Cambrian times. The "Dawn of Life," therefore, occurred in the clouded obscurity of the pre-Cambrian era, in the early half of the history of the earth, and by Lower Cambrian times the seas teemed with a fauna well advanced in its evolution. Many invertebrate groups were well established and most of them were distinguished by a prolific number of individuals.

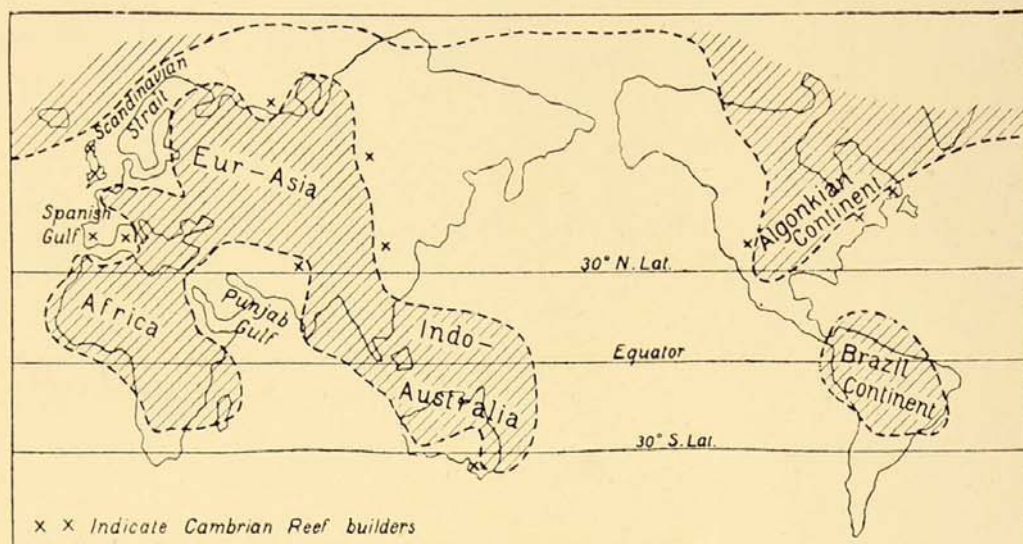
Obscure fossil remains have been found and described from pre-Cambrian rocks from many parts of the world, including Australia. These consist of worm-tracks, numerous fragments of supposed crustaceans, primitive types of "Lampshells" and many other organisms. Most of these occurrences are of doubtful organic origin but even those accepted as being authentic are of little account in the face of the marked number of fossil remains which appear in the lower horizons of the Lower Cambrian.

This phenomenon is readily explained, however, when one takes into consideration two factors. One is the very highly altered state of the pre-Cambrian sedimentary rocks which was brought about by the devastating forces of heat and pressure to which they were subjected. Secondly, it is certain that the early primitive organisms were soft-bodied creatures with no development of any hard structural parts so that their chances of preservation as

* Illustrations after T. Griffith Taylor.

Chart showing occurrences of Archaeocyathinae.





Map of the Lower Cambrian Continents to show the distribution of the Archaeocyathinae Reefs.

fossils would be remote. Under such conditions it is not surprising that most of the record of primitive pre-Cambrian life has been effectively destroyed.

The early condition of the earth prior to and during the beginning of life is shrouded in mystery. Its very beginning is purely a matter of speculation and conjecture, although it would appear that our globe was once a red-hot shapeless mass which, as it spun through space, slowly cooled and shrank in size. Through the vast duration of Archaeozoic times, possibly 1,000 million years, the globe was moulded into a recognizable earth by an incessant deluge of rain which cooled and thus formed a solid outside crust.

Nothing was still in Archaeozoic times and the earth trembled frequently from the effects of cooling and shrinkage. Tides of red hot lava poured out through ever opening volcanic vents and covered the surface crust. Molten matter from the un-cooled central mass frequently forced its way to the surface and materially assisted in the building up of what is now known as the Archaeozoic land mass.

The torrential rains which had been continuously sweeping the surface of the globe had finally made their presence felt and the cooling influence stabilized and brought about a period of quiescence. A world of rock and water was now revealed with mountain ranges thrust high in the air by the crumplings of the crust.

The processes of denudation or destruction of the land surface now became active

and eroded materials, carried by swiftly-flowing rivers, were transported from the high lands to the sea. Their distribution caused huge offshore deposits to be built up which were later destined to form the mudstones, shales and sandstones of new land. This process of destruction of old land surfaces to form the materials for the construction of new lands has persisted from the beginning of time. The growth of a continent depends entirely on its submergence below the sea as it is under these circumstances that sedimentation takes place. At a later stage the sea-floor and its accumulated deposits are raised by great earth movements to form new land.

There is little doubt that both animal and plant life originated in the sea, but the land plants did not appear in geological history until many million years later in the Silurian geological period. The first animals were very simple and minute forms which possibly came into existence during early or middle Proterozoic times. Their appearance and structure are unknown but it is likely they were similar to the larval and embryonic forms of more recent animals. These naked organisms, destitute of hard parts, in all possibility represented the mature creatures of Proterozoic seas.

The face of the globe in Lower Cambrian times was entirely different from what it is to-day. The continents consisted of three great unbroken land masses now spoken of as "massifs" or "shields."

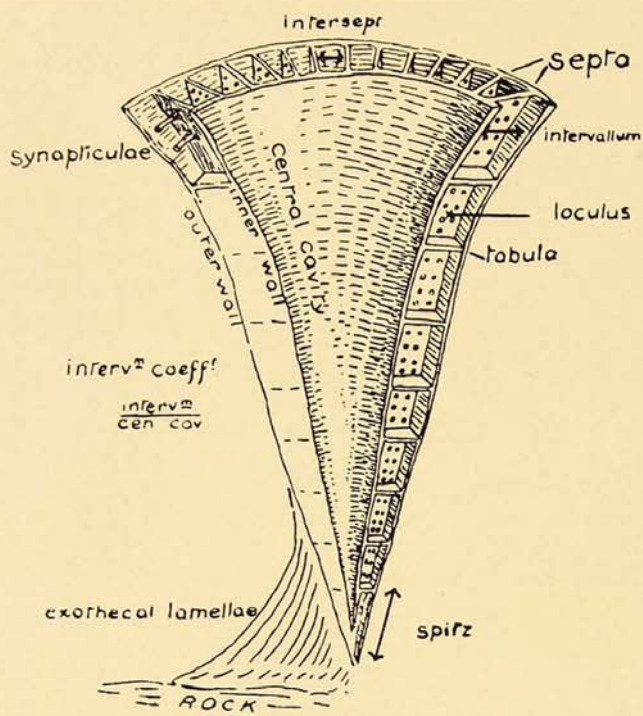


Diagram illustrating the structure of Archaeocyathinae.

The largest continent, usually referred to as the "Old World Continent," included the greater parts of Europe, Africa, Western Asia and Indo-Australia. On the other side of the globe the "Algonkian Continent" comprised the eastern portion of North America, Greenland and Iceland, while the "Brazilian Continent" covered what is now Peru and Columbia.

These Lower Cambrian continents were composed entirely of highly altered Archaeozoic and Proterozoic rocks and they form the foundation or basement of the earth. Overlying and around them have been deposited the newer sediments built up during succeeding geological periods. All the newer rocks are for the most part composed of eroded materials derived from the early and very ancient basement rocks.

The Lower Cambrian seas were extensive and in places covered large areas occupied to-day by land masses built up of younger rocks. The "Scandinavian Strait" extended between Russia and Iceland and deep sea covered the positions where the British Isles and a great part of Western Europe were to be formed in later geological periods. The "Spanish Gulf" covered present-day Spain and Portugal, while the "Punjab Gulf" formed a large indentation in the "Old World

Continent" occupying the position of what to-day includes Arabia, Persia and western India.

The Australian continent in Lower Cambrian times formed the most southern part of a great extension of the "Old World Continent." It is, therefore, not the oldest continent in the world as frequently but erroneously stated, but only has the distinction of being one of the oldest.

A Lower Cambrian sea extended across Australia from the Kimberley area to the entrance to St. Vincent Gulf, and north of that line the continent extended right through to northern Europe. The Australian coast-line was formed by pre-Cambrian rocks now visible on the surface at Tanami, the Macdonnell Range area, and to the north-east at Darwin, Pine Creek and Arnhem Land. The eastern shore-line extended approximately south from Mount Isa in Queensland, through the north-eastern Flinders Range to St. Vincent Gulf.

When the world passed from pre-Cambrian into Cambrian times more than half of geological time had been expended. The duration of time from the Lower Cambrian to the present-day is approximately 650 million years and the geological history of the formation of the earth through this vast amount of time is known with the utmost certainty. Prior to the Lower Cambrian geological period, or the beginning of the Palaeozoic Era, all records were destroyed to such an extent by catastrophic events that they are almost indecipherable.

The Lower Cambrian seas were populated by an abundance of invertebrate life which for the most part had a world-wide distribution. These are now known by their fossil remains which are found remarkably well preserved in the great thicknesses of rock deposited on the Lower Cambrian sea-floor but now elevated to form a not inconsiderable part of the present-day continents.

In Australia these Lower Cambrian strata occur at many localities, including Yorke Peninsula, Flinders Range and Macdonnell Range in South Australia, the Kimberley region in Western Australia, and

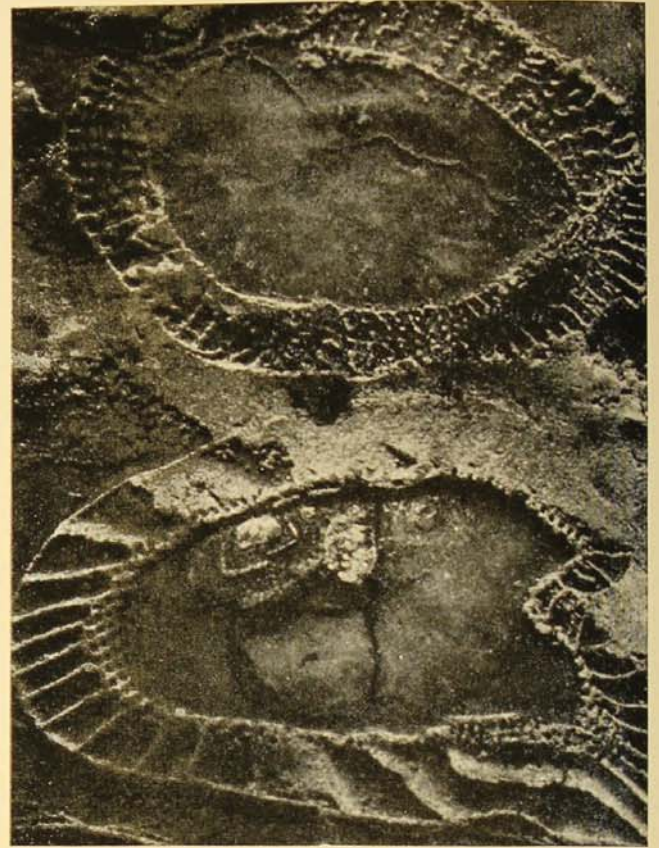


An etched specimen of Archaeocyathinae Limestone from the Ajax Hill, Beltana. The silicified fossils appear white on brown limestone.

north-western Queensland. All these outcrops naturally lie within the area previously occupied by the Lower Cambrian sea.

An important feature of the Lower Cambrian rocks in South Australia is the extent of the limestone reefs, in places more than a thousand feet in thickness, which were built up by a remarkable and most interesting group of organisms known as the Archaeocyathinae or "Ancient Cups." These anomalous creatures have the general outward form of sponges but their more detailed internal structures resemble the corals.

Limestones are fossil-bearing rocks which are built up in a different manner from other sedimentary rocks. They are formed by the remains of lime-secreting organisms

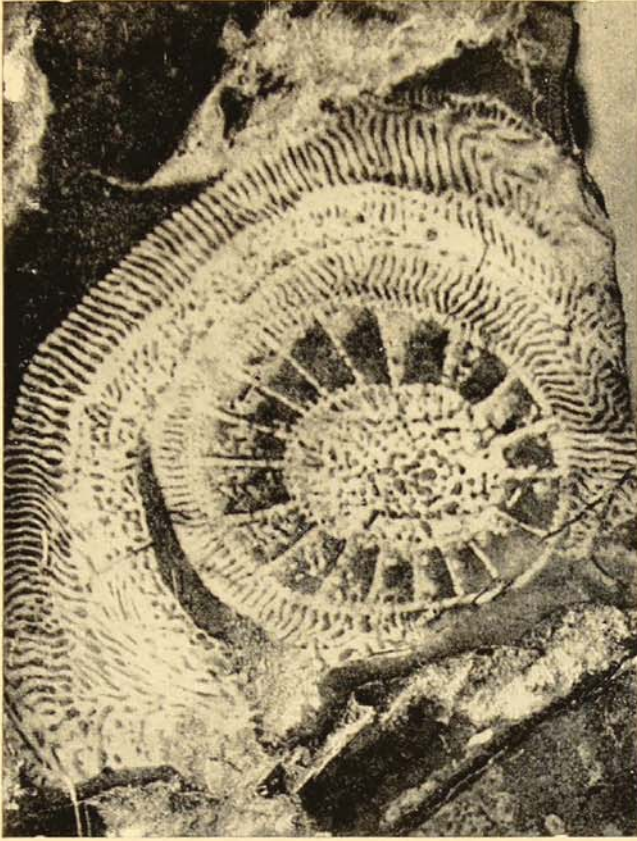


Etched cross-sections of Archaeocyathinae. Compare with adjoining illustration.

which flourish best under conditions where there is only a slight amount of sediment in the water. Limestones may be built up in deep-water by the remains of minute calcareous-shelled organisms which, on their death, fell to the sea-floor and accumulated over a long period of time to form great thicknesses. Coral reefs are formed also under clear-water conditions and massive structures have been developed in most geological periods.

Most of the ancient reefs are not built up entirely by the remains of one particular type of organism but have other components consisting of a variety of fragmentary calcareous material. The Archaeocyathinae reefs, however, are remarkably free of other remains and it seems apparent that the Archaeocyathinae lived an isolated existence away from their contemporaries, the trilobites, winged-snails or pteropods and other invertebrates.

Occurring as they do in the lower horizons of the Lower Cambrian rocks the Archaeocyathinae and the "winged-snails" of the genus *Biconulites* rank amongst the first recognizable life and are the oldest fossils found in Australian rocks.



A cross-section of *Somphocyathus coralloides*
from Wirriialpa.

The fossil remains of the Archaeocyathinae group have been collected from limestone reefs in Canada, New York, Nevada, Sardinia, Spain, Scotland, North China, Punjab, South Australia and from the frozen wastes of Siberia and the Antarctic. Sir Ernest Shackleton found specimens during his unsuccessful dash to the South Pole near Mount Darwin, about 360 miles from the Pole.

Of all the Archaeocyathinae occurrences the reefs of South Australia and Sardinia contain the greatest variety of forms and are the most extensive. The South Australian reef in all probability was continuous over an area of some thousands of square miles and was in places more than a thousand feet in thickness. This area includes the Willunga Range, Yorke Peninsula, and the Flinders Range from a little north of Quorn to Parachilna and Beltana, and also the eastern side of the Flinders Range near Wirriialpa and Mount Chambers Creek.

The Archaeocyathinae were the first great reef-builders of the sea and are of interest in that they had a comparatively

short life history. They came into existence shortly after the beginning of Lower Cambrian times but died out and had become totally extinct before the start of the Upper Cambrian. Nevertheless, during their short life they flourished to an amazing extent and spread to all parts of the world.

In Australian rocks alone more than a hundred different types have been described and these represent a very small percentage of the material awaiting further and more intensive research.

The more important localities where Archaeocyathinae have been collected in South Australia include Normanville and Sellick's Hill, near Cape Jervis, south of St. Vincent Gulf. At these localities there is an abundance of only one species of the genus *Archaeocyathus*. Across on the western shore of the gulf and to the north is Ardrossan where some non-silicified material has been collected. Several hundred miles to the north the fossils become more abundant and with a greater variety of forms at localities such as Wilson, Kanyaka, Wirriialpa and the Blinman and Ajax Mines. The actual locality at the Ajax Mine is a limestone hill, just behind the copper mine, and it is ten miles north-east of Beltana, a small township on the northern railway. This locality has so far produced more species than the others and the material is beautifully preserved.

The Archaeocyathinae are a group of fossils characterized by the presence of two concentric walls—an outer one and an inner one—enclosing a central cavity. The whole structure is usually perforate and the space between the walls is crossed by septa. This description applies to the majority of the genera which Professor T. Griffith Taylor, in his memoir on the South Australian Archaeocyathinae divided into five families. The general shape and form varies from long cone and pipe-like types to bladder-shaped cups and large folded bowls. Between the inner and outer walls of the cup-wall, which comprises the whole skeleton, are found regularly perforate septa, tabulae, dissepiments and other skeletal structures which so closely resemble those of the corals.

It is an interesting fact that the first specimens of Archaeocyathinae were collected about the year 1861 from Anse au Loup, on the straits of Belle Isle, Labrador. In describing the genus *Archaeocyathus* the author mentioned that these fossils occupied an intermediate place in their zoological position, as from their radiate structure they have the aspect of true corals, but yet in polished sections reveal the characteristic perforate structure of the sponges. These original specimens were also the largest yet found as several were two or three feet in length with diameters of the central cavity up to four inches. It is possible that some of the South Australian specimens may have attained this length but usually they are much smaller.

The general concensus of opinion regarding the affinities of the Archaeocyathinae is that they are more closely allied to the sponges (Phylum Porifera) than to any other animal group. The variation of the outward form from elongated cones to bowl-shaped skeletons, all of which are perforate, is paralleled only by the sponges. It cannot, however, be said that certainty has been reached in the conclusions regarding their systematic position.

The Archaeocyathinae are among the most ancient of all known fossils but associated with them in the Lower Cambrian strata of South Australia is a type of "Winged-snail" which may even be older than members of the Archaeocyathinae group. It is the so-called *Salterella*, a creature also of doubtful affinities, but thought to belong to the family Hyolithidae of the Pteropoda or "Winged-snails."

This group constitutes organisms of a very distinct type of the univalve mollusca which frequent the surface of the sea in prolific numbers. They develop small cone-shaped shells, usually not more than an inch in length, and sometimes provided with an operculum or lid. The animal itself is housed in the shell with its foot protruding from the aperture and modified to form two fins which are used for swimming. They have no distinct head and

have not attained the same degree of development as other groups of the Gastropoda.

Fossil pteropods similar to those living are found in the Upper Cretaceous and the Tertiary but the very anomalous pteropod-like creatures such as *Tentaculites*, *Hyolithes*, and *Salterella* constitute a very important part of the Lower Cambrian fauna. They are at present referred to the Pteropoda although there is still some doubt in regard to their definite affinities.

The genus *Salterella* occurs in abundance in the Lower Cambrian rocks of Western Australia and South Australia. In the flaggy limestones with red and green shales of the Ord River, Kimberley region of Western Australia, a species described as *Salterella hardmani* is represented by numerous small, elongate, conical and rapidly tapering shells which may be straight or slightly curved. It was recently proved, however, that this species was not a true *Salterella* but had definite affinities with a closely related genus *Biconulites* which is known from the Lower Cambrian rocks of China. Whereas *Salterella* ranged into the Ordovician it is very likely that the genus *Biconulites* will be found to be restricted exclusively to rocks of Lower Cambrian age.

The South Australian species which is known as *Salterella planoconvexa* is also prolific and it has been traced to an horizon 500 feet stratigraphically below the base of the Archaeocyathinae limestone. It is the lowest horizon from which recognizable fossils have been recorded from Australia. It is also suggested that this species should be referred to the genus *Biconulites*.

The genus "*Salterella*" was originally thought to represent worms allied to the well-known genus *Serpulites* and that the shells were actually worm-tubes. It was soon transferred, however, although with some doubt, to the Pteropoda but in 1925 a suggestion was put forward that *Salterella* was a cephalopod and therefore a type of cuttle-fish. This suggestion has not been accepted and the group still remains in the Pteropoda.

Bandicoots—Rare and Otherwise

By ELLIS TROUGHTON.

PART II.

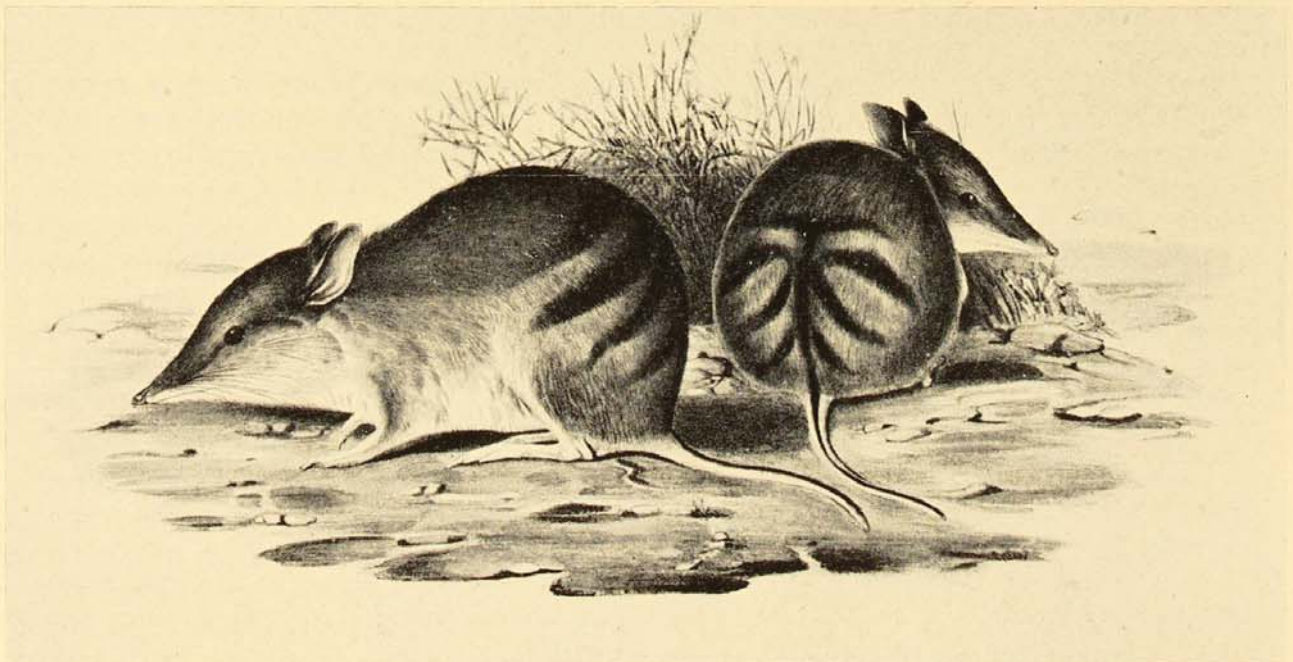
THE title of this concluding part of the article on the small but remarkably interesting bandicoot family of marsupials might more appropriately have read "rarer than otherwise" since it deals with the most strikingly specialized species, which have either been reduced to the verge of extermination or banished to the less hospitable inland regions by the advance of settlement and ravages of the introduced fox and the domestic cat in a wild state.

THE BARRED-BACK BANDICOOTS.

This group of generally smaller and rather more elegant species belongs to the same genus as the Long-nosed Bandicoot (*Perameles nasuta*) previously described, but all are distinguished by having the

rump more brightly-coloured and adorned with a contrasting grid-pattern of dark-brown bars. The largest of the barred species was described from Tasmania in 1838, under the specific name *gunni* after the early naturalist Ronald Gunn, who said it fed on plant bulbs as well as insects; it seems to be assured of survival under present conditions and absence of the fox. Unfortunately, its elegant little mainland confrere *fasciata*, of inland Victoria and western New South Wales, recorded from the Liverpool Plains in 1841, has apparently been exterminated by the spread of settlement and the fox.

The great naturalist John Gould also recorded it from stony ridges about the junction of the Namoi and Darling Rivers,



This Barred-Bandicoot (*Perameles fasciata*) is the south-eastern example of several species distinguished by having a grid-pattern of rump-markings. Equally as conspicuous in the smaller female, the markings evidently have some camouflage value in relation to the surroundings and nesting-habits.

After Gould.

and from the ranges which run down towards the great bend of the Murray in South Australia, where he first collected a specimen in 1838. Its stomach contained the remains of caterpillars and other insects, a few seeds, and fibrous roots. As in others of the genus, said Gould, "The flesh on being roasted proved delicate and excellent food."

According to Gerard Krefft, when Curator of the Australian Museum, about 1865, the barred bandicoot was common everywhere around the River Murray, being known as "Thill" or "Moncat" to the native tribes. They fed on insects, bulbous roots, and various herbs, and were most expert in catching mice, several proving as useful as cats about the camp. Captives rapidly killed the various rodents fed to them, a single individual killing as many as twenty mice in no time. The bandicoot would tumble the mouse around with its forepaws, breaking its hind-legs but only eating the head as a rule, much as in Wood Jones' observations quoted previously for the Short-nosed Bandicoot.

From May to August the blacks caught females with two to four young attached although there were eight teats. These bandicoots are nocturnal and non-burrowing, seeking shelter by day in hollow logs or under rocks, and sometimes making a kind of nest. It is this surface existence which doubtless makes so many of the smaller marsupials victims of settlement, bushfires, and the fox. Sad to relate, specimens of the Western Barred-Bandicoot, reported by Gould as "inhabiting the whole coastal region of the Swan River colony," have not reached the Western Australian Museum since 1900, so that it is now assumed to be extinct.

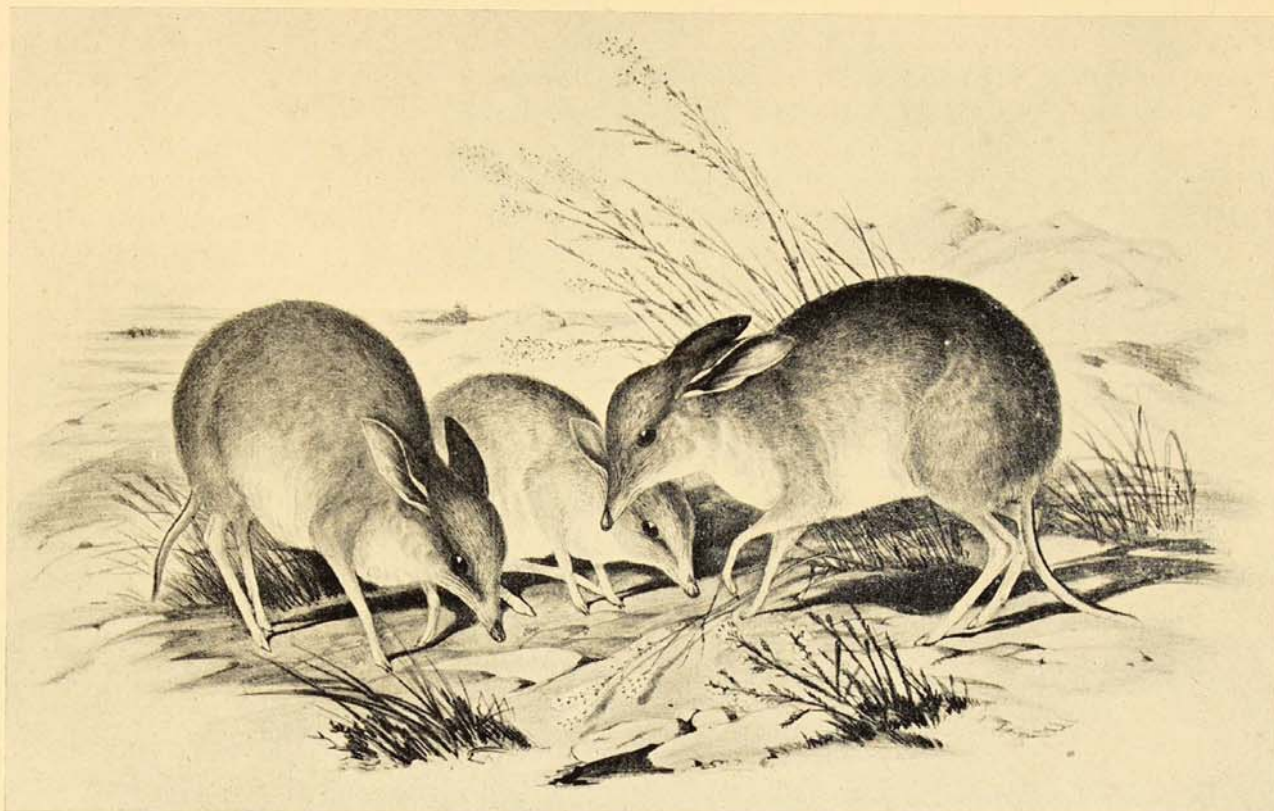
THE PIG-FOOTED BANDICOOT.

This marsupial oddity was first described and illustrated by Surveyor-General Major Mitchell in the account of his *Expedition to the Rivers Darling and Murray in the year 1836*. Camped near the junction of the Murray and Murrumbidgee, the most remarkable incident of the day's journey, he said, was the discovery of an animal of which he had seen only the skull amongst fossils from the Wellington Valley. It was

captured by the native guides from its refuge in a hollow tree, all declaring they had never seen one before. It was described as being about the size of a young rabbit and of nearly the same colour. The drawing showed the "two-toed forefeet" which suggested the name pig-footed bandicoot to the explorer's party and also depicted the lack of tail of the original specimen; this specimen was placed in the Australian Museum. As a result, the genus name of *Chaeropus* (hog-foot) was applied to the quaint marsupial, and the specific one of *ecaudatus* regarding the supposed lack of tail. It was not then realized that their slender tails render most bandicoots vulnerable to such an undignified casualty.

According to Gerard Krefft, who had great difficulty in obtaining specimens when camped at Mitchell's locality in 1857, the showing of a sketch of the tailless example to the black collectors provided an amusing illustration of their primitive resource in gaining proffered rewards, with painful results for the commoner bandicoots. The natives naturally did not associate the drawing with their tailed "Landwang" and, not being able to find the required animal, brought in numbers of the commoner species minus their tails which had been broken off in the hope of satisfying the collector!

The pig-footed bandicoot is regarded as a specialized offshoot of the plains-haunting members of the family, such as the barred bandicoots of the genus *Perameles*. During the course of re-adaptation to a running rather than a hopping action, the forefeet have mimicked the cloven and the hind-feet the solid structure of the feet of the hoofed quadrupeds. Of course, different digits are represented in the convergent adaptations producing this superficial resemblance. Conforming with the hoof-like feet the limbs are remarkably slender and suggestive of a miniature deer, while the action of the animal was described by Krefft as like a "broken-down hack in a canter, apparently dragging the hind-quarters after it." A more precise account of its movements is not available as nearly all the specimens were captured by blacks, few white men having been fortunate enough to observe the living animals.



The Pig-footed Bandicoot (*Chaeropus ecaudatus*). Only species of its genus, this rare marsupial has the appearance of a miniature deer. Adaptation of the slender limbs for a running rather than a hopping action has resulted in the hindfoot mimicking the solid, and the forefoot the cloven, hoofed pattern suggestive of the popular name. The species was first made known by Surveyor-General Thomas Mitchell in 1836, from a specimen placed in the Australian Museum.

After Gould.

According to Krefft, some captives were kept for about six weeks on lettuces, barley grass, bread, bulbous roots and various insects, especially grasshoppers, on which the blacks said they fed. Naturally restless at first, they seemed quite snug by morning, having made a covered nest of dried leaves and grass to which they hurried if disturbed in day time, though becoming very lively at sundown. Due possibly to captive conditions, Krefft said they drank a good deal of water, and that they would not touch meat or attack and eat mice as other bandicoots do. On the contrary, the explorer Sturt stated that they showed a partiality for flesh though not flourishing on such a diet. But the pig-footed bandicoot is doubtless a mixed-feeder, though droppings examined by Krefft were entirely of grass and he concluded that the natural diet was mainly vegetarian.

The young in the pouch never exceeded two, although there are eight teats. Krefft considered this species to be disappearing as fast as the aboriginal population, and

that the trampling of flocks and herds would soon disperse those remaining in settled areas. In the remote sub-desert country to which they have been banished, the habit of sheltering in any available timber, as with many other marsupials, leaves them a prey to bushfires, while invasion of their remaining haunts by the fox has probably sealed their doom. Only one species of this interesting genus has been described, though the naturalist Gould named and pictured the Western Australian animal as a somewhat differently coloured geographical race. There is no specimen in the Museum at Perth and nothing definite is known of the past distribution of the race once abundant in parts of the interior of the State. According to the collector Shortridge the marsupial was known to colonists as "the Camel-foot," and as "Buddile" by aborigines of the Beverly district.

Specimens are in the South Australian Museum from Cooper's Creek and the Gawler Ranges, and from Ooldea where Wood Jones thought they may still exist

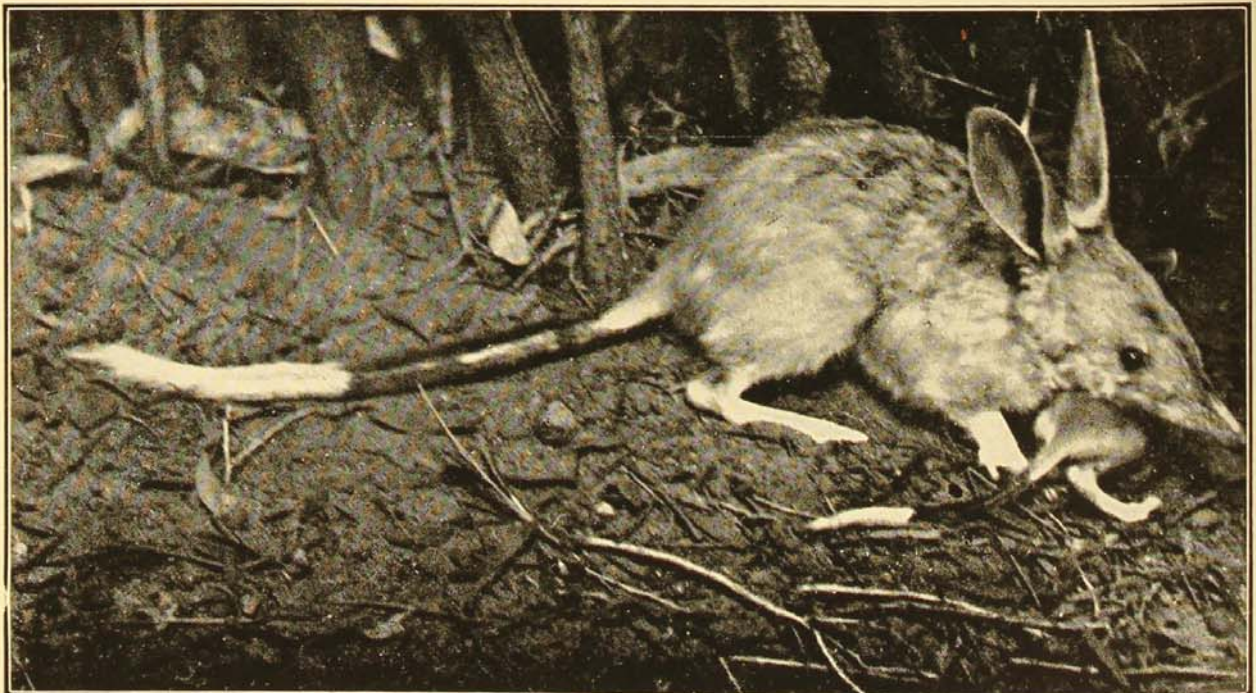
on the edge of the Nullarbor Plain. At Charlotte Waters specimens were obtained for Sir Baldwin Spencer who stated that one was dug out of a hole in a sandy plain by a native woman who said the tribe called it "Dubaija." Showing the general unsuitability of aboriginal words as popular names, the Kukata tribe are said to have known the animal as "Wilalya." According to Professor Stirling the Pig-footed Bandicoot, though extremely scarce in South Australia by 1900, had been taken both north and south of the Macdonnell Ranges, and inland from Fowler's Bay. In spite of the drastic shrinkage in range, it is greatly to be hoped that an interested observer may yet locate a colony in some secluded haven where natural or human protection may ensure its survival for all time.

THE BILBIES OR RABBIT-BANDICOOTS.

The two species of Bilby are amongst the most beautiful of our pouched animals and are readily distinguished from all other Australian bandicoots by their long silky blue-grey fur, and extremely long rabbit-like ears, combined with a long well-haired tail with a small naked spur at its tip. The

hairs tend to form a crest, and the tail in the larger species has a sharply contrasting black basal and white outer half, while the tail of the smaller, more typical desert species differs in having only a slate-grey to blackish line along the top of the inner half, instead of it being encircled with black. In habits also the bilbies differ markedly from other bandicoots in their burrowing mode of life, greater tendency to a flesh diet, as shown by the broader grinding type of molars, in contrast to the spike-cusped insectivorous kind of teeth, as well as in being more strictly nocturnal, coming out at a later hour than most marsupials.

Bilbies are the only bandicoots actually excavating burrows for themselves. Their powerful broad-nailed forearms make them such expert tunnellers that it is useless to attempt to dig them out along the entrance spiral which widens out and descends for about five feet or more. The aborigines, who treat the flesh as a great delicacy and the black and white tails as attractive ornaments when tied in bundles of from ten to twenty, have their own effective methods of capture. The larger species (*lagotis*) usually occupies the extremity of



Bilby or Rabbit-Bandicoot (*Macrotis lagotis sagitta*). Like all its fellows, the silky coated bluish-grey bilbies are useful destroyers of mice and insect pests but the beautiful marsupials have been banished to remote regions of the inland by trade demands and the fox. The aborigines hunt them for food and make ornaments from the white-crested tails.

Photo.—H. C. Barry.

the burrow and the blacks are said to locate its position with an ear to the ground before digging downwards. The smaller paler-tailed species (*leucura*) lies within a foot or so of the entrance in the colder weather when the natives spring onto the surface behind the bilby, cutting off its retreat.

Insects and their larvae, mice and other small mammals form the natural diet, and captives would eat cake or bread and either raw or cooked meat, but could not be persuaded to eat grass, tubers, or fruit. The large canine teeth which, as with other flesh-eating mammals, are adapted for the capture of living prey do not indicate ferocity as bilbies are quite inoffensive marsupials, but they must be handled with care as they may bite savagely when disturbed, inflicting multiple, if not very severe wounds from their reluctance to let go. Of the strictly nocturnal habits of captives in a large open-air run, Wood Jones said they would often appear at dusk and return to bed for an hour or so after a hurried look round, though apparently not disliking moonlight. They slept in a remarkable posture, apparently never lying down but squatting on the hind legs with the long snout tucked between the fore ones, so that they resemble round silky balls, with the tail either flexed under or stretched out behind. The long ears are laid back and then folded forwards with the tips over the eyes. A bilby often started the evening activities with one ear back and the other kinked forward in the sleeping position. Strangely enough, though the leathery ears are doubled flat upon themselves for much of the time, to muffle the acute hearing, no creasing shows in the normal position.

During daylight, at least, the sight appears to be far from keen, the main guiding sense for food being by smell; an active grasshopper is detected in the day time by scent before sight. In the dark the hearing is evidently keen because while the animal fails to notice a still person a footfall is

detected at once. The only sound produced seems to be an indrawn hissing when disturbed. Kreffft refers to the bilby, once inhabiting the plains of the Murray and Darling, as not being gregarious, only a pair occupying the burrow. He procured but a few, including a female with two large young in the pouch. In normal seasons, Wood Jones stated that young are born from about March to May, one or two making the usual litter although there are the usual eight teats in the pouch, which opens backwards and slightly downwards. In the more central regions breeding seems to be regulated by rains and food abundance and, unfortunately, there is little doubt that a reduced rate of breeding in the less hospitable regions must lead to the extinction of these harmless, picturesque, and pest-destroying marsupials.

Sadly enough, the settlers' early tolerance of the Bilby as a useful consumer of mice and insects, under which they received a measure of protection and were sometimes kept as pets about the house, was not maintained by later generations which have shown such quaint creatures scant mercy. According to Wood Jones, small numbers of pelts were still arriving at the Adelaide sales rooms in 1923, where quantities of skins had previously been marketed. Great numbers had also been wantonly killed for "sport" in areas within reach of settled districts, while many more were killed or maimed by rabbit traps or became victims of poison-baits for rabbits. The larger of the species once ranged from west of the Great Dividing Range in New South Wales to the south-west coast of Western Australia, but the last specimen to reach the Museum from the eastern State came from Moree in 1908. Although in areas of intensified settlement native life must inevitably give way, it is nothing less than a faunal tragedy that the spread of rabbits followed by the poison-trail, bushfires, and the inexcusable thoughtlessness of man, should have swept such interesting and useful marsupials from the settled areas of the "Mother State".

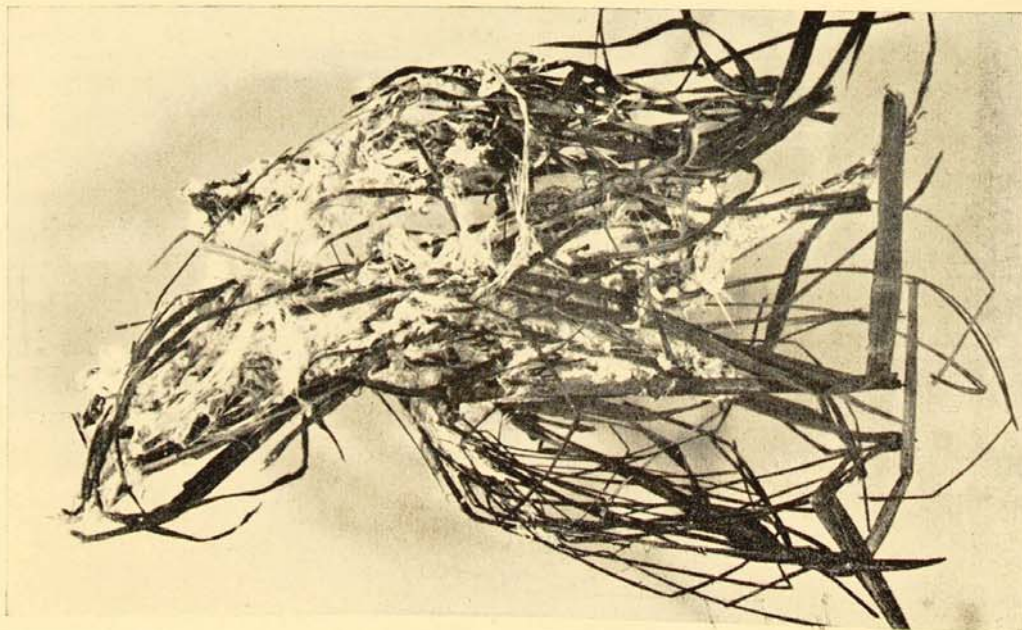
Spider Aeronauts and Gossamer Web

By A. MUSGRAVE.

THE first week of September, 1950, the beginning of spring was, in some districts in New South Wales, heralded in by a flight of spider's gossamer web, resulting in much speculation as to its origin.

News of this aerial invasion was first brought to me by *The Sydney Morning Herald* informing me of a "flight" of gossamer web in the Singleton district west of Newcastle, and asking for any information about such visitations; a paragraph about this occurrence appeared in the *Sunday Herald*, 3 September. Within the next few days specimens arrived at the Museum chiefly from the Upper Hunter district or nearby, and were apparently all part of the same "flight." These pieces of matted silk-like gossamer came from (1) Mr. Guy Singleton, of Glenthorne, via Taree, Manning River, who described a flight of gossamer on 1 September at 9 a.m., the weather being sunny with a cloudless sky; (2) Mr. W. J. Boydell, of Allynbrook, whose specimens appeared on the night of 31 August; (3) Mr. R. A. Laurie,

of Bondi Beach, sent specimens from Dunggog, "collected at about 7.30 a.m. on 1 September, when a steady and warm north-east wind was blowing off the mountains. It was blown and drifted about in much the same manner as thistledown. Mainly it was in straggly pieces resembling cotton waste. It was inclined to be tacky and adhered to and stopped on the first thing it contacted such as telephone lines, wire fences and twigs. The pieces would average about 3 inches by half an inch, though many balled to about the size of a pigeon's egg"; (4) Miss Joyce Weismantel in a letter to Mr. J. R. Kinghorn, from Waukivory, via Gloucester, dated 1 September, recorded the flight at daylight "floating around in the air," and as she pointed out, "it was a muggy morning—a north-west wind inclined to be hot"; (5) Mr. D. F. Stewart, of the McMaster Animal Health Laboratory, C.S.I.R.O., Sydney, forwarded a specimen sent from Cassilis by Sir Frederick McMaster, with a note saying that it was affecting most of the grass in the district.



Flocculent gossamer web secured on grass at Cassilis, N.S.W., by Sir Frederick McMaster, September, 1950.

Nor was an aerial flight confined to this State. In Brisbane *The Courier-Mail*, 4 September, recorded a large area in south-west Queensland, subject to similar conditions, and we glean the following information: "The strange 'snowstorm' in south-west Queensland began early on Friday when white, sticky strands floated from a clear sky to cover thousands of acres. Great masses of the sticky web still festooned Charleville orange orchards and mulga scrub near Cunnamulla yesterday. The Queensland spider 'snow' fell in scattered patches between Charleville, Cunnamulla, and Quilpie. It was first seen at 3 a.m. on Friday by two Charleville engineers, Frank O'Connor and Les Lynch, who were driving a ballast train between Charleville and Cunnamulla. They described it as long strands with a white ball as big as a man's thumb, like sticky cotton wool. The 'things' continued to fall after dawn out of a clear sky, in windless conditions, the drivers said last night." This article also referred to the flight at Singleton, New South Wales, and mentioned my comments given in the *Sunday Herald*. On 9 September *The Courier-Mail* published a special article by Mr. Heber Longman, on gossamer web and its origin. *The Sun* newspaper, Sydney, 8 September, 1950, recorded a similar flight at Redpa, north-west Tasmania.

SPIDER WEB.

This wool-like gossamer has been a subject for discussion down the ages. Dr. W. S. Bristowe, a British authority on spiders, has quoted from Pliny, "In the year that L. Paulus and C. Marcellus were consuls, it rained wool." We in Australia might regard, at the present moment, such a statement as prophetic of our times, since the wool clip is exceeding all records and steadily soaring skywards. To understand these aerial "pennies from heaven" we will be better equipped if we know something about spiders and their methods of utilizing their silk.

The spider's silk glands, which manufacture the web in a liquid state, open by ducts on the spinnerets. These glands vary

in shape and structure. The spinning organs of spiders are the spinnerets situated at the end of the abdomen and are finger-like in appearance. The spinnerets vary from four to two pairs, eight being the primitive number found only in the family Liphistiomorphae, not recorded from Australia, and in this last-named family the spinnerets are not placed at the end of the body. Three pairs of spinnerets are present in most spiders. They are large and conspicuous in the trap-door spiders and their allies, but are small in orb-weavers.

On the end of each spinneret are fine apertures, the spinning tubes, which are of several kinds. These serve to let the silk pass in a liquid state to the outside of the body where it hardens. These spinnerets and the tubes produce various types of silk used by spiders. In certain groups there is also present a spinning plate (cribellum) which is used in conjunction with a carding apparatus (calamistrum) on the hind legs. Spiders employ their silk for nest or web building, enswathing the prey, for their egg sacs, draglines (lifelines) and attachment disks. As the spinnerets vary in structure in the different groups and according to the use the silk is put, these spinning-organs are valuable in classifying spiders.

The spiders of the family Argiopidae (Epeiridae) may use the wind to carry a strand of silk to a neighbouring bush or tree when they start building their orb-webs. The spider elevates the tip of the abdomen and the spinnerets produce a thread which the wind carries in the direction required. Such a line would be of the non-viscid type and would constitute a *foundation* line which may be reinforced with other lines until a sound cable is formed upon which to hang the web with its geometrical design of radii and the viscid spiral.

The question of the aerial flights may be answered with two explanations: 1, an aeronautical flight by baby spiders or Linyphiids, and 2, gossamer which has been torn from webs made by spiders and carried up into the air.

AERONAUTICAL FLIGHTS.

We may briefly consider the first of these two explanations. As a rule it is only young spiders freshly emerged from the egg sac which indulge in these aerial migrations, but adult spiders of the family Linyphiidae in the northern hemisphere are recorded as spider aeronauts.

A still, sunny morning is chosen for the "take-off" and it has been suggested that an air-current is then developed which will carry the spiderlings aloft. Each spiderling stands facing the wind with its legs extended in a "tip-toes" manner, and emits from the spinnerets a strand or several strands of silk. These are borne away on the air-current until the spider feels that it may safely release its hold and become air-borne. It may be carried up into the atmosphere for thousands of feet or be borne by the breezes for hundreds of miles out to sea. These ballooning baby spiders were thus the first aviators.

A now classical record of a flight of aeronautical spiders and one cited by almost every text-book on Araneology, is that given by Charles Darwin in his *Narrative of the Surveying Voyages of his Majesty's Ships Adventure and Beagle, between the years 1826 and 1836*, vol. iii (1839), while the vessel was off the coast of South America. He writes:

On several occasions, when the vessel has been within the mouth of the Plata, the rigging has been coated with the web of the Gossamer Spider. One day (November 1st, 1832) I paid particular attention to the phenomenon. The weather had been fine and clear, and in the morning the air was full of patches of the flocculent web, as on an autumnal day in England. The ship was sixty miles distant from the land, in the direction of a steady though light breeze. Vast numbers of a small spider, about one-tenth of an inch in length, and of a dusky red colour, were attached to the webs. There must have been, I should suppose, some thousands on the ship. The little spider when first coming in contact with the rigging, was always seated on a single thread, and not on the flocculent mass. The latter seems merely to be produced by the entanglement of the single threads. The spiders were all of one species, but of both sexes, together with young ones. These latter were distinguished by their smaller size, and more dusky colour. The little aeronaut as soon as it arrived on board, was very active, running about; sometimes letting itself fall, and then

reascending the same thread; sometimes employing itself in making a small and very irregular mesh in the corners between the ropes. . . .

While watching some that were suspended by a single thread, I several times observed that the slightest breath of air bore them away out of sight, in a horizontal line. On another occasion (25th) under similar circumstances, I repeatedly observed the same kind of small spider, either when placed, or having crawled, on some little eminence, elevate its abdomen, send forth a thread, and then sail away in a lateral course, but with a rapidity which was quite unaccountable.

From the writings of overseas arachnologists it would appear that ballooning spiders are a usual feature of the spring and autumn, and I could not do better than cite some of these authorities whose works are well known to students of Araneology. One of the earliest is that of John Blackwall (*A History of the Spiders of Great Britain and Ireland*. London: Ray Society, 1861-64, 2 vols.), and in his introduction to this classical work he writes:

Although spiders are not provided with wings, and, consequently, are incapable of flying, in the strict sense of the word, yet, by the aid of their silken filaments, numerous species, belonging to various genera, are enabled to accomplish distant journeys through the atmosphere. These aerial excursions, which appear to result from an instinctive desire to migrate, are undertaken when the weather is bright and serene, particularly in autumn, both by adult and immature individuals, and are effected in the following manner. After climbing to the summits of different objects, they raise themselves still higher by straightening the limbs; then elevating the abdomen, by bringing it from the usual horizontal position into one almost perpendicular, they emit from the spinners a small quantity of viscid fluid, which is drawn out into fine lines by the ascending current occasioned by the rarefaction of the air contiguous to the heated ground. Against these lines the current of rarefied air impinges, till the animals, feeling themselves acted upon with sufficient force, quit their hold of the objects on which they stand and mount aloft.

In North America where these flights are of common occurrence, McCook points out (*American Spiders and their Spinning Work*, vol. ii, 1890, p. 257):

Spider ballooning is not limited to a special period of the year, but may be practised at any time. In point of fact, however, the seasons when it most prevails are the spring or early summer, and the autumn after the young have been hatched. The fall of the

year is more especially the season for "flying spiders," and October the month most favoured. But in early November also the balloonists are abroad, particularly during the Indian summer, or when a series of cool days is succeeded by a warm day.

THE BANANA SPIDER.

McCook stated that the Banana Spider, *Heteropoda venatoria* Linnaeus, a member of the family Sparassidae, popularly known as Huntsmen Spiders, or, in Australia as "Triantelopes," occurred in those regions north and south of the Equator lying within the belt of the north or south trade winds, and suggested that dispersal by ballooning by the young spiders was the explanation for this distribution.

In the *Sunday Herald* article, I was quoted as saying that "visitations of the huntsman spider were not very common in Australia." What I had tried to point out was that a certain huntsman spider had been found in those countries in the track of the trade winds. As I had not witnessed the flight reported nor seen at that time any of the webs, I could hardly be expected to know the species of spider or spiders responsible. Moreover, very little seems to have been recorded in Australian scientific literature about these flights, and it is questionable if anybody in this country can say what species of spider has ever been involved in making these flights. This lack of knowledge is more apparent in Australia than elsewhere, for an extensive literature exists about flights in the northern hemisphere. Bristowe, in a recent scientific paper, said¹:—

One of the commonest foreign spiders to be imported [into Britain] with bananas is *Heteropoda venatoria*. McCook's view that the wide range of this species is to be accounted for by the trade winds is followed by later writers; but the fact that it is found in so many countries outside the sphere of the trade winds, coupled with its frequent occurrence in cargoes of bananas, in ships, and in docks all over the world shows, I think conclusively, that Man is the principal factor in its distribution. There is the further fact that it is found in the adult stage in England and many other countries where it is not established. Were it dispersed by air, it could only be carried in the very young stages. Places from which it has been recorded include

the following:—Great Britain and several other European countries, Pacific and Atlantic Islands, North and South America, India, Africa, Japan, and Australia. According as the climate is (1) tropical, (2) sub-tropical or warm, and (3) temperate or cold, it is found respectively (1) out of doors, (2) indoors, and (3) only in the docks, where it has been brought by boat and cannot establish itself.

SPIDER AERONAUTS.

Bristowe, while commenting upon the earlier view advanced by Bechstein, who thought that a single species of spider was responsible for the gossamer flights, states in his *Comity of Spiders*, i, 1939, p. 187, that "a more modern view has been that the young of all spiders become aeronauts in their respective seasons. The latter view is nearer the truth, but there are some interesting exceptions." He shows, too, that much work has been done by observers in America, Britain and on the Continent, in noting the actual species of spiders embarking on flights. Spiders, too, have been collected above the land and sea by means of aeroplanes, and "by means of nets attached to wireless masts, to the masts of ships, and to kites," as Bristowe informs us.

Identification of these spiders has shown that a great number belong to the family Linyphiidae (Sheet weavers). This family is represented in Australia by some eighteen species.

GOSSAMER WEB.

We may now consider the second of our categories—gossamer which has been torn from webs made by spiders and carried aloft.

This word, according to the *Concise Oxford Dictionary*, means a "light filmy substance, the webs of small spiders, floating in calm air or spread over grass," and it is derived from the Middle English word "gossomer—goose summer or St. Martin's summer, *i.e.*, early November when geese were eaten, gossamer being most seen then." Another interpretation is given by E. F. Staveley in his *British Spiders* (1866), p. 10, "The word is found in an early form as "*garsummer*," and is supposed to mean the summer hoar as opposed to the hoar-frost of winter—*gar* or *gor* signifying hoar; and it appears that the

¹Bristowe—Distribution and Dispersal of Spiders. *Proc. Zool. Soc. London*, 1929, iv. (1930), pp. 633-657.



Gossamer web in paddock at Warwick, 8 miles from Cowra, N.S.W., April, 1950. Spiders appeared after floods had invaded district.

Photo.—Mrs. A. W. Bridges.

gossamer was ranked with atmospheric and similar phenomena in old times, from Chaucer's lines—

Sore wondren some on cause of thonder,

On ebbe and floud, on gossomer, and on mist.

In German, the gossamer is *Sommer-weben*, the "webs of summer."

It is interesting to read the opinions of three of the araneologists previously cited. Blackwall (1861) writes:—

The webs named gossamer are composed of lines spun by spiders, which on being brought into contact by the mechanical action of gentle airs, adhere together, till by continual additions they are accumulated into irregular white flakes and masses of considerable magnitude. Occasionally spiders may be found on gossamer webs after an ascending current of rarefied air has separated them from the objects to which they were attached, and has raised them into the atmosphere; but as they never make use of them intentionally in the performance of their aeronautic expeditions, it must always be regarded as a fortuitous circumstance.

McCook (1890) commenting on Blackwall's observations, writes:—

This opinion, I think, must be abandoned, and the conclusion reached that there are two modes of ballooning practised by spiders, viz.: First, ascent by means of the buoyancy of lines issuing directly from the spinnerets, the araneid vaulting upward from its perch; and, second, the ascent upon lines, sometimes thickened by flossy tufts or strands, which are first spun out and attached to fixed objects, and afterward released by the force of the wind or cut loose by the spider.

Bristowe (1939) writes in his *Comity of Spiders*, p. 186, the following pronouncement:—

Before proceeding to a discussion of the efficacy of aerial dispersal it will be as well

to clear up some misconception which still exists as to the exact relationship of gossamer to aerial flights. The two are connected, but not to be confused. On the days when the Linyphiid inhabitants of a field are stirred to uneasy wandering there may be a million or more of them to an acre, each trailing a line wherever they walk. In this manner a silvery canopy is built. Dew laden, it provides a beautiful sight in the slanting rays of the evening sun. On the following morning the sun evaporates the dew and the rising air currents raise the silken carpet. In the process it gets twisted and broken. White flecks float through the air. These are *not* aeronauts' parachutes and are *not* ridden by spiders, but it should interest entomologists to know that springtails, aphids and small flies have been discovered entangled in the meshes of the descending gossamer.

Following upon a broadcast given over the A.B.C. national network, my friend, Mrs. A. W. Bridges, of Warwick, 8 miles from Cowra, New South Wales, wrote to me on 4 September, 1950, enclosing some photographs taken after the big flood in April in that district. She writes:—

Myriads of tiny grey spiders were driven before the water, from the flat country to the sloping hillside and for some 30 or 40 yards from the water's edge around the hill-sides stretched the gossamer-like web. It was a beautiful sight to see fences, logs, trees and grass so covered and the early morning dew made it sparkle in the sunshine as snow.

It would appear that some Linyphiid spider was here involved, but in the absence of specimens of spiders this is mere conjecture. If it could be ascertained if such a phenomenon occurred in those districts

Gossamer web which persisted for about a week at Warwick, near Cowra, N.S.W., April, 1950.

Photo.—Mrs. A. W. Bridges.



from which gossamer flights were reported then the answer to the September aerial riddle could be explained.

In a subsequent letter dated 25 September, 1950, Mrs. Bridges gives further particulars about the webs she photographed:—

I took the photographs on or about 8th and 9th April and during the following week. Of course there are no spiders or webs to be found now. They seemed to stay on and in the grass about two days, the gossamer-web lasted about a week; the web was quite strong, it seemed to break with the wind and, of course, the cattle walking about gradually broke it up. I don't think it rose in the air. There were definitely small spiders, greyish-brown in colour with a light stripe on the back similar to garden spiders. They were mostly $\frac{1}{4}$ inch in length or smaller. They just moved on one thread when first arriving with the breeze off the flood water, then within two or three hours everything was covered with gossamer. Our utility truck was covered with web in one hour; the dairy cows had web spun between their horns, they were most amusing draped in gossamer and spiders. Flocks of starlings no doubt helped to clear many of the spiders. Our farm was covered by flood four times; from the first flood we had many crawling insects, some snakes, also many frogs. At night there were many spiders of the garden type on the paths about the high ground, and with every step one could walk on them. Folk who have lived in this locality for forty-five years have only seen the spider webs once before.

One of the earliest observers of these flights in England was the Rev. Gilbert White, author of *The Natural History of*

Selborne, which consists of a series of letters to naturalists describing the natural history and history of his district, and in Letter xxiii written at Selborne, 8 June, 1775, he describes a "shower of cobwebs" witnessed on 21 September, 1741. These, he points out, "were not single filmy threads, floating in the air in all directions, but perfect flakes or rags: some near an inch broad, and five or six long, which fell with a degree of velocity which showed that they were considerably heavier than the atmosphere." This account reads like the description of the "flight" at Dungog, which seems to have been a part of that in the Hunter River valley.

It will be seen that much remains to be learnt about the habits of our Australian spiders, particularly those of the family Linyphiidae, which, in other countries, are responsible for most of the flights. Bristowe has shown that most spiders disperse by ballooning with the exception of such groups as the Mygalomorphae (Trap-door and funnel-web spiders).

It is difficult to find any records in Australian scientific literature of aerial flights or of the fall of gossamer web, and few observers have left any record of the Australian spiders which disperse by ballooning. My late chief, Mr. W. J. Rainbow, has referred to certain Argiopids which disperse by this method, but records of flights or the spiders responsible are absent.

Clingfishes

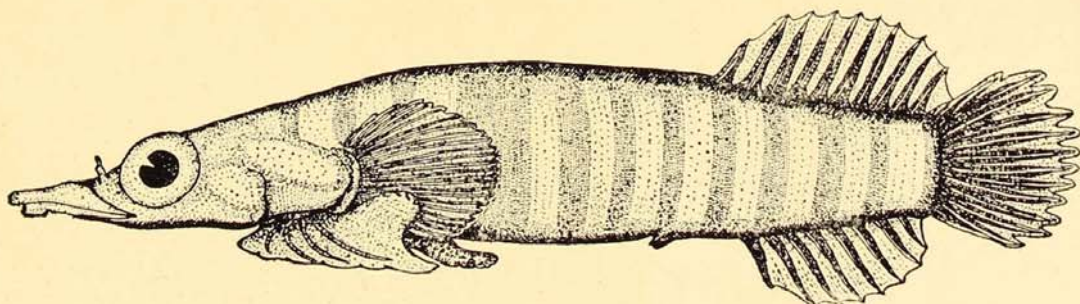
By GILBERT WHITLEY.

IF you turn over the loose rocks and stones in shallow water near the low tide-mark you are likely to find the curious Clingfish, a small fish which, instead of swimming away, either glides over the surface of the rock or creeps over your hand in a most unfishlike manner. An old English writer put it thus: "It is inactive, its movements being a species of wriggle," and another said "it usually assumes the curious habit of throwing its tail forward towards the side of the head." You will see the remarkable "orb of adhesion" or sucking-disk under the fish's body which enables it to cling to a rock, shell, or your hand, and you realize the provision of Nature which enables this fish to resist the ocean surges and the sweep of the waves which might wash it from the shallows and the tiny rockpool animals upon which it feeds.

Clingfishes are sometimes called Sucker Fishes but need never be confused with the Sucking Fishes¹ which have a very different sucking disk on top of the head instead of below the body. Suckers have been independently developed from various organs by different types of fishes. In Lumpfish, Sea Snails, and Gobies the ventral fins

form suckers; in torrent-loving fishes of India and the East Indies much of the lower surface of the body and the pectoral and ventral fins may be involved; in the Lampreys and the American Suckers the borders of the mouth are used, whilst in the Sucking Fishes the sucker is a highly-modified remnant of the dorsal fin. The adhesive disk of Clingfishes is formed from the ventral fins in front and from the surface of the belly behind. Its parts, attachments, and relationships to the skeleton and pectoral fins are too complex for present treatment but the structures have been described in detail in Gunther's *Catalogue of Fishes* (iii, 1861, pp. 489 *et seq.*) and some are illustrated by the French zoologist, F. Guitel. Frenchmen, too, have been responsible for some quaint names for what are now known as Clingfishes. Plumier, in the 18th century, called them Testar, from the old French for a head. Gouan called them Port-Ecuelles (dish-carriers) or Barbiers (barbers) because they carried a porringer or cupping-glass (the disk) like that held by the old-fashioned leech-cum-barber. In parts of the Riviera, they are known as St. Peter's Fish because of a chapel consecrated to that saint at Vil'efranche, built on part of the shoreline favoured by certain Mediterranean species.

¹See *The Australian Museum Magazine*, x, 1950, p. 17, illustr.



A Tasmanian Clingfish (*Aspasmogaster tasmaniensis*), a little over 2 inches long. Note the narrow snout and joined posterior fins.

After E. O. G. Scott.

Due to the provision of the complex sucker, the rest of the fish shows sign of degeneration. There are fewer gill-arches than usual amongst fishes. The head and body are dumpy, scaleless and slimy; the fins lack spines and the dorsal and anal have dwindled to rows of short stubby rays, united with the tail fin in some species. Everything points to a slothful fish. The nostrils are prominent, like little chimneys, and there may be sensory pores on the head. In the horseshoe-shaped mouth, with its curled lips, are tiny teeth of varying form in different species; in the American *Gobiosox* they are like the incisors of man. The eyes "are its especial beauty, resembling living opals set in burnished gold," says Day in his *Fishes of Great Britain*; these eyes, which can move independently of one another, are sometimes covered in skin or glow through a gelatinous projection.

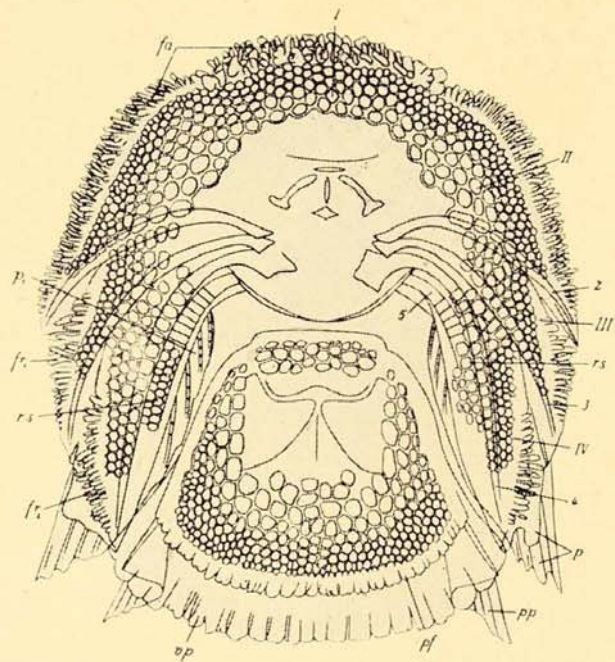
The colour is very variable and may be changed by the fish itself or is perhaps partly due to minute organisms in the slime on the skin. Purple, claret, yellow, and green Clingfishes are met with and some are mottled to simulate corallines and weeds. They may have favourite habitats on rocks or seaweeds but seasonally appear and disappear sporadically for no known reason. Certain European and American kinds have fantastic eye-spots, bands, hourglass-shaped markings, and so on.

It is not often that a new species of fish is discovered by a Duchess, yet that happened in the case of a Clingfish named the "Bimaculated Sucker" by Pennant in 1776: "Her Grace the Dutchess Dowager of Portland did me the honor of communicating the following species. This is a new kind of Sucker found near Weymouth [England] . . . and may be called the Bimaculated." Nowadays it is called the Two-spotted Sucker and in the Rev. David Landsborough's *Excursions to Arran*, the little two-spotted sucker-fish (*Diplecogaster bimaculatus*), whose fry he found on opening a scallop, furnished him with a subject which he treats in a very pleasant and edifying manner:

How wonderfully the Lord teaches the feeblest of his creatures to provide for their

own safety and that of their offspring! What a charming nursery this little sucker-fish selects for itself! It is rather nice in its choice. It is not an old, weather-beaten scallop that it takes possession of, but one that is fresh without, and smooth and pure within. After it has entered it certainly has some way of gluing the valves together, for it is not without difficulty that they can be torn asunder. Neither is it imprisoned, though the apartment is thus shut against intruders; for, closely as the valves cohere, there are some little apertures about the ears of the shell through which it can make its exit with its numerous family, or by which such little creatures as they feed on may, in their simplicity, enter.

In the New Naturalist series, Professor C. M. Yonge (*The Sea Shore*, 1949, p. 103, pl. vii, fig. b) has illustrated in colour the Cornish Sucker Fish (*Lepadogaster gouanii*) guarding its eggs fixed on a rock



Structure of the sucking apparatus of a Clingfish (*Mirbelia decandollii*), the front end being at the top of the illustration.

- fa*, front fringe of ventral fin which forms anterior sucker;
- fr_{1, 2}*, front and hind interradial fringes;
- p, p₁*, pectoral fins and rays;
- pf*, smaller fringe of posterior sucker;
- pp*, the "little pectoral" fin;
- rs*, supplementary region of papillae;
- vp*, larger fringe of posterior sucker;
- 2, 3, 4, 5, rays of ventral fin (the 1st ray is non-existent in this species);
- i*, unpaired median membrane and *ii* to *iv* interradial membranes—another hidden membrane joins up to the pectoral fin.

After F. Guitel.

surface. The true eyes of the fish are less conspicuous than two greenish ocelli on the back which would have a ferocious, eyelike appearance to any enemy.

As with some blennies, gobies, and other rockpool fishes, the eggs of Clingfishes are attached to rocks or shells, generally with the young embryo lying on its side with the egg adhering by its longer axis. J. L. B. Smith records of the South African *Ekloniaichthys* that it is exceptional in producing eggs when fertilization is by copulation. The females of that Clingfish lay ten to twenty eggs, each 1 mm. in diameter, on seaweeds. The larvae of British species hatch in about four weeks. There is no sign of the disk on hatching, but later a muscular patch appears and the sucking disk (at least in *Mirbelia decandollii*) develops in about forty-six days after the eggs were laid. The best observations on any Australasian Clingfish are those of David H. Graham, who studied the New Zealand *Diplocrepis puniceus* in the Portobello Aquarium. I quote part of his account in his interesting book, *Pairing, Courtship and Parental Care among Three New Zealand Fishes* (1937):

The largest female the writer has seen measured seven inches, but the average is about four inches. The male is ever so much smaller and does not attain more than two inches in length . . .

The female attaches her eggs to the under surface of rocks, stones and empty shells, but as a rule only to smooth surfaces. The eggs are laid in irregular masses and as soon as the female has finished spawning the male sucker has a decided urge to parental care and, small as he is, he will guard the egg masses at the risk of his life. The writer has often turned over stones and rocks to find females attaching their eggs to the under surface, and they soon wriggle out of sight; but as soon as the male comes to the eggs for the purpose of fertilising them, he is in no haste to leave his newly-acquired charge and will guard them at all risks. If another male appears on his recently-acquired domain he will engage in a hectic fight, rushing at the newcomer and biting viciously. The victor afterwards resumes his charge, displaying his striking colours which harmonise with the egg capsules attached to the rock . . .

Individual eggs measured 0.065 inch. Considering their size the females must be regarded as prolific. Medium-sized females, 3½ inches in length, produced up to 1,600 eggs . . . When the female sucker fish is

depositing her eggs a great deal of movement takes place. The fish rests in one position for a few minutes, and when the extruding egg is being laid, she moves from side to side as though securing the egg to the rock.

Throughout the period of guardianship the male fish constantly fans the mass of eggs, moving over the large surface. This action, I suppose, keeps the whole free from silt and more or less bathed in moving water. He goes entirely without food and moves away from his post only when he has to chase off some intruder. . . .

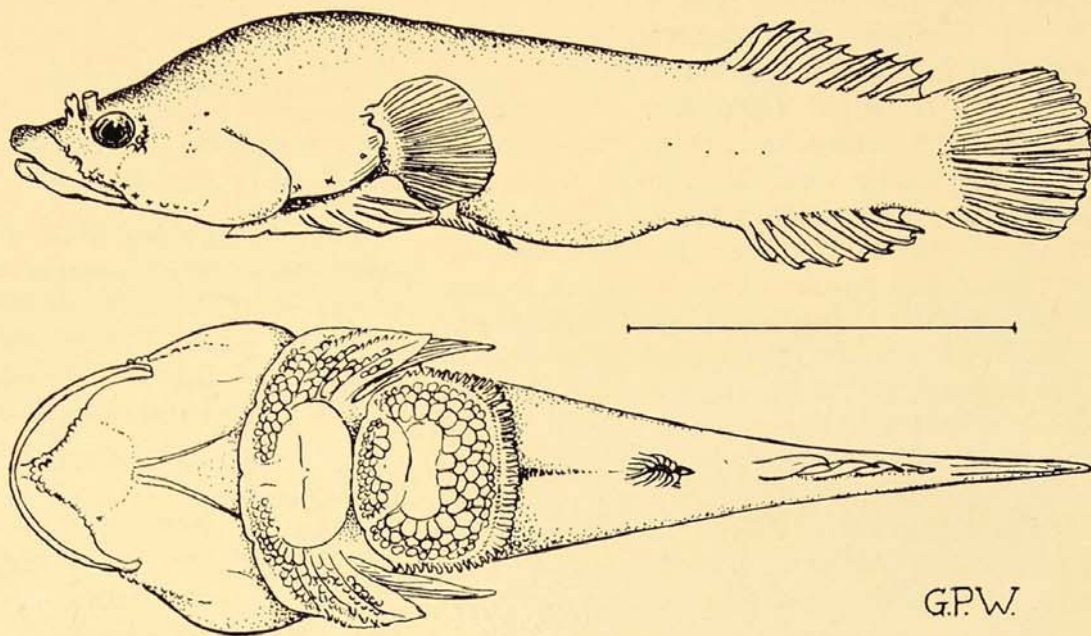
I have noticed that after the eggs had hatched the male was caught and devoured by the female which laid them, but whether this is customary in their natural habitat I do not know. For a fish not more than five inches in length to swallow another fish about two inches in length and wide in proportion is no small task, and seemed a painful operation for the consumer as well as the victim. The male was swallowed head first, and was still alive an hour after the female had caught him. . . .

Clingfishes are mainly inhabitants of temperate seas, but a few odd ones have penetrated tropical waters. There are several kinds in New Zealand, and in Australia they are restricted to the southern half of our shores. Various types are found in Alaska and the Americas, in Europe, Africa and Japan, and even in the Galapagos and Juan Fernandez Islands and those of the West Indies. Usually marine and littoral, they seem to travel into deeper water at times and the *Endeavour* dredged a few in 80 fathoms off Gippsland, Victoria. A few kinds have penetrated freshwater in parts of America, but not in Australia. Pickering found *Gobiesox* in Peru 40 feet above the water on shore and thought it might ascend the trunks of trees inclining into the water!

Generally Clingfishes are of small size, 2½ inches being long for most of the Australasian ones, but we have noticed that *Diplocrepis* may reach 7 inches in New Zealand and the *Chorismochismus* of South Africa reaches a foot in length and, when attached to the rocky sea-bed by its sucker, gives an angler the idea that he is on to a much larger fish. Because of their attachment to piles, rocks and other objects, Clingfishes are nearly always missed by nets, and their mouths are too small for

The Mohiaru of New Zealand (*Trachelo-
chismus pinnulatus*).
Side view of a speci-
men from Queen
Charlotte Sound, and
under surface, show-
ing sucker.

G. P. Whitley, del.



an ordinary hook. They are of no commercial value but are of much scientific interest and can be kept in salt water aquaria.

The relationship between Clingfishes and the rest of the finny tribes has never been explained. No fossil remains are known. The very unusual skull has been studied in detail but not even the otoliths or ear-bones gave any clue. "The skeleton," says Jordan, "shows several peculiarities: there is no suborbital ring, the palatine arcade is reduced, as are the gill-arches, the opercle is reduced to a spine-like projection, and the vertebrae are numerous." The osteology and anatomy of the Australian species would form a fascinating field of research for any young university student. When embryos, Clingfishes have an air-bladder which disappears soon after they hatch and this suggests a free-swimming ancestor which may have retreated from its oceanic enemies into recesses along the shorelines of some earlier geological age, but there is no link with any other known family of fishes, though Clingfishes are by common consent placed next to the Frog-fishes (family Batrachoididae).

Clingfishes are accordingly classed as an independent Order, the Xenopterygii (strange-finned fishes) and most of them enter the family Gobiesocidae; however, the long-snouted, striped forms with well

separated gill-openings may be segregated as family Diademichthyidae. About 40 generic names have been proposed but not all of them are valid.

The classification of the species is difficult and should be referred to museum experts. Precise details of the teeth and mouth-parts, the sucker and its adjacent fins, and the number of fin-rays are of importance, also the size of eye, proportions of head and body, and degree of union or separateness of fins and tail. No modern review of the whole group has yet appeared but the American Clingfishes have been revised by Schultz² and a good key to the Australian ones known in 1935 was afforded by Scott³.

Certain long-snouted, striped forms with well separated gill-openings are separated as the family Diademichthyidae. The unusual shape is shown in our illustration of *Diademichthys lineatus* from New Caledonia; this fish is probably black and white striped in life but in preservative it is red and white. The Danish zoologist, J. R. Pfaff⁴ has given a fascinating account

²Proc. U.S. Nat. Mus., 96, 1944, p. 47.

³Proc. Roy. Soc., Tasmania, 1935 (1936), p. 118.

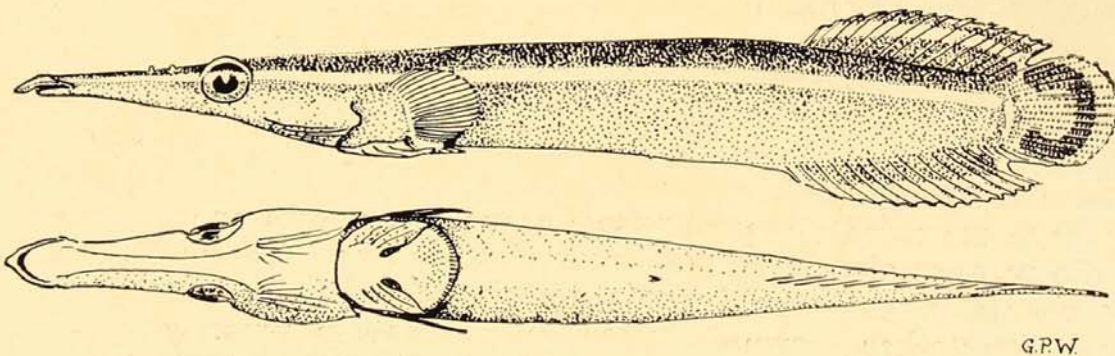
⁴Vidensk. Medd. Dansk. nat. Foren., cv., 1942, p. 413, pl. iii.

of this type of clingfish, which I propose to call, in English, the Diadema Clingfish, because it is associated with a tropical sea-urchin genus called *Diadema*. Species of it have been described from New Caledonia, the Java Sea, Mauritius and the Philippines, and visitors to the Great Barrier Reef might discover it there too if they brave the spines of sea-urchins to see if the Diadema Clingfish is also Australian. Several authors have pointed out that some fishes swim near or amongst the dangerous bristling spines of sea-eggs or urchins, notably soldier fishes (*Lovamia*) and possibly anchovies, but amongst the spines themselves, apparently well disguised by their stripes, are to be found the Diadema Clingfishes. The fishes are not only protected by the sea-urchin but are slightly parasitic as the tube-feet of the urchin have been found in their stomachs, ungratefully bitten from their host. In America, clingfishes have been noticed hiding under sea-urchins or living constantly with certain species in rockpools, so perhaps it is but a step from this association to taking up residence amongst the spines, with consequent elongation of the snout and striping of the body. Pfaff proposes the word *protectionism* for the type of companionship shown by *Diademichthys* which lives under the protection of *Diadema*. He also demonstrated that the female was smaller and slenderer than the male, with a longer, narrower and more spatulate snout. It

would be interesting to learn more of the life-history of these fishes. Observations could perhaps be made by transferring some sea-urchins to shallow water where they and their curious attendants could be continually watched.

The Australian Museum has numerous specimens of Clingfishes belonging to about twenty different species and coming from various parts of Australia and New Zealand, Lord Howe Island, New Caledonia, New Hebrides, Europe and Mexico.

Leaving the realm of fact for that of fancy, I feel I should mention here what I may term an Apocryphal Clingfish reported from the George's River, New South Wales, in Easter, 1897. Drawings purporting to represent this "creature" were made by Mr. Varney Parkes (son of Sir Henry) and given to Mr. D. G. Stead in 1905 and Mr. Stead has kindly given them to me. It was "caught clinging to ankle, 18 inches deep in the mud." It had a *dorsal* sucker, incessantly expanding, quivering and withdrawing, and had a spine in its centre, rising from one of the vertebrae, which "punctures by force of suction." The whole fish was coated with thick slimy skin, there were no anal or dorsal fins and no scales; the length was seven inches. No such fish is known to science, so if one is discovered it would be of extraordinary interest, relegatable to a new Order, if it exists!



The Diadema Clingfish (*Diademichthys lineatus*) from Noumea, New Caledonia. This type is associated with sea urchins.

G. P. Whitley, del.

GPW

Geological Curiosities

By R. O. CHALMERS.

PART II.

IN a previous article¹ an account was forecast of some of the curiously-shaped objects found in nature other than concretions. Like them, these are formed by groundwater in its ceaseless work of dissolving mineral matter from rocks and depositing it again under different conditions. Apart, therefore, from concretions, we may define geological curiosities as objects simulating fossilized animal or plant remains or else shaped in some regular or symmetrical fashion suggesting that their origin is not entirely natural but may have been caused by some other agency, possibly human.

Pseudo-fossils.

Quite a number of pseudo-fossils are received at the Museum and they fall into two groups. In the first group are those that could actually be fossilized remains. These, in the main, bear a close resemblance to plants, bones or shells. In the previous article we dealt with dendrites, probably the best known of all pseudo-fossils. Fossil bones of long extinct vertebrate animals are well known to the geologist and we illustrate a pseudo-fossil in the shape of a rib bone. It is a coarse-grained ferruginous sandstone and is entirely a product of weathering. The second group of pseudo-fossils comprises objects that could not possibly be found fossilized as a whole. The first example, accompanied by an illustration, consists of ferruginous sandstone, like the "rib," and



A pseudo-fossil rib bone formed by the weathering of ferruginous sandstone. About quarter natural size.

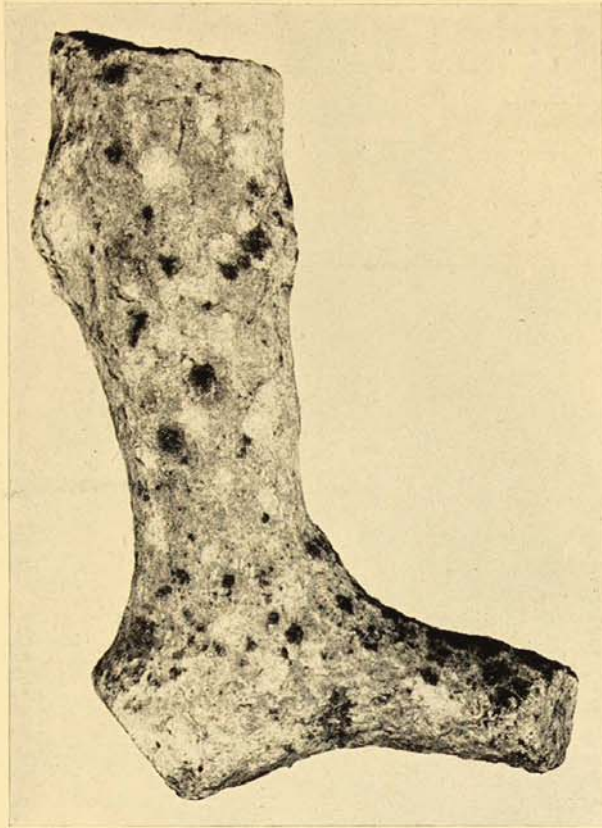


Weathered ferruginous sandstone resembling a sheep's head. Slightly less than half natural size.

bears an astonishing resemblance to the head of a sheep, excepting that it is much too small. It is a prime merino, too, if one is to judge by the abundant masses of wool round its neck. In highly ferruginous rocks, commonly referred to as ironstone, there appears to be considerable migration of iron-bearing solutions. Certain portions of the rock deprived of the iron content may become softer and more easily weathered than other portions that may have been enriched in iron and consequently are harder and more resistant. This is primarily the reason for the many odd shapes seen in weathered ferruginous sandstones and shales.

Limestone also assumes strange forms, due to its high solubility. It consists mainly of calcium carbonate which is readily dissolved both by rainwater and groundwater. As is well known, the many and varied formations found in limestone caves are due to the solvent action of the rain and groundwater on limestone and the subsequent deposition of calcium carbonate to form stalactites, stalagmites,

¹Chalmers, R. O., Geological Curiosities. Part I. *Aust. Mus. Mag.*, x, 3, 1950, 84-88.



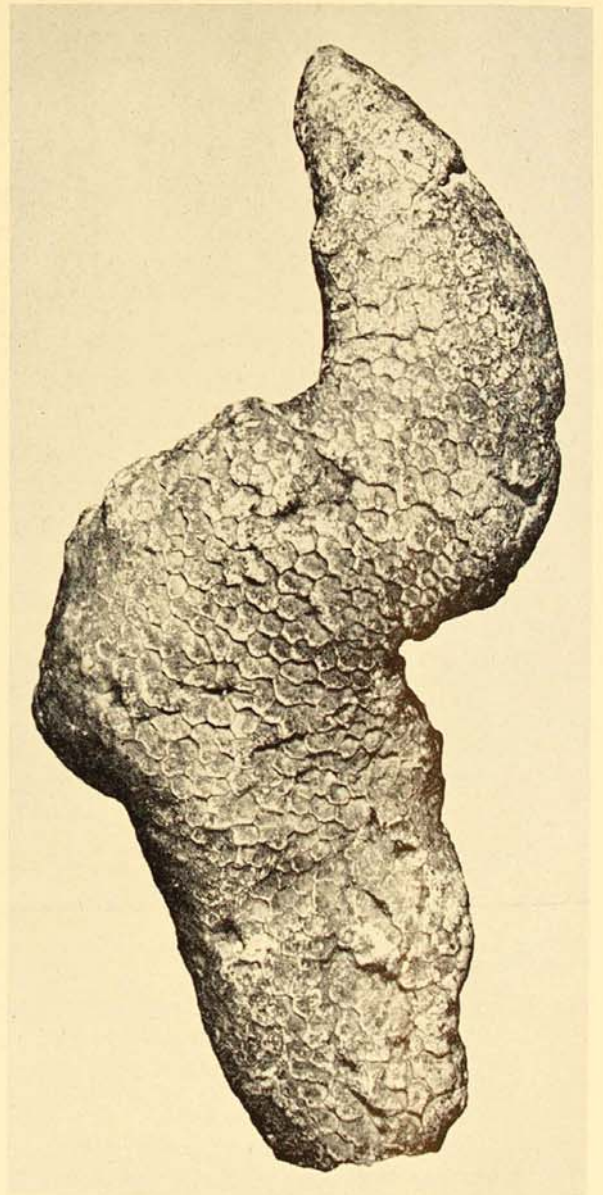
Limestone mass resembling a mummified leg. About quarter natural size.

mysteries and the rest. In previous issues of the *MAGAZINE* various authors have described limestone caves at Belubula, Wellington, Jenolan and Colong. Even on the surface, limestone shows some strange effects due to its high solubility, and outcrops often show deeply incised parallel channels dissolved out by rain. The example illustrated is of a piece of limestone that looks like a mummified leg with foot attached. A leg, of course, could not be fossilized as a whole since everything pertaining to the flesh, the soft tissues, is of a transient nature.

Massive varieties of magnesite (magnesium carbonate) occasionally occur in peculiar shapes. This mineral is formed by the attack of carbonated groundwater on the rock serpentine, which is a hydrated magnesium silicate. It is deposited, as veins of a hard white compact mineral, in cracks near the surface; when the serpentine weathers, the magnesite is then found as separate nodular masses in the surface soil. An illustration is shown of one such elongated mass, shaped somewhat like the letter "Z". Although of purely natural origin, it was submitted to the Museum

some time ago in the mistaken belief that it was a fossilized death-adder. Once again, one would not expect to find anything more than the hard parts, bones, of an animal preserved—the skin, flesh and internal organs would decompose rapidly after death. The surface of the specimen was covered with deeply incised hexagonal markings bearing a fortuitous resemblance to the skin of a snake, these, no doubt, caused by shrinkage of the magnesite after deposition.

Recently a number of supposed fossils were submitted to the Museum. These bore a crude resemblance to bivalve shells as, indeed, the finder believed them to be. They had the shape of a flattened spheroid broken in half, in other words



Nodular mass of magnesite showing hexagonal surface markings. About half natural size.



Structures in fine grained chert produced in all probability by the precipitation of silica under colloidal conditions. About half natural size.

the shape in outline was half an oval. The straight portion in the largest specimen was a narrow edge some four inches long resembling the bottom margin or "gape" of a pelecypod shell. The curved portion, too, bore some resemblance to the top portion or "hinge-line" of a shell. The maximum length was four inches, the maximum width three and a half inches and at its thickest part the object measured one and a half inches. These were not shells but consisted of the mineral chalcedony, a cryptocrystalline form of silica. These objects are actually the linings of large steam holes or vesicles in basalt, formed by the escape of steam from molten lava when it is in the closing stages of consolidation; the thickness of the lining ranged from one to three millimetres. After the cavity forms, a further phase of activity is frequently the deposition of chalcedony round the

walls. When finally the lava solidifies to form basalt, these lined cavities remain either hollow or become filled with other minerals deposited by solutions active in the very late stages of consolidation. When weathering of the basalt takes place, the rock is decomposed to form rich black or red clayey soil, but these resistant "amygdules", as the solid objects are called, remain unaltered. The word amygdule means "almond-shaped" and it is interesting to note that these specimens bear some resemblance to large nuts. Some of them are hollow and filled with black decomposed basalt soil. Others are solid and filled with quartz inside the chalcedony layer. These specimens were found at Werris Creek.

The final example is from Queensland and has been described previously by Dr. F. W. Whitehouse² of the University of Queensland. In the Thornton River district in far-western Queensland one finds thin beds of chert which is an exceedingly fine-grained siliceous rock. As the illustration shows, on the surface of these cherts occur markings in the form of grooves arranged in various ways. Sometimes they are in the form of concentric rings, other times they occur in series of sweeping parallel curves or show some other fairly regular arrangement. Comparable structures can be produced artificially by causing precipitation under colloidal conditions, and very likely this is the explanation of these structures. Colloids are jelly-like substances and silica is a substance that commonly forms a colloid. These structures do not particularly resemble any known fossil nor would their form suggest that human agencies were responsible. None the less the regularity and parallelism of the structures suggest something out of the ordinary which would entitle them to be regarded as geological curiosities.

²Whitehouse, F. W., *The Cambrian Faunas of North-eastern Australia. Mem. Qd. Mus.*, xi, 1, 1936, p. 67.

Australian Insects XLI

Coleoptera, 18.—Byrrhids, Histerids, and Silphids

By KEITH C. McKEOWN.

SUPERFICIALLY somewhat similar in appearance to members of the genus *Anthrenus* of the preceding family, the Dermestidae, the Pill-beetles or Byrrhidae are an extremely interesting group. Some fifty species have been described from Australia; unfortunately, the study of the life-histories of our forms appears to have been completely neglected and, as a result, we know nothing of them. Australia, however, is not alone in this respect, for the lives of the Byrrhids in other parts of the world still remain almost equally obscure. The adult beetles together with their larvae—where these are known—mostly occur on the ground among the roots of grasses, in moss, or under stones. There is little doubt that new species await the diligent entomologist who, literally “getting down to the ground,” sieves moss or other accumulations of vegetable matter.

The beetles, as befits their name of “Pill-beetles,” are very rounded and convex, with the antennae and legs capable of being brought closely into contact with the body. This, together with their habit of shamming death when disturbed, often renders their detection difficult, unless one has the time and patience to wait until they decide to extend their limbs and walk away. The head is completely retractile into the prothorax, with the exception, as Tillyard states, of *Nosodendron*, but Imms places them in a separate family, the Nosodendridae. The antennae are very variable in form, and no reliance can be placed in them as characters for classification. The beetles are mostly small and dull-coloured, but some are brightly tinted and of gem-like beauty.

The larvae of the Australian species are, as already indicated, unknown, but Imms states that, according to Chapuis and Candèze, “the larva is cylindrical and fleshy and may be recognized by the large size and breadth of the prothorax and the last two abdominal segments. The head is

short and broad, the antennae very short and there is a pair of ocelli on either side. The pronotum is markedly chitinized and sculptured, and the last abdominal segment carries a pair of locomotory processes.”

The most abundant Australian genus is *Pedilophorus*, which contains a number of beautiful metallic species. *P. carissimus* Lea, found in Tasmania among moss on the slopes of Mount Wellington, is a metallic green, the elytra bearing prominent bosses of burnished red-gold. It is one of our largest and most striking species. *P. gemmatus* Lea, of similar appearance, is smaller and is found on the mainland. *Microchaetes australis* Boisd., and *tuberculatus* Lea are a dull-brown with the elytra sculptured with irregular raised bosses and lines. *Byrrhinus* and *Aspidiophorus* contain small insects with smooth and sometimes glossy wing-covers. Other genera occurring in Australia are *Limnichus* and *Morychus*.

More than one hundred and twenty species of Histeridae have been described from Australia. They are small to medium-sized beetles, compact and hard, with strongly clubbed antennae. They are mostly scavengers, feeding on carrion, animal droppings, or decaying vegetable matter; but some are carnivorous, while others are found in ants' nests. The food



One of the most beautiful metallic Byrrhids (*Pedilophorus carissimus* Lea). The ground colour is green, the raised bosses, coppery-red.

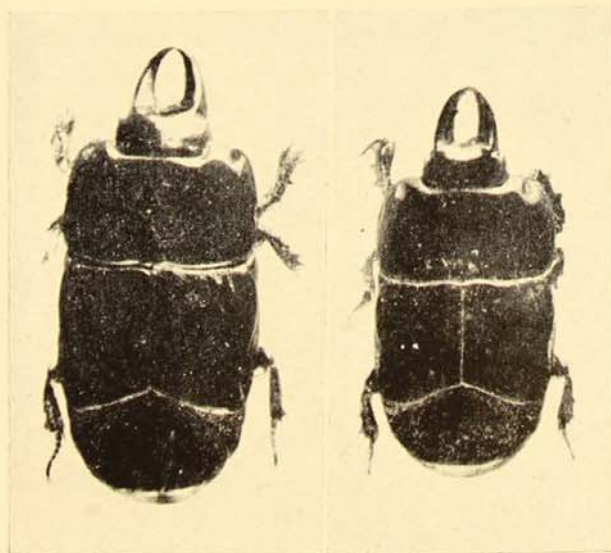
of the latter is uncertain; they may be sanitary officers, living upon waste matter in the nest, or they may prey upon ant larvae and pupae; their study offers a remarkably interesting field for observation and research. The larvae, which are soft and wrinkled with very short legs and terminal cerci upon the broad ninth segment of the abdomen are, it would seem, wholly carnivorous, even the frequenters of excrement probably destroying fly maggots.

Possibly the finest of our species, and certainly the largest, is *Hololepta australica* Mars., a widely distributed, broad and flattened, shining black beetle with strongly projecting mandibles. *H. sidnensis* Mars., is generally similar in appearance, but somewhat smaller; it is found in the rotting cores of the grass-trees (*Xanthorrhoea*), a habitat which may indicate carnivorous or vegetarian tastes, since these plants, when decaying, provide nutriment for a host of insect larvae. In these, as in other species of Histeridae, the two terminal segments of the abdomen are exposed by the truncated elytra.

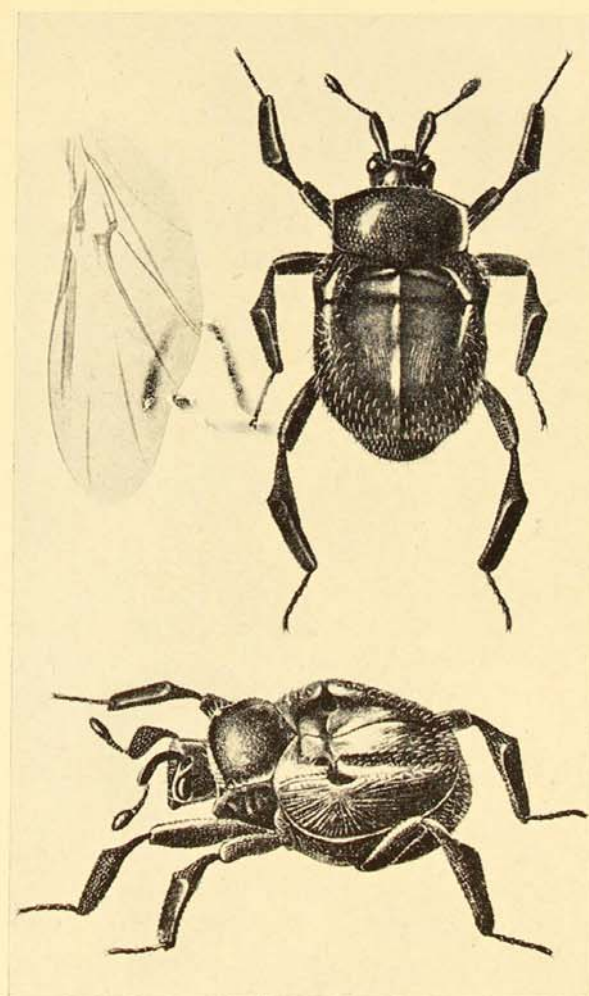
Turn over the remains, either rotting or desiccated, of any dead animal in the bush, and in all probability many small black or metallic beetles, panic-stricken by the sudden exposure to the light, will be seen rushing frenziedly in all directions in search of shelter, or shamming death until the danger has passed. Many of

these Histerids are almost certainly members of the genus *Saprinus*, inveterate frequenters of the carcasses of animals. They are smaller than the members of *Hololepta* with strongly convex backs and, although some are garbed in the dull black of the undertaker caste, others are brightly metallic and surprisingly beautiful for members of their profession. *Saprinus australasiae* Blkb. is a handsome creature with a bronzy prothorax and metallic blue elytra, while the wholly blue *S. cyaneus* Fabr. is possibly our commonest and most widely distributed species.

The little ant-nest inhabiting species of the genera *Chlamydopsis*, *Pheidoliphila*, and *Ectatomphila* are very remarkable beetles. They seldom measure more than about 5 mm. in length, and are of bizarre form, sometimes with expanded and flattened hind legs. In colour they are usually a bright brown, sometimes marked with



Two typical Histerid beetles (*Hololepta australis* Mars. and *H. sidnensis* Mars.).



One of the remarkable little ant-nest beetles (*Chlamydopsis epipleuralis* Lea).

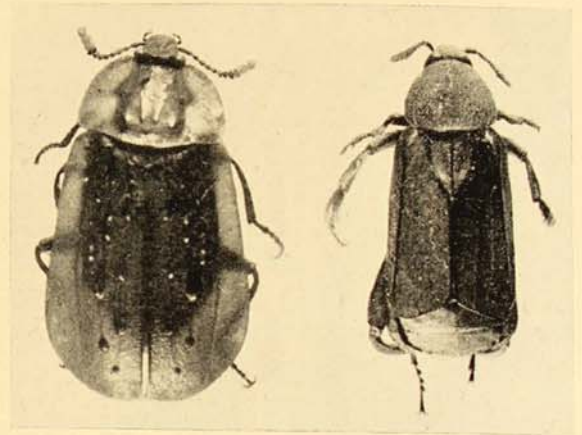
After E. H. Zeeck.

patches of red and yellow. These strange little insects live in the nests of ants in apparent amity with their hosts. Indeed, they are cherished on account of an attractive secretion produced by glands covered with hair-like brushes upon the body—a secretion eagerly licked up by the ants which seem to become completely obsessed by the insidious liquid. Whenever food-bearing workers return from their foraging excursions these little beetles emerge from the shadows of the nest galleries, deliberately making every effort to attract attention by raising the forelegs high above the body. Their efforts are usually successful. An ant will approach and, seizing the beetle in its forelegs, lick the secreting tufts with evident satisfaction; then, having exhausted the supply, it will feed the "guest" with a drop of food from its mouth, just as it would disgorge food for one of its own nest mates. Sometimes several wildly signalling beetles will be attended to before the ant appears satisfied. When the ants evacuate a nest for any reason, and move to a new home, the beetles are transported along with the ants' larvae and pupae, each beetle being carried away held high in the jaws of a worker. The larvae of these ants' nest beetles do not seem to have been found, and the exact nature of the association between beetles and ants is obscure and needs close study before any definite conclusions can be drawn.

Since the insects are small and feign death for some time when disturbed, the search for them is a tedious one requiring a great deal of patience, often strained by the insistent attentions of the disturbed ants. The quest is, however, well worth while, especially when rewarded by the discovery of one or more of these rare little beetles.

Of the family Silphidae about forty species are known from Australia, and many of the smaller species still await description. Most of our species are small and inconspicuous, but there are several large and striking insects which are not uncommon. The Silphidae includes the true burying-beetles. Almost all are scavengers, feeding upon carrion or decaying vegetable matter; possibly a few are

carnivorous, attacking the larvae of other insects in the odorous substances they frequent. The larvae are broadly oval, active, and with well-developed legs. The perfect beetles are broad, with the elytra either completely covering the abdomen or slightly shortened to expose the terminal segments of the abdomen. The joints of the feet may be 4-4-4 or 5-5-5, and the antennae may be apically expanded.



Burying-beetles (*Silpha lachrymosa* Schr. and *Diamesus osculans* Vigors), which enter the bodies of small animals as food for their larvae.

The largest and one of the most striking species, *Diamesus osculans* Vigors, has its short, dull-brown elytra blotched with yellow. Much of the upper surface of the abdomen is exposed by the considerably abbreviated wing-covers. *Silpha lachrymosa* Schr. is a brown and orange insect with the somewhat broad elytra embossed with raised pear- or tear-like "warts". It is a striking and very widely distributed species. *S. perlata* Kraatz is rather similar in appearance, but is more elongate in form.

These insects get their popular name of "burying-beetles" from their habit of digging away the soil from under and around the bodies of small animals, and piling it above them until the whole becomes completely buried. The eggs are then laid upon it, and, on hatching, the dull metallic larvae feed upon the decaying carrion. Compared with these giants of the family, members of the genera *Choleva*, *Clambus* and one or two others, are extremely small and inconspicuous. Insects of the genera *Clambus* and *Myrmicholeva* occur in ants' nests, but details of their lives and habits are unknown.

A Large Stargazer

By G. P. WHITLEY.

Stargazers or Stonelifters are rather ugly-looking fishes belonging to the family Uranoscopidae, with cube-like, bony heads, upward staring eyes and, in some kinds, a tentacle or lure near the capacious mouth or a long, fringed flap behind the shoulder. They lie in wait for other fishes, often burying themselves in sand or lifting stones to cover themselves. On the rare occasions when one is hooked, it pulls hard and heavily; generally stargazers live in deep water and are taken by the trawlers.

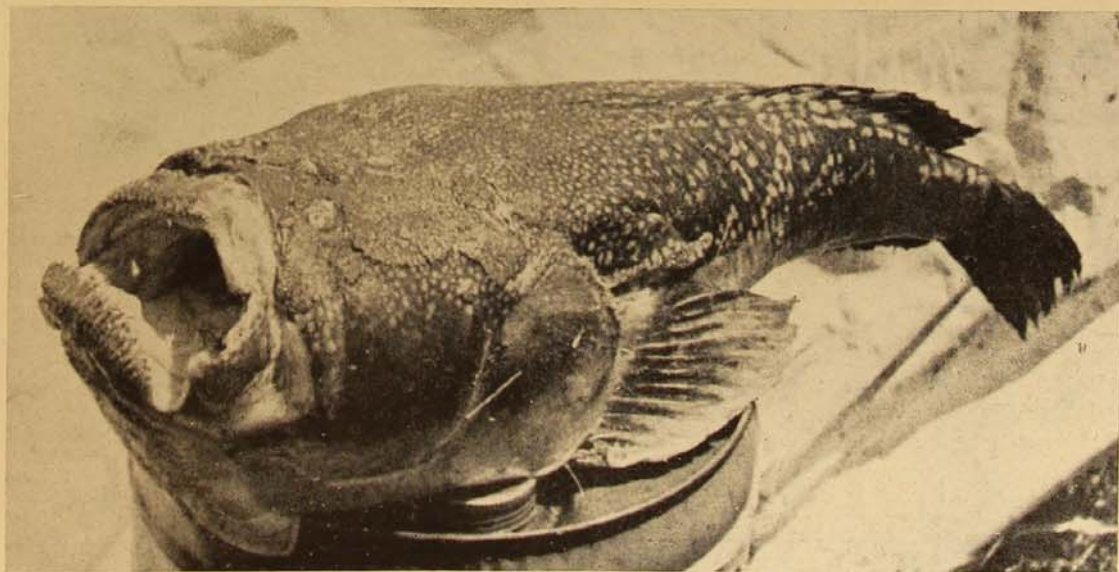
There are a number of Australian species. The best known one is *Kathetostoma laeve* which grows to about 26 inches long. A smaller kind (*Gnathagnoides*) is known to the trawler men as the Bulldog or, with due respect to the British statesman, as Winston Churchill, from its physiognomy. The most decorative species is *Ichthyscopus sannio*, a warm water fish, mottled brown on a canary yellow ground, with or without round or oval white spots, and sometimes having three dark bars down the upper parts of the fish. It is further distinguished by a long, fringed appendage on each shoulder which may be for keeping the gill-openings free of sand or grit, or may aid in burrowing since this kind apparently hides about a foot below the sea-bottom. The accompanying photograph shows a record sized specimen, about 30 inches long and 11 lb. in

weight when cleaned, which was caught at Forster, New South Wales, on March 1, 1948. Mr. M. H. Blevins, of Parramatta, kindly presented this photograph together with some bones of the fish itself and particulars about it. The species is found in New South Wales, Queensland and Western Australia and is allied to an Indian one, *I. lebeck*. It has been caught in various depths from below low water mark to 75 fathoms or so, and southward as far as Nowra. The eggs are remarkably small and it has been calculated that half a million ova were produced by one female. The eyes are on the sides of the head in the very young fish, but move dorsally, this movement being accommodated by disproportionate growth and hardening of the skull bones. The young float on the sea surface in great numbers and are extensively preyed upon by pelagic fishes such as tuna.

Certain American stargazers have been recorded as being able to give an electric shock, but this has not yet been demonstrated in any Australian species. In spite of their rather repulsive appearance, stargazers are good to eat. Cuvier called attention to the unusual amount of gall or bile in these fishes which gave rise to proverbial expressions amongst the ancient Greeks, and doctors of old employed this gall in their weird concoctions, more suitable to stargazers and alchemists than men of science.

A Mottled Stargazer, about 30 inches long, from Forster, New South Wales, showing the wide mouth and small upwardly directed eye.

Photo.—M. H. Blevins.



Review

THE MAMMALS OF VICTORIA.—By C. W. Brazenor. (National Museum of Victoria, Melbourne, Handbook No. 1.) 8vo., pp. 125, 1 coloured plate, numerous text illustrations. Price, 7s. 6d.

This excellently-produced handbook by a fellow mammalogist, C. W. Brazenor, marks a forward step in the educational sphere of museum activities within the Commonwealth, as first of a series which the National Museum, Melbourne, proposes to publish on the fauna of Victoria. Because of the profound overseas as well as local interest in the unique egg-laying and marsupial fauna of Australia, it seems most appropriate that the first handbook should deal so comprehensively with the mammals, or furred animals, to use a popular evasion which the title wisely avoids.

The handbook performs the national service of demonstrating that there are also many fascinating kinds of bats or flying mammals, and rodents, indigenous to the country, as well as the seals inhabiting our southern shores or appearing as migrants from Antarctica, and the ocean-roving whales. The introduced placental mammals are wisely included, but one could wish for a rather more detailed treatment concerning the dingo and fox especially. The fox was apparently first released in the district between Geelong and Colac about 1868-1870 and no doubt research in the National Library records or newspaper files would supply some definite information on this tragic episode.

The text is most informative on matters of classification, as well as in the somewhat limited explanatory details which accompany the numerous and generally effective illustrations. Readers may naturally wish, however, in these days of inflated costs of publication, that the format had been less prodigal with unused space. Notably is this so with the Common and White-footed Pouched-Mice (pp. 22-23), an enlargement of the respective mouse-sized feet of which occupies half a page, when it could have been reduced and fitted easily on the blank half page opposite. With the Long-nosed Bandicoot also, comparative sketches of the ear-lobes might have been reduced and included at the foot of the preceding page, thus allowing for fuller details about that interesting and mainly useful marsupial. Again, although the koala is represented in the coloured frontispiece of the excellent habitat group in the National Museum, the statement on a partly-filled page that "this animal is too well known to need detailed description" scarcely does justice to the expressed aim of the handbook.

The illustrator has provided many charming studies, such as the plump little Fat-tailed Pouched-mouse with its grasshopper prey, and the larger Brush-tailed Phascogale with a nestling bird, which are specially good in indicating the diet tendencies of the two marsupials. In general, the characteristics of all the animals are faithfully shown, a notable exception being the Tiger Cat which is too stocky in build and rounded of face for this rather lean and long-snouted predatory marsupial. The possums or phalangers are beautifully illustrated, including Victoria's exclusive rarity, Leadbeater's Possum, but the miniature nature of the Pigmy or Feather-tail Glider, in comparison with the Sugar or "Lesser" Glider opposite, could have been emphasized by suitable treatment of the background foliage. The kangaroo family is also most effectively illustrated, though the three-quarter page enlargement of the Black-faced Kangaroo head could have been omitted in favour of more detailed text.

Concerning the general balance of the subject-matter, the work presents a rather extreme contrast between a popular and technical approach, notably regarding marsupial reproduction, and the cranial and dental characteristics of the mammalian fauna. Especially is this so with the four diagrams of group variations in the marsupial organs of reproduction, and the accompanying explanations. A single diagram of the basic features, in contrast with one showing the main placental features, would have served to emphasize the marsupial characteristics which inhibit birth at a later stage. The crudely-drawn illustration of the pouch-embryo kangaroo on the teat is out of keeping with the artistic standard of the work and might be redrawn in the simple line used for the hopping kangaroo with pouch-young (p. 14), for later editions which will surely follow.

However, it is hoped that both the general reader and one's fellow workers will realize that the various comments are proffered as constructive suggestions towards future editions, and the several handbooks which are to follow. The Mammal Handbook can be warmly commended as fulfilling the hope expressed in the foreword by the Director of the National Museum, Mr. R. T. M. Pescott, that it should foster a proper realization of the unique nature of the Australian fauna, and the vital need of progressive measures for its conservation. To the author, his colleagues in other museums, and the public in general, owe a debt of gratitude for supplying such attractive and comprehensive answers to the perennial questions which become so exacting a part of the routine of a museum specialist.

—E.T.