

The
AUSTRALIAN
MUSEUM
MAGAZINE

Vol. VII, No. 5.

JUNE-AUGUST, 1940.

Price—ONE SHILLING.



Wedge-tailed Eagle.

THE AUSTRALIAN MUSEUM

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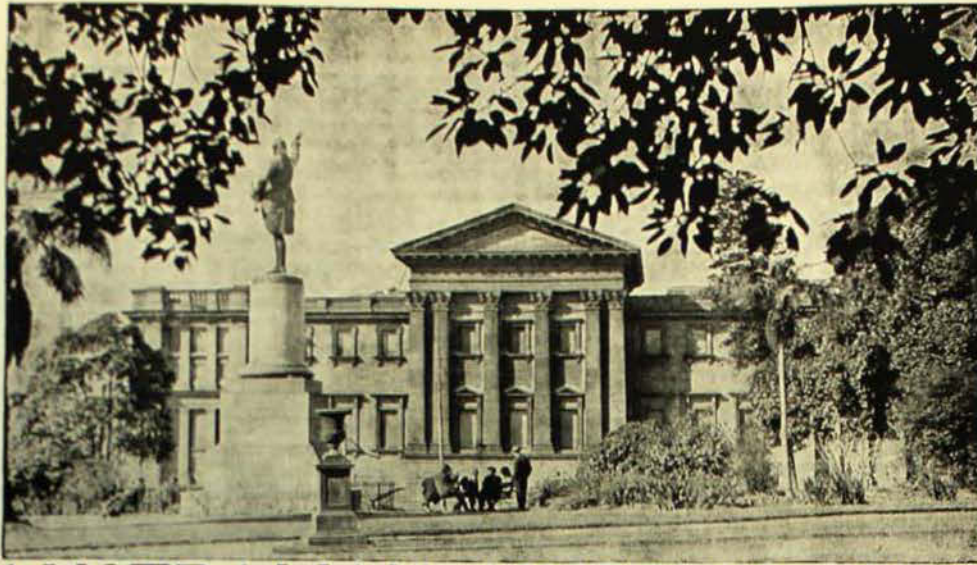
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(Photography, unless otherwise stated, is by G. C. Clutton.)

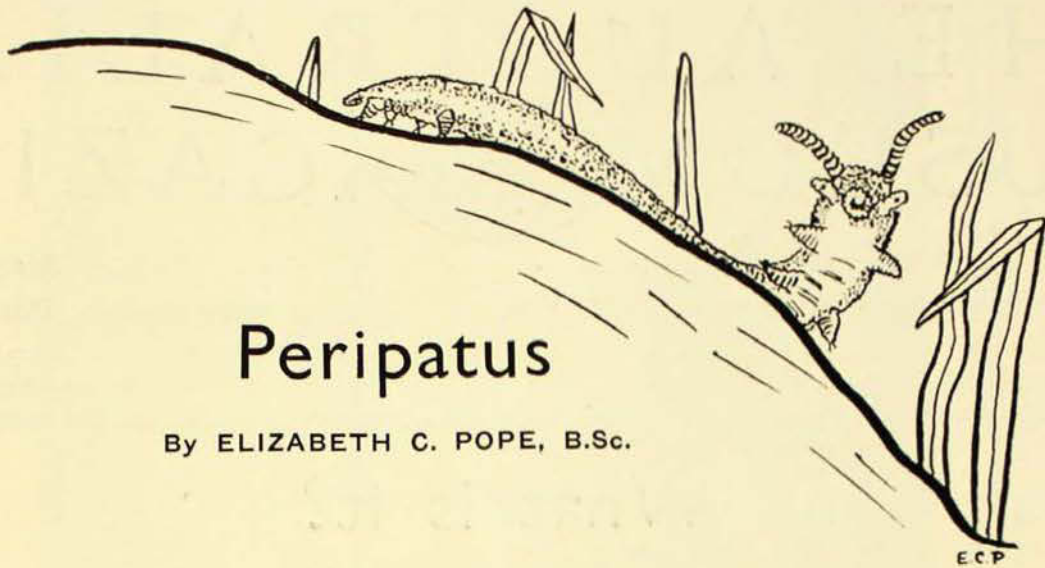
● OUR FRONT COVER. The Wedge-tailed Eagle (*Uroaetus audax* Latham) is by Lilian Medland. It is one of a series of postcards issued by the Trustees of The Australian Museum. Though this magnificent bird is the largest eagle in the world, and though other countries are so proud of their eagles as to make them national emblems, Australia modestly refers to it as the Eagle Hawk, and destroys it in great numbers because it is known at times to eat lambs. It is also known to eat rabbits and other vermin in great numbers, and offers one of several cases in which a precise scientific inquiry into the food habits should be made before unlimited poisoning and shooting are allowed.

This Eagle varies in colour from a golden-brown which vies with that of the famed Golden Eagle of Europe to a dark brown that is almost black. It is distributed throughout Australia in all kinds of country, but prefers the open plains of the interior. It breeds in the winter, the nest being a huge structure of twigs and small branches, in which usually two, but sometimes three, eggs are laid. The eggs, like those of all birds of prey, are roundish, and have a white ground heavily mottled with reddish-brown.

All birds of prey have hooked bills, a cere more or less covering the nostrils, long strong wings and strong clutching feet with sharp claws, and all are carnivorous.



A new Museum exhibit representing a nesting colony of sea birds on the Admiralty Islets, Lord Howe Island. Wideawake Terns, Gannets, Mutton Birds, Noddies, and Blue-Billies crowd together to nest and rear their young. Constructed by Messrs. H. S. Grant, J. H. Wright, and W. Barnes. Background by Miss Mary Soady. See page 157.



Peripatus

By ELIZABETH C. POPE, B.Sc.

IF we call an animal a "missing link" when it is clearly intermediate in structure between two of the major groups (phyla) of animals, then *Peripatus* is a strong candidate for the title, since its structure seems to be intermediate between that of the segmented worms (Annelida) and the Arthropoda or jointed-foot animals. In fact, so hard is it to decide to which of these two groups *Peripatus* should belong that the difficulty has been temporarily solved by placing these animals in a group of their own—the *Onychophora* or claw-bearers.

Peripatus is always found in rather damp situations, such as in the bush at the foot of the valleys of the Blue Mountains, where it inhabits or lives under rotting logs and may be captured by rolling away the logs or cutting them up. Recently two zoologists obtained some of these animals between Hampton and Jenolan Caves, at a point about four thousand feet above sea-level. Here the animals were plentiful and the collectors were able to capture several hundred specimens after a few hours' work. The reader should not collect these little beasts indiscriminately, however, as they are rather rare, and, unless required for scientific purposes, should be left, as far as possible, undisturbed.

In appearance *Peripatus* resembles a caterpillar with a soft velvety skin and

many pairs of legs. The species captured at Hampton was from one to two inches long and had fifteen pairs of legs. While much of its structure appears to be similar to that of the Arthropods (to which true caterpillars belong), *Peripatus* differs from this group of animals in a number of important ways. The chitinous skin is comparatively thin and is covered with little spiny lumps, and it is the latter structures that give the skin its characteristic velvety texture. Externally there is no appearance of body segmentation as we see it in the Annelida and Arthropoda, but internally there are indications of segmental structure and there is a pair of legs for every one of these segments. The legs end in claws, like the crustaceans', but the limb itself is not segmented.

Peripatus has a layer of muscle beneath the skin similar to that of the segmented worms and also possesses a pair of eyes, at the bases of the antennae, which are like worm eyes. The animal seems to prefer, however, to feel its way about by means of a pair of antennae situated at the front of the head.

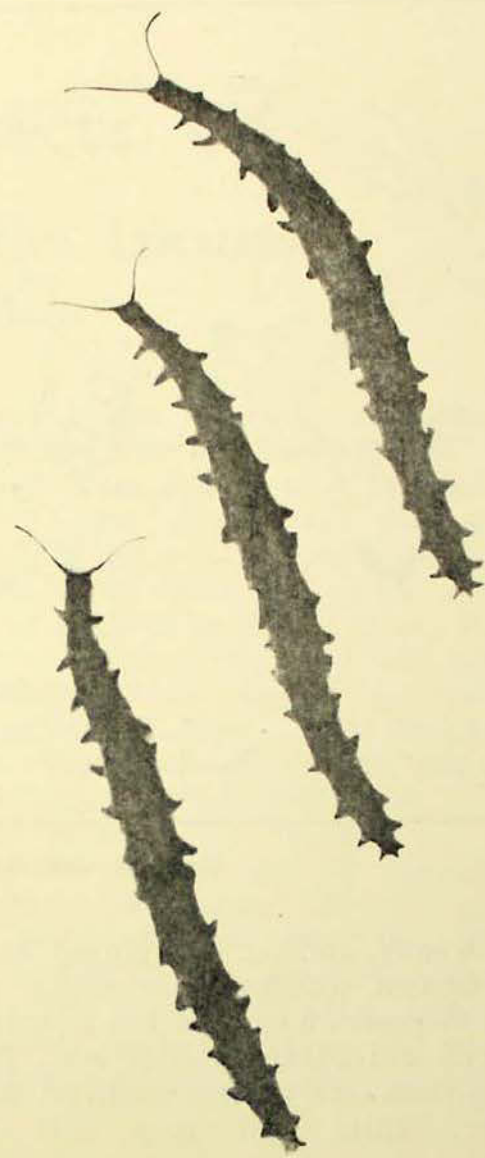
Peripatus comes out at night and forages, its food consisting of insects and other small animals, which are chewed up by means of the horny cutting jaws. When annoyed or attacked, the animal ejects a sticky secretion from a pair of

slime glands which open at the base of the oral papillae. This slime is exceedingly tacky and is probably used to entangle not only enemies, but also prey. The slime does not stick to the skin of the animal itself, probably owing to its velvety nature.

The internal structure of *Peripatus* is very interesting since it is here that it displays the structures that link it to the worms or to the arthropods.

The digestive tract has no very distinctive features and the circulatory system is similar in basic plan to that of the arthropods. Another feature which relates *Peripatus* to this group is the presence of a respiratory system consisting of air-tubes (tracheae) which carry the air directly from the environment to the tissues of the body—a condition which exists in the Animal Kingdom nowhere outside the terrestrial arthropods.

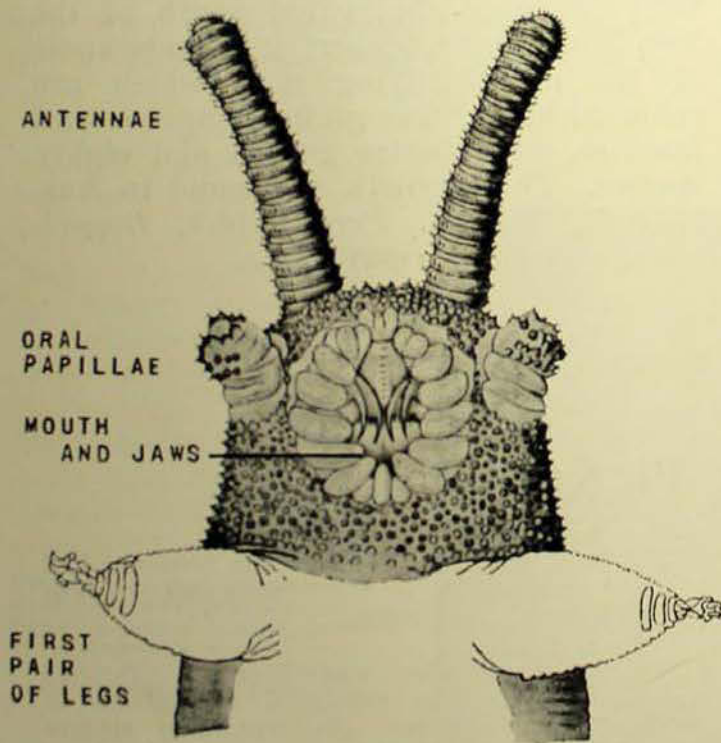
Resemblance to the worms is shown by the possession of a similar type of excretory system. This consists of a series of paired kidney-tubes (nephridia), one pair corresponding to each pair of legs



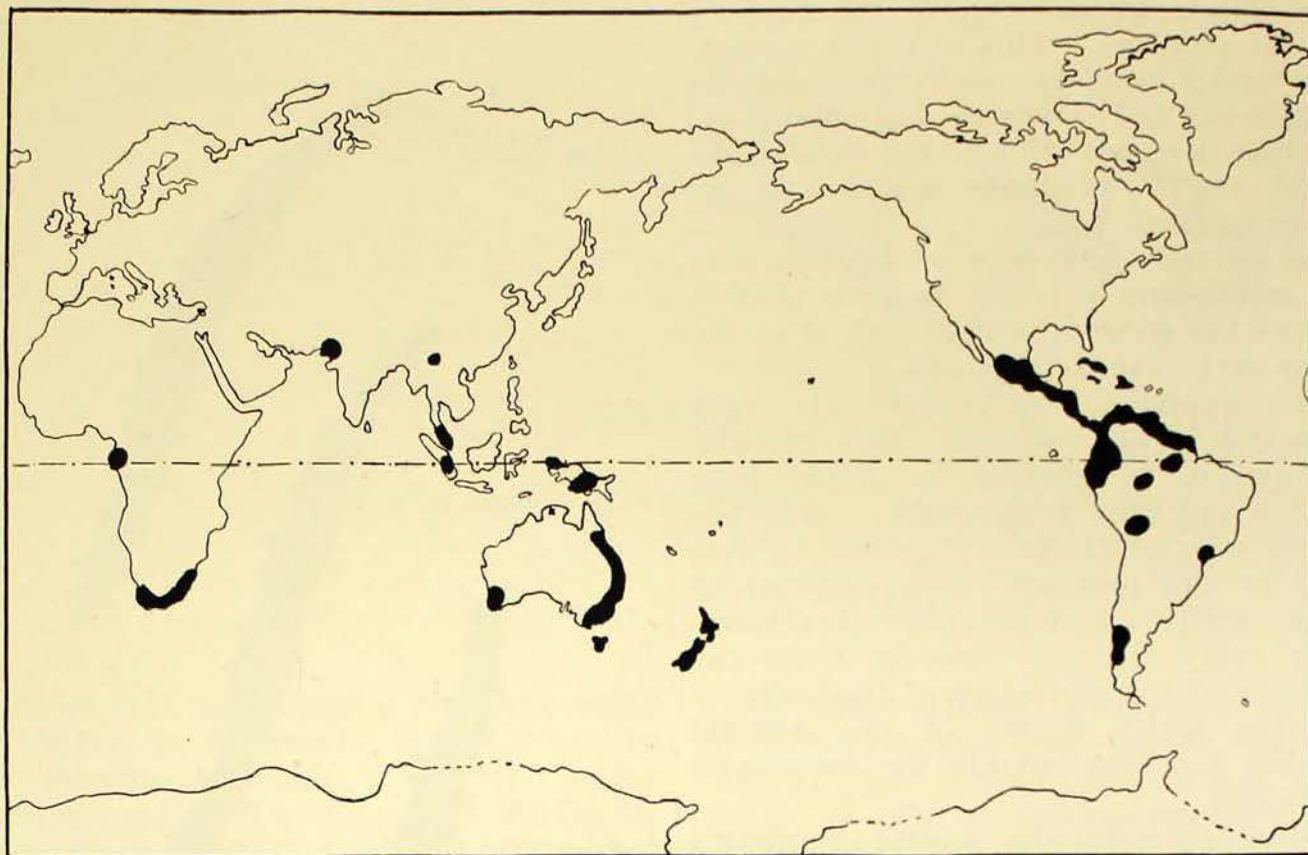
These cuts from a film of *Peripatus* illustrate the oar-like movement of the limbs in animated progression. Unlike pad-footed caterpillars, the legs end in curved, gripping claws. In forward progression the tendency for two successive pairs of legs to move in unison is most apparent (see centre and lower figures). The specimen was kindly lent by Mr. H. F. Consett Davis, M.Sc., of the Armidale University College.

and opening to the surface by a pore. The nervous system is primitive, consisting of two widely separated ventral nerve cords connected by regular cross-connections like the rungs of a ladder.

In regard to breeding habits the various species of *Peripatus* differ, some being oviparous and some viviparous. One of the females taken at Hampton, now kept in a culture in the laboratory, laid twelve eggs—six separately on top of the culture medium (in this case it was bits of moist



The head of *Peripatus* seen from below, showing the mouth, jaws and appendages. After Parker and Haswell.



Map showing the distribution of *Peripatus*.

E. C. Pope, del.

rotting wood), and six in a clump, but it is not known whether this action was natural oviposition or was due to culture conditions which caused abortion. Each egg was from one to two millimetres in diameter, white and very soft and jellified.

Members of the phylum *Onychophora* can live only in places where the mean annual temperature lies between 50° and

60° F. and where the humidity is uniformly high. They are restricted in their range to the region south of the Tropic of Cancer, occurring in those areas of the accompanying map which are coloured black. The group comprises two families, with twelve genera and eighty species. Three genera are found in Australasia, namely, *Peripatoides*, *Ooperipatus* and *Symperipatus*.

Mr. James McKern

Mr. James McKern, who had been Crown Trustee of the Australian Museum since 1919, recently resigned from his office. Mr. McKern, who has been in indifferent health for some time past, had always taken a keen interest in the administration of the institution. During part of this time he had been Chairman of the Finance and House Committee, and his help

in forwarding the interests of the Museum had been considerable. His resignation was accepted with great regret.

Mr. McKern, who was formerly Deputy Auditor-General, has rendered a lifetime of service to the State. He was also closely identified with philanthropic movements.

Australian Insects. IX

Orthoptera, 4. — The Locusts

By KEITH C. McKEOWN

UNFORTUNATELY, confusion in the use of popular names for insects is only too common, but seldom has it attained such complexity as in the use of the term "grasshopper". To the layman the insects which form the migratory swarms which devastate crops and native herbage are "grasshoppers"; to the scientist these short-horned insects are "locusts" (Acridiidae), while the long-horned, tree-frequenting forms are "grasshoppers" (Tettigoniidae). To add to the confusion, the typical small boy persists in referring to the cicada (a member of the order Hemiptera-Homoptera) as a "locust"! The tangle has not been simplified by the economic entomologist, who has recently divided the Acridiidae into two groups according to their habits, the gregarious, migratory species being

referred to as "locusts", and the non-migratory forms as "grasshoppers". Since some of these insects pass through both solitary and gregarious phases, the division is not a happy one, especially as regards those species of which we know little or nothing of their habits. For the purpose of this article we will refer to the short-horned species as "locusts" irrespective of habit. The long-horned forms (Tettigoniidae) will be considered in the next article of this series.

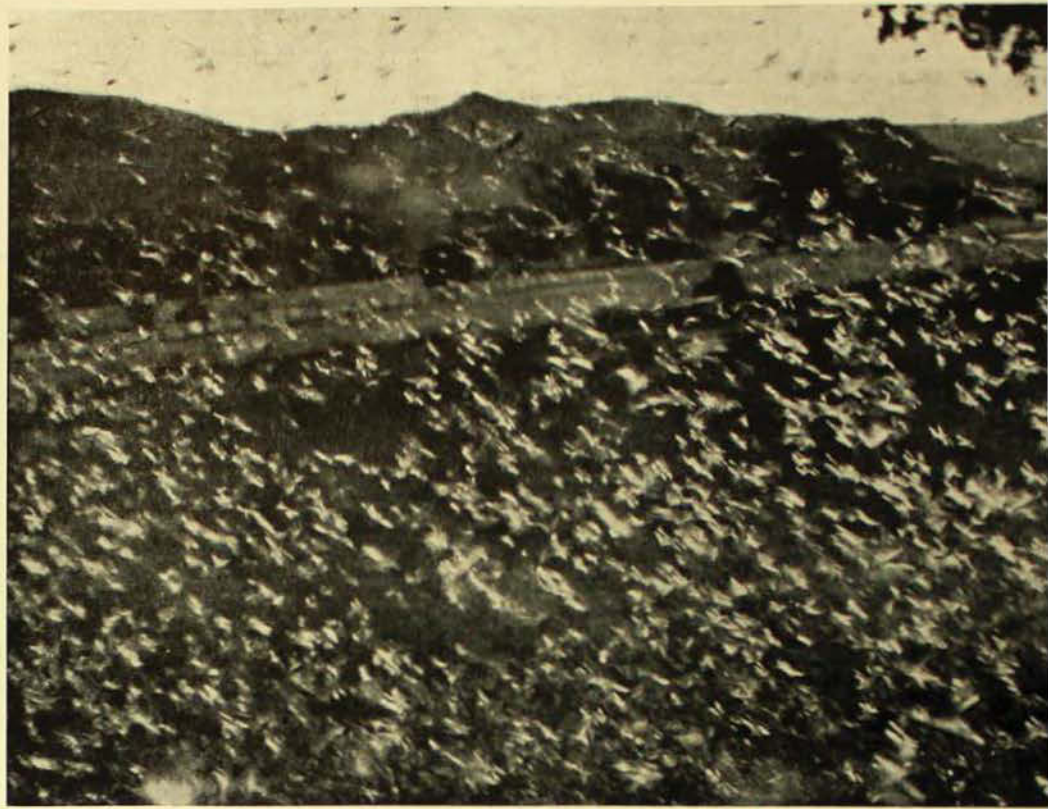
The locusts, by reason of their destructive habits, are of considerable importance, and some 360 species have been described from Australia; fortunately, not all of them are to be classed as pests. The most outstanding features of the locusts are in the wings; the fore pair are narrow, protective covers or tegmina,

Plague Locust "hoppers", with well-developed wing-pads, massed upon sun-baked ground.

Photo.—Waite Agricultural Research Institute, S.A.



**Swarm of locusts at
Bulga, near Singleton,
New South Wales.**
Photo.—I. Eather.

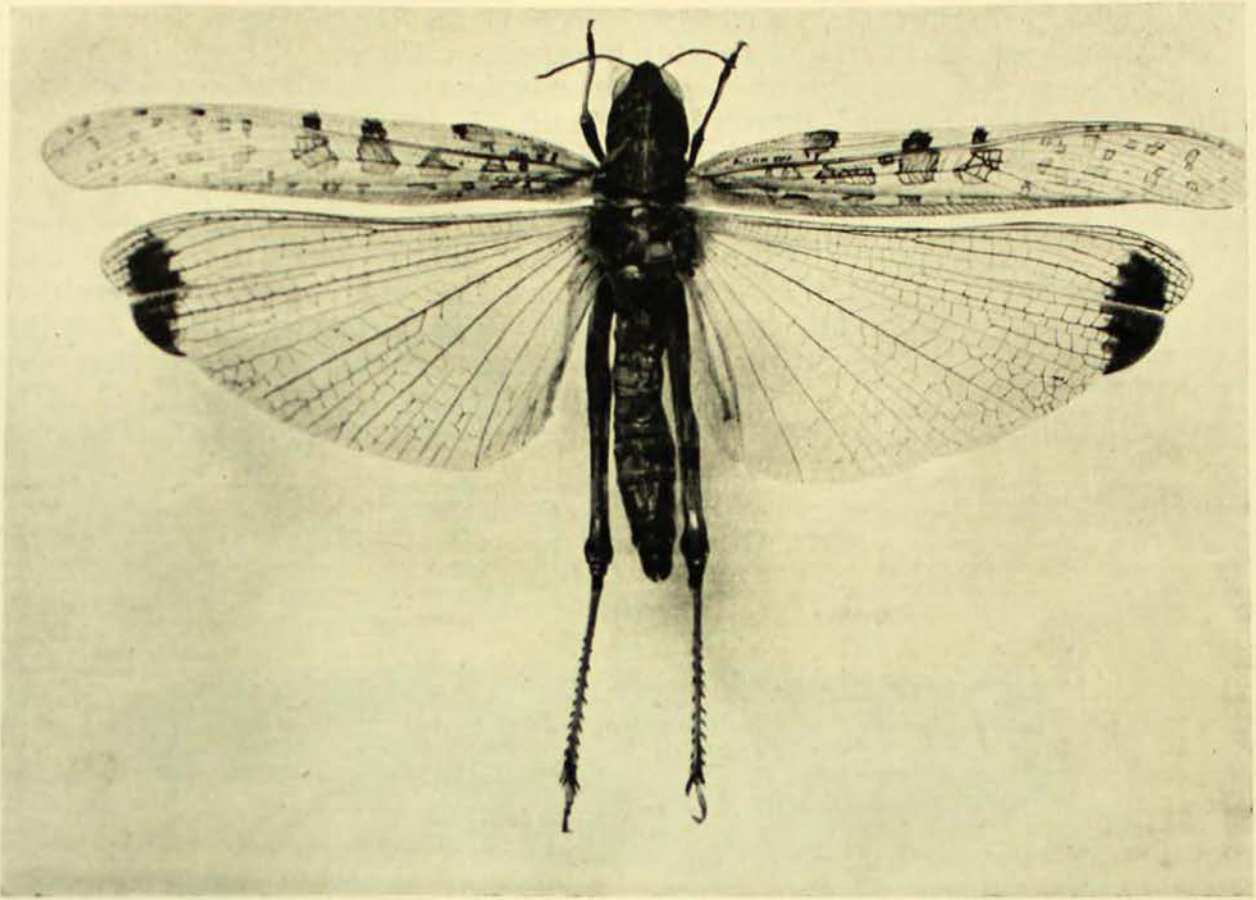


the hind pair are gauzy and fan-like, and are folded up below the tegmina unless the insect is in flight. When at rest, both pairs of wings are held roof-wise over the body. The antennae are short, and sometimes slightly thickened. The hind legs are spined, with strongly thickened thighs, and are efficient levers for jumping.

There is some variation in the habits and life-histories of the different species of locusts, but those of one of the gregarious forms will, perhaps, give the best general idea of their mode of life. The mature females deposit their eggs in holes bored in hard, sun-baked soil by means of horny plates situated at the extremity of the abdomen which act as drills. The eggs are laid in masses, each containing some thirty or forty eggs, each female depositing several of these masses during her life. The egg-mass is drenched with a frothy fluid, which on drying hardens and welds the individual eggs into a cluster or egg-capsule, and, at the same time, provides them with a weather-proof covering. Where the insects occur in plague numbers, the egg-laying grounds will contain enormous numbers of eggs.

It has been estimated that there may be from 200 to 800 egg holes to the square foot, with an average of 300 to each square foot over several acres, giving a conservative estimate of 10,000 eggs per square foot, or over 400,000,000 eggs per acre! After a period of a couple of weeks, or it may be many months, according to climatic conditions, these eggs hatch.

The young hoppers on hatching are miniature replicas of their parents, save that they are wingless. As in other families of the Orthoptera, growth proceeds by a series of moults, small wing-pads being developed, and with the last casting of the skin the fully developed wings are acquired. The young hoppers soon commence to feed, and move outwards from the egg-bed on an ever-widening front as the herbage is destroyed by the advancing army. With increased growth the rate of destruction and of the advance increases progressively. This hopper stage usually lasts about two months. With the acquisition of wings, migration is speeded up, and the swarms travel long distances, alighting when conditions are favourable to feed and deposit their eggs. When all the eggs



The Australian Plague Locust (*Chortoicetes terminifera*). Female with outspread wings.
Photo.—A. Musgrave.

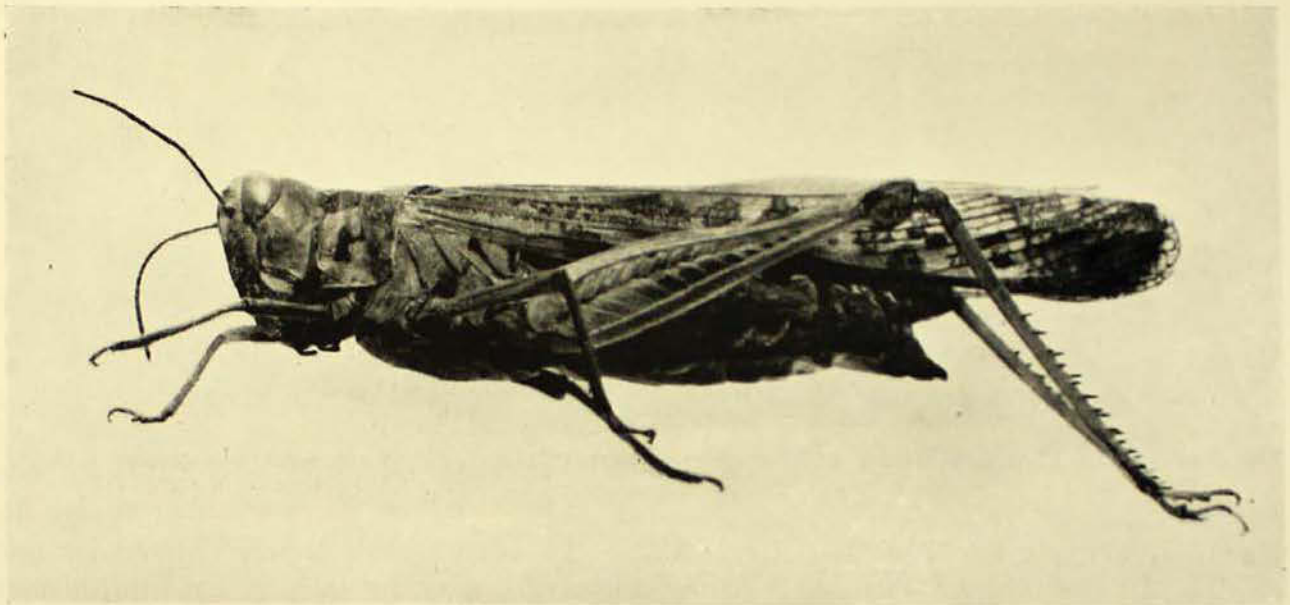
have been deposited the females die. A sudden drop in the temperature will cause heavy mortality. Three generations may develop in a season, and the winter months are usually passed in the egg state. In brief outline the life-cycle of a plague locust is somewhat as follows. The eggs laid in the autumn over-winter, hatching in about five months, or somewhere about September. The first hopper swarms are to be found from September to November; the winged forms appear from December to February, depositing their eggs at almost any time during this period. From these eggs a second brood will emerge and feed from January to March, and the winged insects from March to May will again deposit eggs which will over-winter. Climatic conditions may cause some variation in the programme and some overlapping, permitting the development of a third brood; but the foregoing gives, at least, some indication of the sequence of the swarms.

An idea of the losses caused by locust swarms may be gained by figures issued regarding the plague in the Warren, Tottenham, Condobolin, and Forbes districts, in New South Wales, during 1933-34. The main brood appeared in December. The egg-beds were distributed over an area of 522,240 acres. The second brood hatched in February, the area of the egg-beds extending over 2,944,000 acres. The area affected by this second swarm was calculated at 21,000,000 acres which were severely damaged, while an additional 11,750,000 were moderately damaged. A third brood hatched out in April, but climatic conditions were unfavourable for their development. The total loss to graziers from the 32,750,000 acres damaged by the locusts was estimated at £2,687,000, in addition to the cost of hand-feeding stock and other costs. The loss to the wheat grower was set down at £920,500. The infestation included the greater part of New South Wales as well

as other States, so, when the relatively small area represented by the districts mentioned is taken into consideration, the total loss must have reached figures of startling dimensions. It is such figures which bring home to us the economic importance of insects to our primary industries.

But, to turn to lighter matters! The locusts are capable of producing sounds, most of them possibly in the nature of a love serenade. Some chirp, some click, while others again produce rattling notes.

forms is the Black-tipped Locust, or the Australian Plague Locust (*Chortoicetes terminifera*), a medium-sized insect about $1\frac{1}{4}$ to $1\frac{1}{2}$ inches in length, the females measuring about $2\frac{1}{2}$ inches in wing-span; the females are larger than the males. The hind wings have a strongly marked black patch at their tips, a feature that renders their determination easy. This species is widely distributed throughout Australia, and is that responsible for the most widespread damage during locust irruptions. The second



The Australian Plague Locust (*Chortoicetes terminifera*). Female from side.

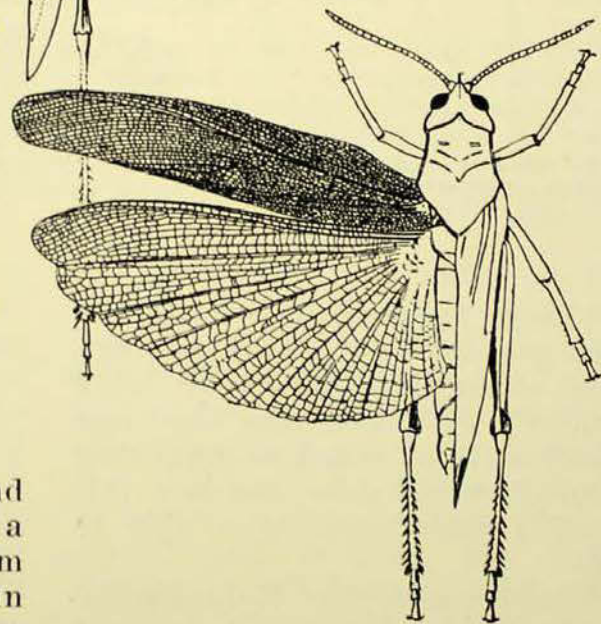
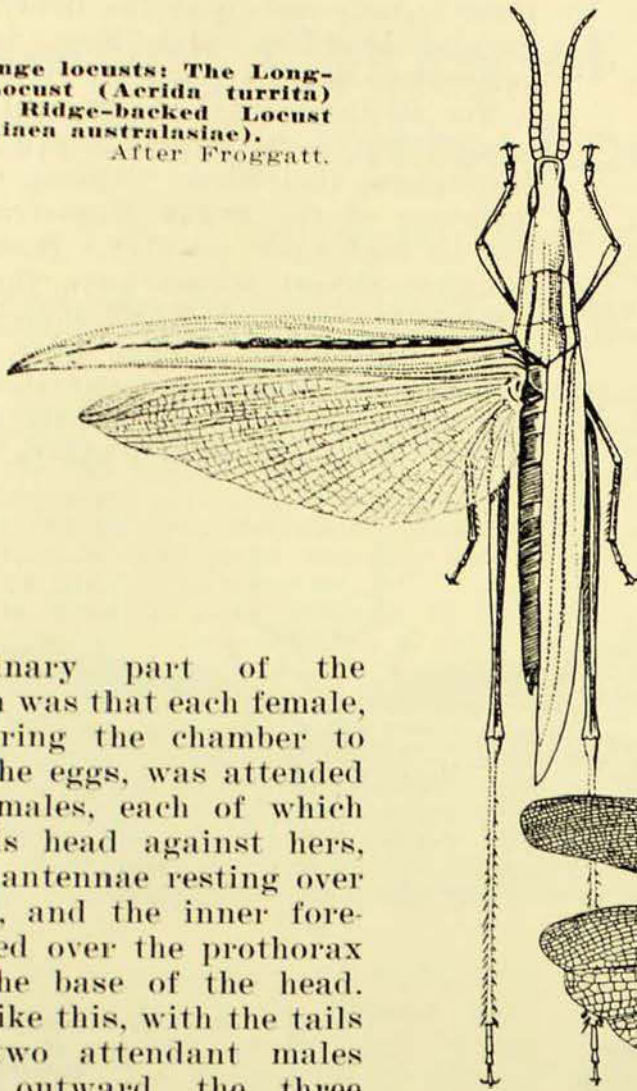
Photo.—A. Musgrave.

Most of these "songs" are produced by rubbing a row of small, closely-set, peg-like points upon the thigh across a hard ridge upon the wing-covers. Where there is sound production in an animal one naturally expects to find provision for its detection—or, to put it in another way, organs of hearing. These are not wanting in the locusts, and their "ears" are situated on the sides of the first abdominal segment. The sounds produced by locusts are best heard on hot days, when the males rest on open spaces among the herbage, basking in the sunshine and calling to prospective mates in the neighbourhood.

Some of the Australian species of locusts merit more detailed consideration. The most important of the gregarious

species usually associated with these plagues is the Small Plague Locust (*Austroicetes cruciata*), measuring about 1 inch in length and $1\frac{3}{4}$ inches across the outspread wings. Again the males are much smaller than their mates. The females are greenish, and the males yellow. In the Riverina, in some areas where it was formerly abundant, this little species seems to have been displaced by its larger relative. There is a remarkable difference between the egg-laying habits of the two species; the large insect deposits its eggs with business-like individuality; the small form seems almost to make a carnival of the event. The late W. W. Froggatt described the scene upon the egg-beds and the method of egg-laying. He says: "But the most

Two strange locusts: The Long-headed Locust (*Acrida turrita*) and the Ridge-backed Locust (*Goniaca australasiae*).
After Froggatt.



extraordinary part of the operation was that each female, while boring the chamber to deposit the eggs, was attended by two males, each of which rested his head against hers, with his antennae resting over her head, and the inner fore-leg clasped over the prothorax behind the base of the head. Resting like this, with the tails of the two attendant males pointing outward, the three formed a three-rayed star; wherever the business of egg-laying was going on, each female and her attendants were surrounded with a cluster of admiring males, averaging from thirty to fifty in number, generally in bunches of fours and fives, forming an irregular ring around them, but separated from her by a clear space of three or four inches; in no instance were there ever more than two males touching the female, though we examined thousands of them at work.

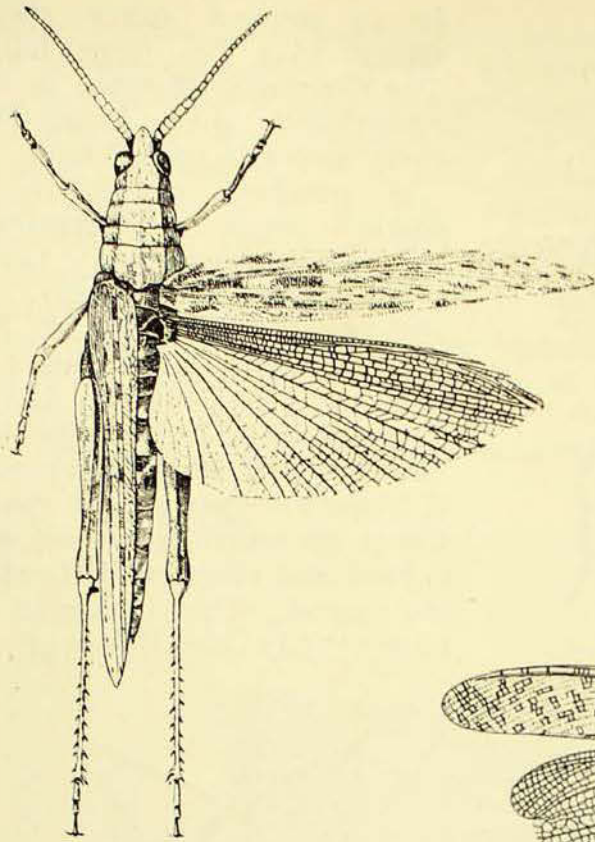
"The probable and only reason that I can see for the attendance of the two males on the egg-laying female, is that it enables her to get a firmer grip of the ground, and in fact holds her in position till she completes her task. I can find no record of this habit in any of our described species and have never noticed

it in several other species which have the same habits. The disparity of sexes is very remarkable, there being fully forty males to each female."

A common species in the eastern areas of Australia is the Yellow-winged Locust (*Gastrimargus musicus*). In the coastal districts of New South Wales this insect is more or less solitary, but in Queensland it forms migratory swarms. In its solitary state it frequents open grassy spaces, flying up when disturbed with a loud and characteristic clicking sound. This is one of the most easily identified of our

locusts, the hind wings having a bright sulphur-yellow area at the base surrounded by a broad black band; there is a transparent, colourless wing-tip.

The Long-nosed Locust (*Acrida turrita*), a curious elongated creature of bright green or pinkish colour, has the head produced forwards into a narrow point, with the eyes set well forward near its apex. The hind wings are a delicate greenish tint. The antennae are curiously thickened and finger-like, and the hind limbs appear excessively long and



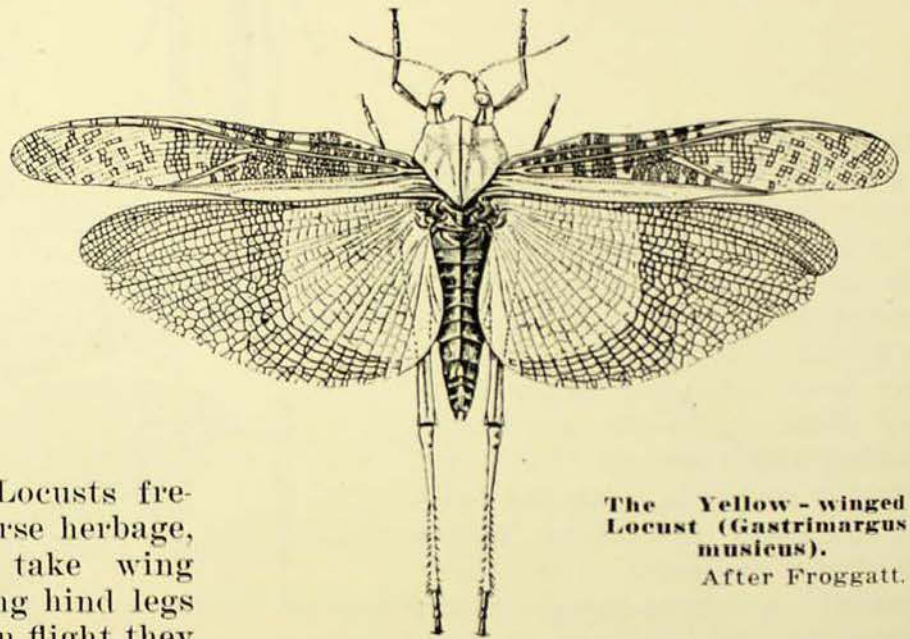
The Blue-winged Locust
(*Coryphistes cyanopterus*).
After Froggatt.

slender. These Long-nosed Locusts frequent open grasslands or coarse herbage, and when disturbed they take wing readily, and fly with their long hind legs trailing behind them. When in flight they emit a loud crackling noise, but how this is produced I have never been able to determine.

Goniaea australasiae, the Ridge-backed Locust, is a large reddish-brown insect about two inches in length, with the thorax produced into a sharp ridge or crest. It inhabits open forest country, and when resting among fallen and dry eucalyptus leaves it is very hard to detect. Another inhabitant of the same type of country is *Coryphistes cyanopterus*, a mottled greyish insect which rests upon the tree trunks, where its coloration renders it very inconspicuous and very difficult to see, especially as it usually remains quite motionless until one touches, or almost touches it. At Wagga

these locusts rest upon the lichen-covered granite boulders, and here again its camouflage proves truly effective.

Not all the locusts are winged in their adult state, some forms remain wingless throughout their lives. Among these are members of the genus *Monistria*, which live in high open country. Some of the wingless desert forms have the thorax remarkably expanded and blotched with white and brown. They bear a really remarkable resemblance to the pebbles among which they rest. Little is known of their life-histories and habits.



The Yellow-winged
Locust (*Gastrimargus musieus*).
After Froggatt.

Mention may be made here of another family of locusts, the Tettigidae or Pigmy Locusts, which appear to be an offshoot of the true Locusts (Acridiidae). They are remarkable little insects and have the tegmina reduced to minute scales. When the hind wings are present, they are often folded so closely as to appear like threads. Only eighteen species have been described from Australia. Members of the genus *Paratettix* live on the margins of streams and pools, and sometimes even under the surface of the water. Most of the species are small and seldom measure more than about half an inch in length. Nothing is known of their lives.

A Nesting Colony of Sea Birds on the Admiralty Islets, Lord Howe Island*

By (the late) ALLAN R. McCULLOCH

[Some years ago generous friends of the Australian Museum jointly provided funds to enable an expedition to proceed to Lord Howe Island to gather material for the construction of group, or habitat, exhibits.

One of the results was the Admiralty Islets group, which vividly portrayed sea-bird life. This was one of the first attempts at this type of exhibition, and it earned much praise from visitors, both from museums abroad and others that knew the island. However, the passage of time and the consequential advances in technique suggested that improvements could be effected in the way of accessories, art-work, lighting and casing. So in these directions alterations were made. The mounting of the birds had been done so realistically, and they were in such a good state of preservation, that they required little or no attention.

The Trustees were fortunate in obtaining the services of Miss Mary Soady, the well-known artist and sculptor, to paint an entirely new background which is a very faithful and artistic reproduction of the natural scene. The construction of the exhibit is the work of the Museum's preparators, Messrs. H. S. Grant, J. H. Wright and W. Barnes.

The original description of this exhibit, penned by the late Allan R. McCulloch and published in this MAGAZINE, July, 1923, is reprinted here. It seemed desirable that this be done, for McCulloch had conceived the idea of this group and he knew the island and its animal life thoroughly. There have been some slight alterations to his text, but these relate solely to the scientific nomenclature, which has been brought up to date, and the indication of island vernacular names by enclosing them in quotation marks.

EDITOR.]

SEA birds wander far and wide over the oceans during the greater part of the year, but, at the call of the mating season, they foregather at chosen places to nest and rear their young. The colonies thus formed often include countless thousands of individuals, and may be comprised of either a single species or of several different kinds. There is reason to believe that many birds repair to the same places year after year, regardless of the great distances they may have travelled between whiles, and it is probable that young birds return to the islands upon which they were reared when the time comes for them to undertake the responsibilities of parenthood.

The Admiralty Rocks at Lord Howe Island are a group of islets of fantastic form, with a scanty growth of grass and occasional low bushes upon their rocky faces. They are difficult of access except in very calm weather, and are favoured accordingly by many sea birds as nest-

ing sites. Early in December each year thousands upon thousands of Sooty Terns or "Wideawakes" (*Onychoprion fuscatus*) wend their way in from the sea, and, meeting with their fellows, chatter loudly as they select favoured positions. Not that any one site would appear to be better than the others, because, as no actual nest is built, any surface flat enough to rest the egg upon seems to be all that is required. As the month goes by the terns become more and more numerous, and, when the chickens make their appearance, the ground is covered with a living mass. Walking among them, one must tread warily to avoid crushing a young bird or an egg under foot, while clouds of their distracted parents fly close above one's head, screaming and chattering, and occasionally swooping down to peck at the intruder.

The egg of the "Wideawake" is excellent eating, and, though the yolk is richly coloured, it lacks that fishy flavour which is common to most sea-bird's eggs.

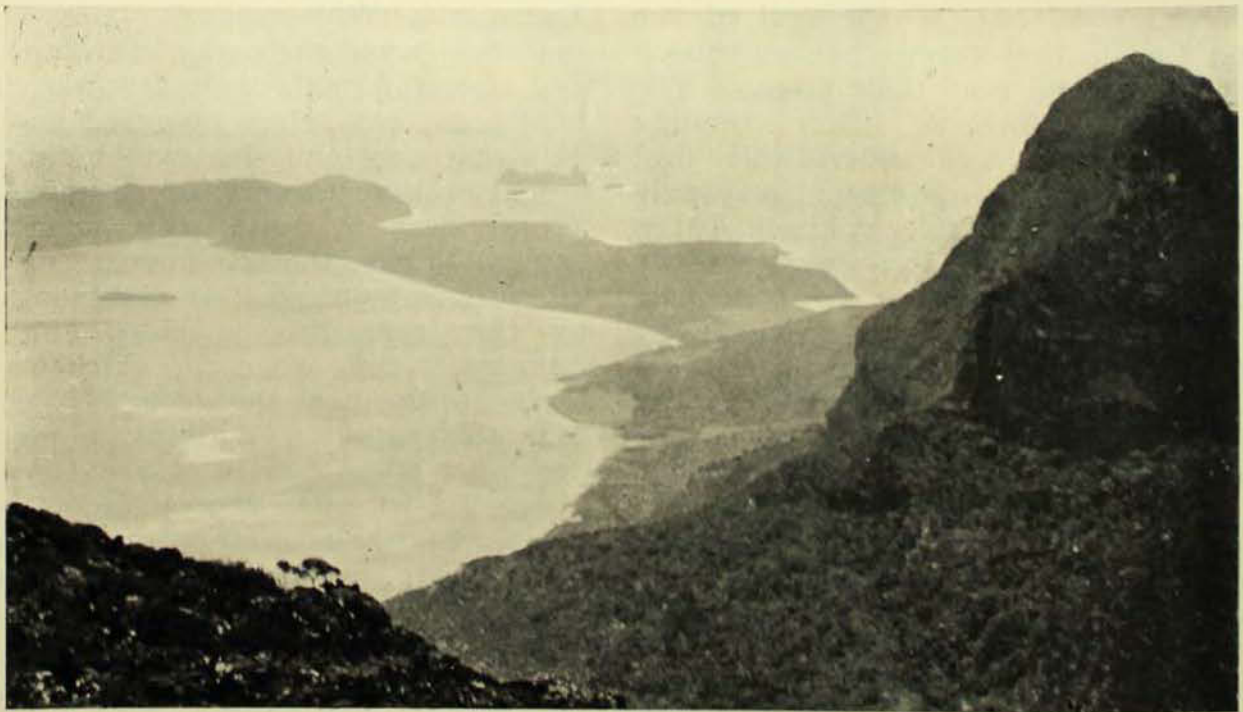
* See Frontispiece.

Great quantities of them are collected for the table by the residents of the island during the early part of each season, but, as each bird robbed of its egg soon lays another, the numbers are not diminished. The eggs are beautifully mottled and blotched with brown, and no two appear exactly alike. Maybe each bird recognizes its own by the marking upon it, though experiments have shown that its position is largely the parent's guiding feature. What happens when a crowd of similarly marked chicks are disturbed by some intruder can only be left to the imagination, for they scramble off in every direction and become hopelessly confused as they jostle and tumble over one another in their frantic efforts to hide.

The chickens develop rapidly, changing from little balls of fluffy down to fledglings with a sooty black plumage speckled with white. When they are ready to fly their parents encourage them seaward and introduce them to the stern realities of their future lives. They are taught the art of fishing and of battling with adverse winds and waves. But they return to their rocky homes at nightfall,

and one hears them high overhead as they struggle with youthful effort against the fresh breeze, their shrill cries being ever answered by the rolling notes of their guardians calling "Wideawake Wideawake" as they guide them in from the sea.

Gannets (*Sula cyanops*) are also plentiful on the Admiralties, their bulky white forms being everywhere conspicuous from afar. Their large white eggs are deposited upon bare rock, and, though always dirty, are white upon their outer surfaces; if scratched, however, the inner layers of the shell are shown to be pale green in colour. At sea, gannets are particularly powerful birds, flying with ease and speed, and often diving headlong from considerable heights upon some luckless prey; but on land they are ungainly in the extreme, and if disturbed are apt to trample cruelly upon their offspring in their confusion. They are armed with powerful beaks, and occasionally show fight when approached, while squawking harshly at the intruder. But, as though well aware of their awkwardness, they more often vomit up half-digested fish which they leave as spoils to the victor,



From the summit of Mt. Gower one looks upon precipitous Mt. Lidgbird, and then over the lower lying parts of the island. Nearly 3,000 feet below is the broad lagoon, while away to the north is the little group of islets known as the Admiralties.

Photo.—A. R. McCulloch.

and, deserting their hapless chickens to fate in a most cowardly manner, make their escape at the first opportunity. Their wings are so long, however, as to beat upon the ground if the birds attempt to arise from a flat surface, so they must reach a ledge or slope before they can take off into the air.

When first hatched, gannet chicks are sprawling, naked, and remarkably ugly objects, but by dint of much feeding they grow apace, and soon rival their bulky parents in size, even while covered with fluffy white down. Grey feathers then make their appearance, which develop into a speckled plumage strangely different to the black and snowy white of their parents, as is the fashion among sea birds.

The few scattered bushes growing upon the rocky islets are tenanted by graceful grey-capped Noddies (*Anous stolidus*), which construct crude nests of grass among their branches. Mutton birds (*Thyellodroma pacifica*) scoop out

shallow burrows where they can find sufficient soil, or secrete themselves among grass tussocks and in holes among rocks. The parents share the duties of incubating the eggs and of keeping their ever hungry babies supplied with food, and upon the sea around the islets one sees long black ribbons which are composed of thousands of the adults fishing together around a shoal of fish or some other massed marine life. Shelves upon the cliffs serve the graceful little "Blue-billies" (*Procelsterna caerulea*) as nesting places, the more inaccessible their position, the greater their favour with the birds.

The group illustrated in the frontispiece of this issue represents a corner of a nesting colony of sea birds on the Admiralty Islets. Representatives of the five species are assembled just as they occurred under natural conditions, chicks and fledglings being mounted in life-like attitudes with their parents. . . .

The Statistics of Gold Nuggets

By T. HODGE-SMITH.

IN a previous issue of the AUSTRALIAN MUSEUM MAGAZINE Dr. C. Anderson,¹ under the heading of "The Lure of the Gold Nugget", gave a description of some of the more important nuggets of Australia and discussed their mode of origin, but did not go into the question of statistics. It was Mr. D. J. Mahony, Director of the National Museum, Melbourne, who brought under my notice some of the interesting facts that a study of the statistics of gold nuggets revealed. I finally decided to investigate the subject when I was appealed to by a gentleman who had become embroiled in an argument as to which country produced the largest nuggets.

The first problem is to decide what is meant by a large nugget. I am quite sure

that should I ever pick up a ten-ounce nugget I would consider it to be large. However, nuggets of this size are so common and any records of them are so incomplete that they are useless for statistical purposes. I started off my inquiry with the lowest weight class weighing between ten and twenty-nine pounds, and after finding sixty records, of which forty-six came from Australia, I rejected this class because I was not reasonably certain that even this record was complete. Thus my definition of a large nugget is that it must weigh thirty pounds or more.

In the following table I have divided the nuggets in the vertical columns according to their weight in pounds (troy). The largest is known as the "Welcome Stranger Nugget" and comes from Bulldog Gully near Dunolly, Vic-

¹ AUSTRALIAN MUSEUM MAGAZINE, i, 1, 1921, pp. 16-18.

toria. It was twenty-one inches long and ten inches thick, and weighed 2,520 ounces. The next largest is the "Welcome Nugget", found at Ballarat, Victoria, weighing 2,217 ounces; while the third, weighing 1,932 ounces, comes from California, United States of America.

The first interesting fact brought out by this table is the rarity of large gold nuggets, as only forty-seven have been found. Of this total no less than forty come from Australia. This rarity is even more strikingly illustrated when we consider the geographical distribution of the Australian nuggets. It is first necessary to realize that eighty per cent. of those from Australia come from Victoria. Further investigation shows that all those from Victoria come from an area about sixty miles by thirty miles, bounded on the north by Bendigo, in the east by Castlemaine, the south by Ballarat, and the west by Maryborough. This is the area generally spoken of as the Ballarat-Bendigo goldfields.

Locality.	Pounds (Troy).				Total.
	Over 100.	70-99.	50-69.	30-49.	
Victoria.. .. .	6	5	10	11	32
New South Wales .. .	2	—	—	2	4
Western Australia .. .	—	1	—	3	4
North America .. .	1	1	—	1	2
South America .. .	—	—	1	1	2
Haiti	—	—	—	1	1
Russia	—	1	—	—	1
Total	9	8	11	19	47
Australian percentage	88	75	91	84	85

Perhaps when we realize fully the great rarity of gold nuggets, much of the mystery that has grown about the origin disappears. Many years ago a resident of one of our goldfields came to see me at my office. He told me that the then Government geologist had given a lecture on the geology of his district. In the course of this lecture he had stated that in past geological time the area had been under the sea, as evidenced by the presence of marine fossils contained in the rocks. My visitor pointed out that

some large nuggets were also found in the district, and he had ascertained that sea water contained as much as one grain of gold per ton. Heigh, Presto! the problem was solved. It was obvious that gold nuggets grew on the floor of the ocean much the same as mushrooms do on the land. This theory, like some of those which have appeared in scientific literature, has no foundation in fact, but, at least, it leads them in ingenuity.

All alluvial gold, that is gold found as grains or nuggets in soil or gravel, was at one time a constituent of rocks or the reefs that traversed them. They have been reduced to soil and gravel by the work of rain and rivers. The gold being the heaviest constituent and least affected by weathering, is not carried as far as the other constituents, and is therefore concentrated in placer or alluvial deposits. Gold is quite soft, but because of its tenacity it is able to resist abrasion by friction; even so it will become more or less rounded if it has to travel any distance.

But, you say, we do not find big masses of gold weighing up to 100 pounds in reefs. You could even quote an official American publication, dated 1920, which records: "The origin of nuggets of such size has been a matter of much speculation, since no masses of similar size have been found in veins." True, they are exceedingly rare, but such masses are not unknown.

There is the case of the famous "Holtermann's Nugget", which is not a nugget because it was not found in an alluvial deposit. It consisted of a slab of rock and gold measuring four feet nine inches by two feet, and was wedged off the side of the reef at a depth of 130 feet in Beyer and Holtermann's claim at Hill End, New South Wales, in 1872. The gold was valued at £12,000 approximately.

Incidentally, this is the largest individual mass of gold so far found in any reef in the world. Thus Australia holds two records: one for the largest mass of gold to be found in alluvial deposits, and the other for the largest mass to be found in a reef.

The Carved Trees of New South Wales

By FREDERICK D. McCARTHY

AMONG the wealth of aboriginal relics found in New South Wales, the carved trees constitute a most interesting group. They have formed the subject of innumerable notes and photographs in newspapers and magazines, and a large number of inquiries about them are made at the Australian Museum each year. Etheridge¹ called them dendroglyphs and classified them into two series: those beside graves he termed taphoglyphs, and those on initiation grounds he termed teleteglyphs.

TAPHOGLYPHS.

The taphoglyphs mark the grave of a notable member of a tribe, such as a medicine-man, warrior, leader in ceremonies, orator or man of wisdom; sometimes the site of a combat in which there had been a death was denoted by a carved tree. Only one tree was engraved beside the majority of graves, but as many as four and five taphoglyphs at one site have been recorded. They are usually to be seen on river banks and flats, where the graves were dug in the soft earth. The orientation of the carved trees in relation to the grave is not consistent; there are records of two trees standing north and north-west of a grave, of three trees forming a triangle, and four a rhomboid. In addition there are several instances of four trees standing at the cardinal points round a grave. The trees were not given any care after the burial ceremonies were finished.

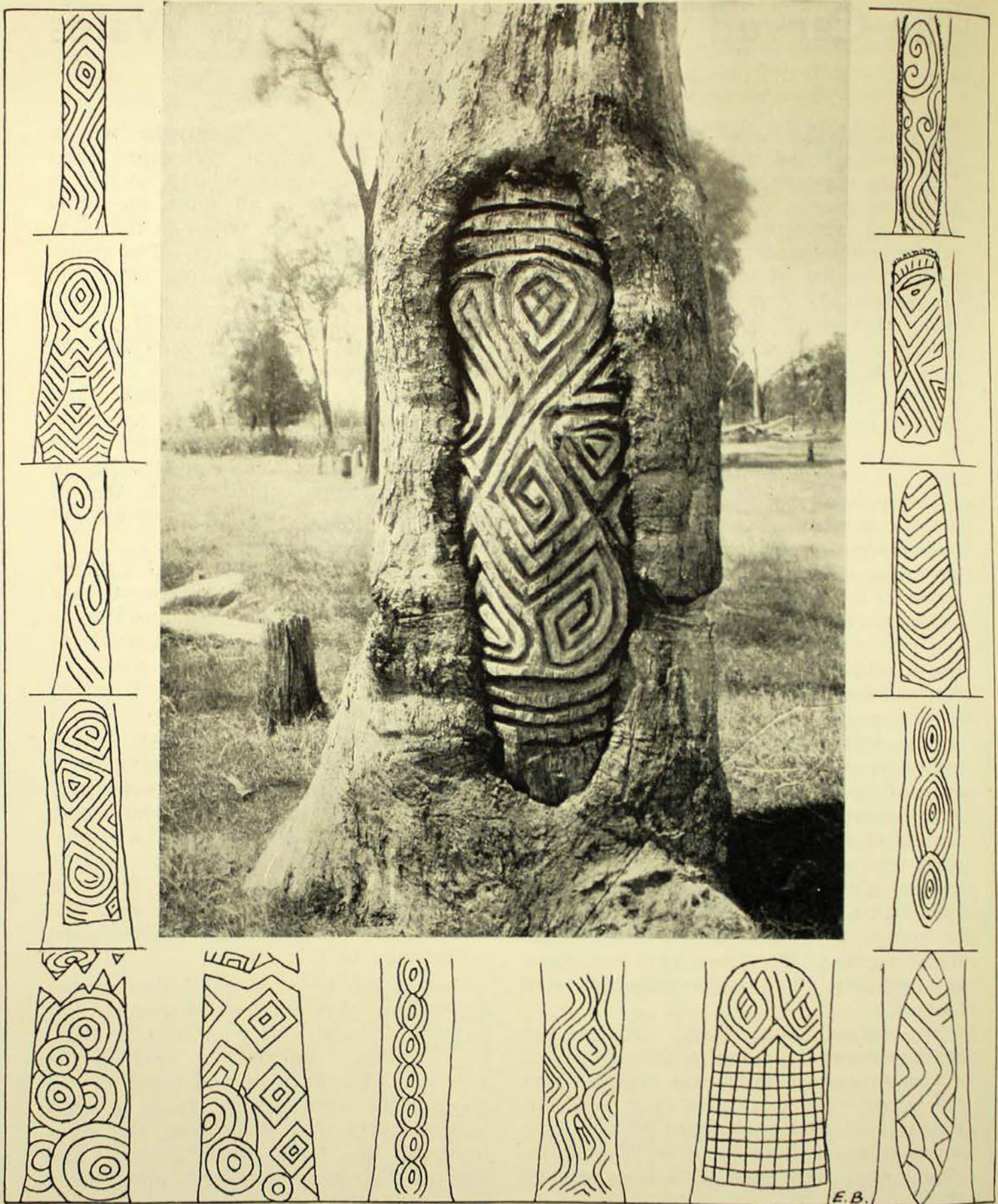
In central New South Wales the graves were of the tumulus type, in which a high mound of earth was raised above the grave, with a strip of bare soil surrounding it, and sometimes several long raised mounds along one side. The taphoglyphs were associated with these graves.

The carving of taphoglyphs was a culture trait of the Wiradjuri and Kamilaroi tribes particularly, and from them it diffused on all sides, spreading as far as the Murring tribes on the south coast of New South Wales. The centre of the practice was the area extending from the upper Macquarie and Bogan Rivers to the upper Lachlan, and especially in the Warren-Wellington district. Taphoglyphs have been recorded as far north as Gunnedah-Coonamble, and as far south as Niemur Creek and Lake Cargellico, but they are unknown along the Darling River. The southern line of their distribution coincides with that of the tumulus grave, but the latter did not spread to the south coast.

It is known that the tribal culture-heroes came down from and went back to the sky world *via* the trees, and Howitt has recorded a belief that the spirit of the dead man went to the sky world by means of the taphoglyph. An interesting example of the powers of the evil spirits to interrupt this spirit journey lies in the digging of a dummy grave with incised trees to delude them—especially Kruben, a powerful evil-doer who wandered about at night. The taphoglyphs were not worshipped nor used as idols, their significance being that the carved design was associated with the clan of the deceased and the religious background of this group.

One of the trees on exhibition at the Australian Museum was discovered by Surveyor-General Oxley on July 29, 1817. In describing the site, he said in his Journal: "To the west and north of the grave were two cypress trees, distant between fifty and sixty feet, the sides towards the tomb were barked, and curious characters were cut upon them. The grave consisted of a mound nine feet long by five feet high, with a semi-circular bank of earth half-way around

¹ Etheridge, Robert, Jr.—The Dendroglyphs, or "Carved Trees" of New South Wales. *Memoir. Ethnological Series No. 3, of the Geological Survey of New South Wales, 1918.* 104 pp., 38 pls., map.



Geometrical designs carved on trees in New South Wales. The design on the example second from the top on the right probably represents a culture-hero. The specimen in the photograph is at Dubbo.

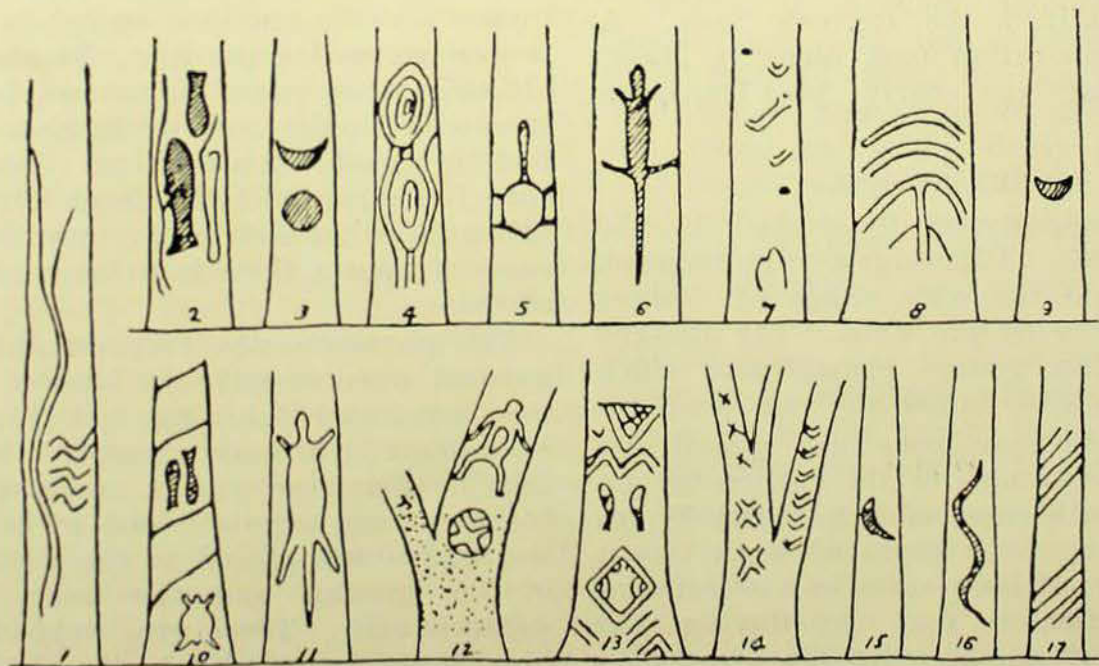
it, and three banks, about one foot high, in a row on its open side." The Australian Museum is indebted to the late Mr. Edmund Milne for the acquisition of this valuable historical relic.

TELETEGLYPHS.

The teleteglyphs were associated with the initiation ceremonies known as the *bora*. This type of initiation was practised throughout south-east Australia, and extended north to the Condamine River in Queensland. The ceremonial ground consisted of two circular spaces, cleared of all vegetation, and each had a low raised bank of earth around it; the spaces were some distance apart and were connected by a sacred track. Sometimes one circle was in thick bush on a river or lake shore, and the other on a ridge top. Varying numbers of trees, from seven to one hundred and twenty, growing along this track and around one of the circles, were engraved. Apparently, a site was not selected on which the trees were growing in such a position that they formed a traditional pattern, but merely to permit of the preparation of a relatively straight and secluded path between the circles.

The arrangement of the ceremonial ground is of interest, because it illustrates the connection between the carved trees and other elements of tribal religion. Figures of the culture-heroes, kangaroos, emus, and other totemic animals, and those upon which there were food restrictions during initiation, in addition to geometric patterns, were made in the earth of one circle and along the path. Near Wellington, and at Bulgeraga Creek, the trees were engraved along both sides of a straight track to the smaller circle. They extended for about one mile at Wellington, and on a *bora* ground on Tallwood Holding, Redbank Creek, southern Queensland, there are one hundred and twenty teleteglyphs around the smaller circle and extending for one hundred and seventy-five yards along the path. They are carved around the smaller circle on the Richmond and Clarence Rivers, around the larger circle on the Manning River, and near either circle on the Bellingen River.

The distribution of the teleteglyphs is almost the same as that of the taphoglyphs. The cult was centred mainly in the Kamilaroi and Wiradjuri tribes; it is found just over the Queensland border



Naturalistic designs carved on trees on the bora initiation grounds at Bulgeraga Creek, Quambone district (Nos. 1-6, 17), and Gnoura Gnoura, Boomi River, New South Wales. Nos. 1 and 16, snakes; 2, 10, 13, fish; 5, tortoise; 6, 11, goannas; 9 and 15, crescent moon; 10, flying phalanger; 12, human figure.

in the north, on the Narran River in the north-west, at Darlington Point on the Murrumbidgee River in the south-west, and at Ulladulla in the south-east. In the west their limit coincides with that of the four matriarchal sections, which extended to the Cobar district.

HOW THEY WERE CARVED.

The methods of engraving the trees varied. On the north coast of New South Wales the designs were incised in the bark, and sometimes only a series of nicks and cuts were made. To the west of the Great Dividing Range the bark was removed and the pattern cut into the sapwood; on many trees a panel of bark and sapwood has been removed and the design engraved in the heartwood. An effective method was to cut a piece of bark off a tree in the shape of a human being, animal, moon or sun, thus leaving a silhouette, the positive being hung on a tree.

Prior to English colonization the dendroglyphs were carved with stone tools, and it is probable that relatively few trees were engraved in comparison to the large numbers that were cut, and the elaboration of the designs that took place, since white occupation, when metal tools simplified the carver's task. A similar elaboration took place in Maori art during the early post-European period.

THE DESIGNS.

The dendroglyphs illustrated in the plates of Etheridge's monograph demonstrate the wide range of designs associated with the cult. The designs comprise four groups, examples of which are widely distributed and not localized.

The anthropomorphs are practically all representations of the culture-heroes. On the south coast of New South Wales the Murring tribe engraved on a tree a large figure of *Daramulan* in a ceremonial dance attitude, for use during the initiation rites. At a Kamilaroi *bora* on the Moonie River, near Gundablui, two male figures, representing the sons of *Baiame*, were cut out of bark and set

against trees, one on each side of the sacred pathway; emu feathers were placed on the head of one, and the other held a shield. On this *bora* ground one tree bears two human figures carved one above the other. There is a representation of *Baiame* at the Mulga clan initiation ground on the Bogan River near Nyngan.

Representations of animals, or zoomorphs, are not as numerous as one would expect in view of their predominance among the rock paintings and engravings. The reason for this is that the geometrical designs which form the basis of the cult and their associated myths diffused from New Guinea into eastern Australia, and, when they were incorporated into the ritual life of the New South Wales aborigines, they supplanted the naturalistic subjects to an extensive degree. The zoomorphs are usually "cut-out" figures, which were hung on trees during the rituals. Goannas up to six feet long are commonly seen, depicted from above, and one has its head turned to the side. Tortoises occur at Bulgeraga and Gnoura Gnoura. One teleteglyph at Redbank Creek shows a snake just over nine feet long, with its head pointing to the ground, and at Bulgeraga another snake, four feet six inches long, is cut in a spiral as though it were ascending the tree. Fish are rare, although they occur in several localities in reversed pairs, and up to almost three feet in length. An echidna (Spiny Ant-eater) is recorded at Redbank Creek, but, although other species are mentioned in various reports, there is no known example of them.

The physiomorphs (representations of natural phenomena) are limited to the sun, moon and lightning. At Gundablui, on a Kamilaroi *bora* ground, a sun two feet in diameter and a moon eighteen inches across were cut out of bark; the sun figure was placed at the eastern end of the ground and the moon at the western end. These two subjects have also been recorded at the Bulgeraga Creek and Redbank Creek *bora* grounds. The lightning was represented by longitudinal, zig-zag, and spiral lines.

By far the greater majority of the designs are geometric in nature. The patterns in this group include a number of motifs of great importance in the decorative art on south-east Australian weapons. There are two important series of geometric designs. One has the concentric diamond, which varies from a triangle to an hexagonal figure, and from a rhomboid to a pointed ellipse, set in a field of chevrons. The other series has curvilinear lines, scrolls, and concentric circles, sometimes associated with other art elements. Equally interesting are the motifs suggesting boomerangs, chains, flying-foxes, and the sets of criss-cross grooves which form a lozenge- or checker-work pattern. The zigzag and St. Andrew's cross also appear.

The designs engraved on the dendroglyphs reveal great strength and control in the line work. The repetition of the design elements in admirably balanced patterns is an outstanding feature, which, together with the graceful curves of the bark frame enclosing the glyph on trees growing in the open forest, make the dendroglyphs an impressive record of the ritual life of the aborigines.

SIGNIFICANCE OF THE DENDROGLYPHS.

The function of the carved trees is fundamentally the same whether they be taphoglyphs or teleteglyphs. There is reason to believe that the clans of each tribe had their own designs; thus the emu pattern belonged to the clan which had the emu as a totem, and in each tribe the emu clan would have the same basic pattern, though probably varying in detail, and with the same myths and ritual associated with it. Similarly, all of the other totemic clans had their own designs. Thus, within a tribe, there would be as many as, and probably more designs than, there were totemic clans. As the cult spread more widely, the designs with their myths became incorporated into the ritual life of other tribes. These designs were connected with the culture-heroes of the clan and tribe, especially *Baiame*, the great beneficent All-Father of the area, who introduced the various customs,

kinship rules, and ritual practices. *Daramulan* figures in the Wiradjuri myths, and his importance lies in his ability to swallow the noviates at initiation, and later reproduce them as men.

Baiame forms the central figure of the beliefs and ritual in the carved tree cult. On the Macquarie River the glyphs represented his offspring, during whose transigrations all but two were destroyed by an evil spirit named *Madjegong*. The emu was *Baiame's* food, and is associated with him at Wellington and on the coast between Sydney and Newcastle; this association is to be seen in the rock engravings of the Sydney district. Thunder and lightning were expressions of *Baiame's* wrath, and in some places the thunder was the voice of *Daramulan*. The relationships of these legendary beings are tangled; among the Wiradjuri *Daramulan* is the son of *Baiame*, but among the Murring he was the son of the emu or *Ngalalbal*. Actually, the legendary all-father had a variety of names in the different tribes of south-east Australia, where *Baiame*, *Daramulan*, *Koin*, *Bunjil*, and others were all used to denote "our father" by the aborigines in different localities. They all lived in the sky.

There is another important belief associated with the dendroglyphs. It was believed that the spirit of each individual came from the sky-world, *via* the trees, and at his death returned in the same way. Thus, the Wiradjuri believed that, prior to the extraction of a tooth which formed the final ordeal in their initiation, *Daramulan* came from the sky to the earth down a pathway made by stripping the bark spirally from a large tree. Similarly, the designs on the trees beside the graves formed the path of the dead man's spirit to the sky-world.

During the initiation ceremonies the meaning of the designs, the myths associated with them, and their significance in tribal history, were explained to the initiates. Thus, the designs on the taphoglyphs represented the ritual and kinship affiliations of the deceased. It is apparent that the dendroglyphs formed a most

intimate link between the aboriginal and his world of legend and myth, and the designs were symbols of the very core of his religious beliefs.

Over six hundred dendroglyphs have been recorded, over fifty of which are in the Australian Museum collection. Although a large number of them are still standing in the country, it is regrettable that many specimens have been wantonly destroyed by firewood and fence-post cutters, and they have not been spared in

the clearing of land on farms and grazing paddocks. Bush fires are, perhaps, the most destructive factor. It is incumbent upon every citizen of the State to do his utmost to preserve the dendroglyphs in his district, and it is especially important that pastoralists and farmers make every effort to protect carved trees on their property. If a dendroglyph cannot be left standing, then it should be cut out of the tree and sent to the Australian Museum.

Native Art in International Exhibitions

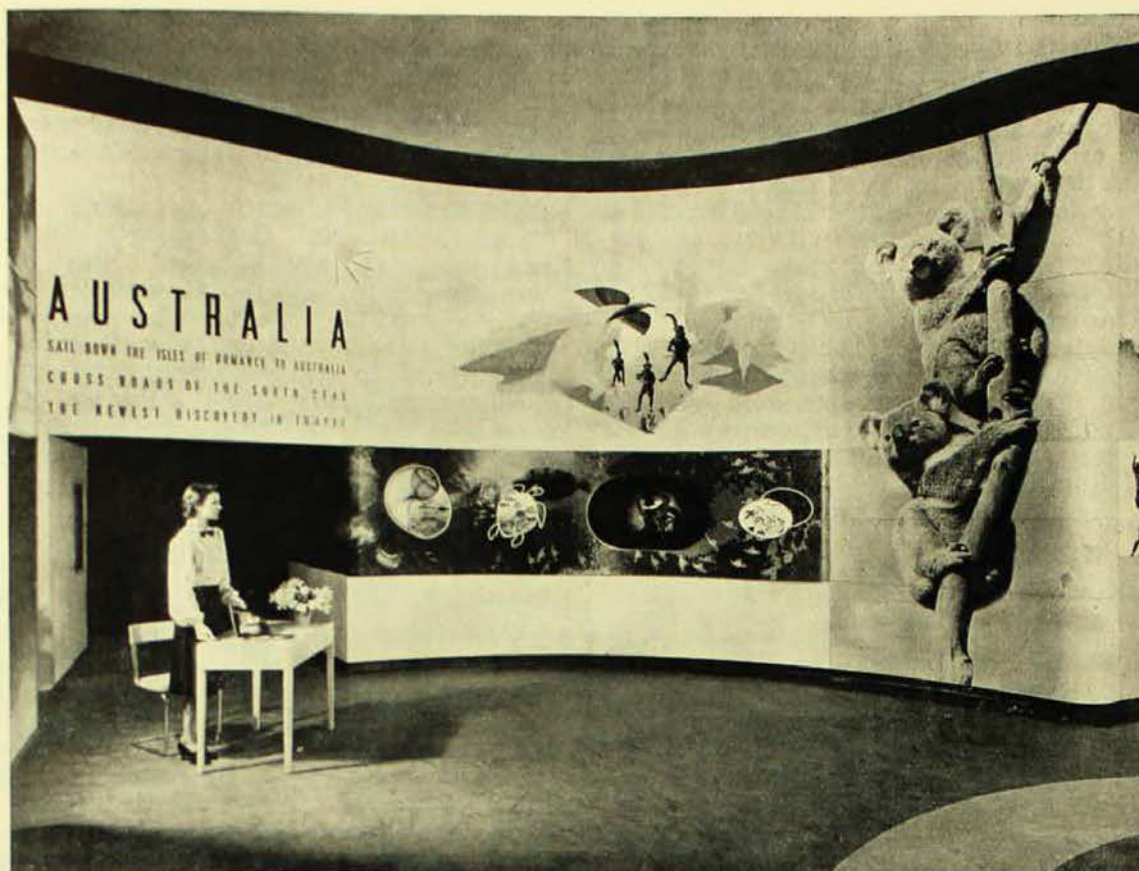
By DOUGLAS S. ANNAND

THE Australian pavilions at the New York World's Fair and the New Zealand Centennial Exhibition have been designed in a modern way to satisfy the aesthetic and be understood and appreciated by the layman.

At New York the undoubted attractions of tropical Australia and New Guinea are symbolized in a wing of the Travel Section of the pavilion. A dark-toned photo-montage forms an excellent frame for three brightly-lit peep-shows, showing tropical fish and gay parrots with each design on two sheets of plate glass, to give an effect of movement to the subjects.

Above this is a mural painting with a brilliantly coloured bird of paradise flying over an imaginative landscape in the form of a map fringed with islands and exotic vegetation. Three photographic warriors beat their war-drums as they dance across the sea, and the shores are strewn with actual sea-shells in soft colours blending with the pinks of the landscape.





At New Zealand, the Commonwealth displays the art of New Guinea and of Australian aborigines on a mural 25 feet high by 20 feet wide. The design is composed of photographs in black and sepia, drawings in oil colours, and some actual specimens of New Guinea art.

The beautiful curvilinear designs of the Trobriand Islanders are to be seen in some canoe prow-board and dance-wands. Masks from the Sepik River and from the Solomon Islands, together with pierced tortoise-shell plaques, basket work, carved and painted implements, weapons and ornaments, show the beauty of form and the unerring feeling for designs for which

the art of the peoples of New Guinea is remarkable. The specimens used were all lent by the Australian Museum, and with a few exceptions the photographs were made from pieces in the Museum collection.

The series of Australian mammals and the New Guinea birds of paradise exhibited were mounted by the Museum taxidermists.

On the lower left section of the mural an Australian aboriginal is seen at work on a series of *Wandjina* rock paintings. These interesting drawings were reproduced by William Kinsela, who has made an intensive study of aboriginal art.

Herbert James Carter

THE death of Mr. Herbert James Carter, on April 15, 1940, makes a serious breach in the decreasing ranks of the small band of Australian systematic entomologists. His loss will be felt not only by scientific workers, but also by many beginners in the study of our insects, to whom he was always ready to give encouragement and assistance.

Mr. Carter was born on April 23, 1858, in Marlborough, Wiltshire, England, and was educated at Aldenham School and Cambridge University, where he took the degree of B.A. He came to Australia as second mathematical master at the Sydney Grammar School, where he served from 1881 to 1902. He was principal of Ascham until 1914. He soon became inter-

ested in the study of beetles, and taking up their study seriously became one of Australia's leading coleopterists, his name and work being known throughout the world. He was the author of some sixty scientific papers on the Coleoptera of Australia, as well as six produced in collaboration with Mr. E. H. Zeck. He was well known to an even wider circle as Joint Editor with A. W. Jose of *The Illustrated Australian Encyclopaedia*, and as author of *Gulliver in the Bush—Wanderings of an Australian Entomologist*, 1933, a breezy account of his travels in most of the States of the Commonwealth in search of insects, and of his impressions of many Australian and visiting scientists, and bushmen met in his wandering.

Mr. Carter was president of the Linnean Society of New South Wales in 1925-1926, and was also honorary entomologist to the Aus-

tralian Museum. The types of the many new species of beetles he described are housed in the British Museum (N.H.), the National Museum, and in the Australian Museum. An account of the latter collection may be found in *THE AUSTRALIAN MUSEUM MAGAZINE* for May, 1936.

It was the writer's privilege to be associated with Mr. Carter over many years, and to have accompanied him on a long collecting trip into north-western New South Wales in 1932. Those who knew him well, and they are many, will recall many pleasant days spent in his company, and of long discussions not only upon subjects of scientific interest, but on literature and his other manifold interests with which he kept in such close touch to the end of his life.

K.C.McK.

Review

NEW GUINEA EXPEDITION: THE FLY RIVER AREA, 1936-1937. By Richard Archbold and A. L. Rand. (Robert M. McBride and Company, New York; 1940.) Pp. 206, 114 illustrations, 8 maps. Price \$3.50.

THIS is an account of the second expedition to New Guinea sponsored and led by Mr. Archbold; the first took place in 1933, and in July, 1939, he and his associates returned from the third, the largest and most successful of all.

The two authors are Research Associates in the Departments of Mammalogy and Ornithology, respectively, in the American Museum of Natural History, New York, and the scientific work of the expedition was mainly concerned with mammals and birds, though other branches of natural history were not neglected and the work contains many interesting observations on the natives.

Experience gained in the 1933 expedition convinced Mr. Archbold that journeys by land in New Guinea, where supplies have to be transported by native carriers through almost impenetrable forest country, is too slow and toilsome to enable adequate natural history collections to be made inland. Consequently a new technique was employed on the second expedition, and an amphibian plane which could alight on the sea, the rivers, or at the few available airports, was the most important item of the equipment. This was supplemented by parachute, radio telephone, and other modern devices.

A coast base was established at Daru, near the mouth of the Fly River, and from here a number of reconnaissance flights were made to examine the country and select camp sites. From Daru, personnel, equipment, and stores were conveyed by boat to Palmer Junction, the highest point on the Fly accessible by this means. This spot was reached on May 13, 1936, and two weeks' collecting at this

mountain forest camp yielded excellent results. From this river base advance camps were established on the Black River, a tributary of the Palmer, and at Mt. Mabion, in the limestone mountains near the boundary between Papua and the Mandated Territory. Supplies for these camps were conveyed by plane and dropped by parachute, and communication was maintained by radio. Everything proceeded satisfactorily until, unfortunately, the plane was sunk by a storm in Port Moresby harbour. Fortunately, the advance parties received the bad news almost immediately, and were able to make plans for the retreat from the mountains before supplies were exhausted. This was accomplished by rafting down the Palmer to Oroville, on the main Fly River, where they were met by a relief boat. The description of this hazardous journey by raft down an unknown and turbulent river is perhaps the most exciting part of the narrative, which is told in a straightforward and exceedingly modest manner, devoid of flamboyancy or any attempt to dramatize events. Indeed, the style is here and there reminiscent of Defoe's great masterpiece, with its placid day-to-day recital of endeavour and accomplishment.

After the loss of the plane the party decided on intensive collecting in the lowlands, using water transport on the Fly. Here were spent the last six months of the expedition's year in New Guinea, and during this time a rich harvest of specimens, animals and plants was gathered, as well as a wealth of observations regarding the lives and behaviour of the mammals and, particularly, the birds inhabiting the country. The expedition's work was brought to a close in February, 1937.

The book is illustrated by many photographs, some of which, however, are not of the highest quality, probably because the negatives suffered deterioration through the damp, hot climate.

C.A.

Ambergris

Its Uses and Identification

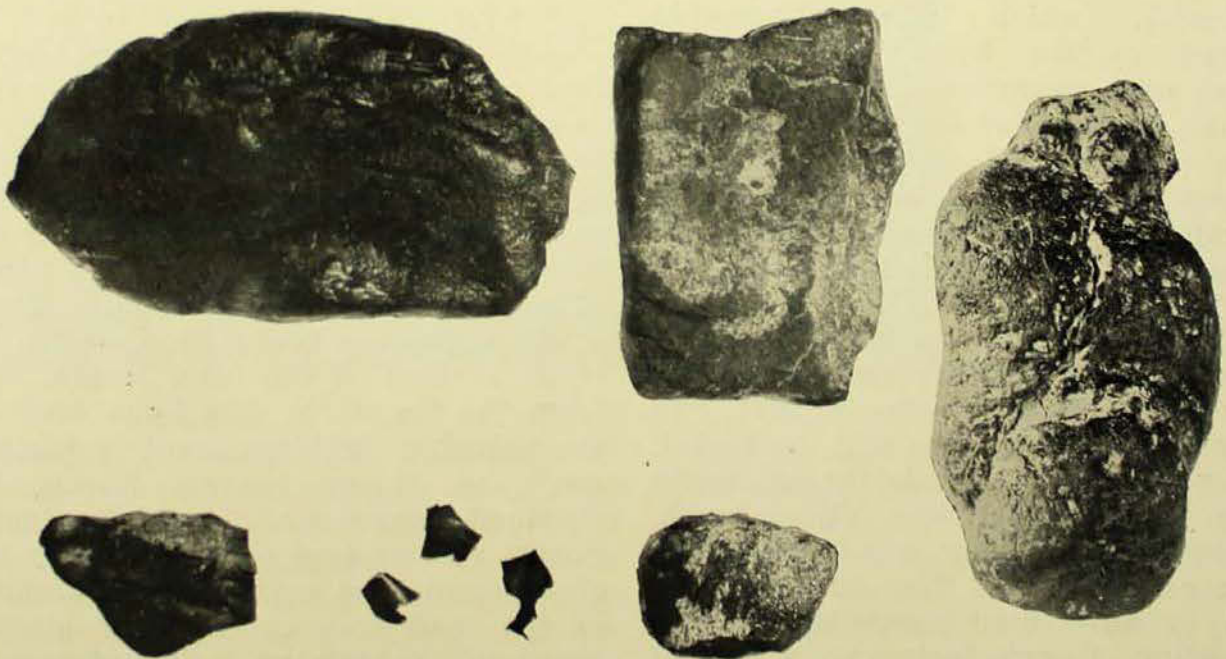
By ELLIS TROUGHTON, C.M.Z.S., F.R.Z.S.

But flowers distill'd, though they with winter meet,
Leese but their show; their substance still lives sweet.
Shakespeare's *Sonnets*.

THE quotation from the *Sonnets* in which the Immortal Bard gives beautiful expression to the modern thought—"If winter comes, can spring be far behind?"—is not actually applicable to ambergris itself. Yet it expresses in a lovely way the strangely pervading ability of that unattractive substance to sustain the floral fragrance of perfumery, so that the rose and violet fields of the Riviera may bloom again in the dust and fog of distant cities.

This quality alone made ambergris the answer to an alchemist's dream, until the development of effective synthetic substitutes reduced the importance and

value of the substance in preparing the more exquisite and expensive perfumes. Its use emphasizes yet another of Nature's paradoxes in that a substance derived from sickly sperm whales becomes the pervading medium of fragrant scents. Such use also corrects the popular misconception that an extremely objectionable smell is a constant characteristic of ambergris. As a source of museum enquiry, identification of supposed samples even rivals the perennial subject of marsupial birth, and popular belief that a decaying odour is essential to the substance lends a spice of unpleasant variety to the examination of most samples.



Examples of ambergris. The prices quoted per ounce approximate the normal or peak rates which have been subject to upwards of a fifty per cent. drop since 1930. Upper row: left—soft black or "raw" ambergris, 5s. to 10s.; centre—blackish to dark grey or medium hard ambergris, 40s. to 50s.; right—an 8 oz. piece, of excrement shape, found at Lord Howe Island and sold in London for £28 in 1922. Lower row: left—a piece of nugget brown ambergris, which forms harder lumps in the softer kind, 60s. to 80s.; centre—fragments of horny cuttle-fish "beaks", often embedded as an indication of ambergris; right—a piece in the Museum since 1902, brittle and chalky-white because of age, of uncertain value.

COSMETICS AND CONDIMENTS.

Obviously delicate perfumes are not based upon consistently objectionable material, and ambergris recently taken from a dead whale merely carries the unpleasant odours of decay, just as in weathered maturity it conducts the fragrant ones. The matured substance actually has a rather sweet and treacly though decidedly musty aroma, and it evidently appealed to the sense of taste as well in early times, judging from its use in the East for spicing food and wines, as well as in ancient perfumery and pharmacy. In bygone days in Europe ambergris was used with foods and became an important ingredient in medical nostrums, though modern analysis does not suggest any reason for its use in any form of medical practice, sedative or otherwise; nor are there any attractive recipes to be quoted from Madame Pharaoh's cookery books. Most references in literature are to its use as a spicy flavouring and for perfumery in the age-old art of the "beautician".

The basic derivation of the name is given as the Arabic word *anbar* (for ambergris), which was afterwards extended to the French *ambre gris* through some confusion of the substance with the fossil resins known as grey and yellow ambers. Of many entertaining references in literature, one by Elyot in 1533 refers to "Ambergrise" as the accompaniment of the "Harte hotte", while perfumery was indicated by Drayton writing in 1612 that "Their lips they sweet'ned had with costly ambergrease". Concerning cookery, Milton wrote, in 1671, "In pastry built, or from the spit, or boiled, Gris-amber-steam'd", while the epicurean Sedley, in 1687, refers to a bilious breakfast concoction of "new laid eggs, ambergrease and gravy". The final thought seems to have been expressed in the penetrating, though inelegant, words of the satirical Pope, in *Swift's Works* (1841), that "Praise is like ambergris; a little whiff of it . . . is very agreeable; but when a man holds a whole lump of it to his nose, it is a stink and strikes you down". A more pleasant observation

referred to the fact that papers perfumed with a grain of ambergris still retained a strong scenting after forty years, indicating the pervading aromatic quality of ambergris as a scent-conductor in perfumery.

ORIGIN.

Many absurd hypotheses were once advanced to account for the origin of ambergris, such as a belief that it was composed of solidified sea-foam, or that it was a fungoid growth in the ocean similar to those formed on trees, or even that it was the accumulated excrement of sea-birds. The actual source of ambergris was satisfactorily established in a communication to the *Philosophical Transactions of the Royal Society*. It was found by Dr. Swediaur that ambergris very frequently contained the horny "beaks" of species of squid on which sperm whales were known to feed. Coupled with this observation, the fact that ambergris was frequently taken from the intestines of that whale, clearly proved that it was formed within the animal, and not from an extraneous substance swallowed by the whale.

Although the main interest of the Sperm Whale or Cachalot for coastal dwellers is as a source of ambergris, it is generally known as being the largest of the toothed family of whales, of which it is the most sought for commerce and famed in the chase; it may attain a length of sixty feet. Its most striking feature is the enormous blunt head, which may equal a third of the total length. It is from the "case" in this huge head that the valuable fluid sperm-oil is taken, as much as thirty barrels having been obtained from one of the giant mammals. Sperm whales feed almost entirely upon giant squids and cuttle-fish or calamaries of the molluscan order, their stomachs commonly containing bodies of squid up to six feet long, with the longest tentacles varying from ten to fifteen feet. Struggles between giant octopuses and sperm whales have been witnessed by whalers, though the mightiest combats are probably far below the surface. There is no doubt that the



A Sperm Whale attacking one of the huge squid upon which it feeds at great depths. Although the artist has exaggerated the proportions in the squid's favour, a tentacle exhibited abroad is 20 ft. long. Smaller squid and octopods nearer the surface are also eaten by the sperm and other toothed whales.
After "Marvels of the Universe."

whales feed at great depths, and many old whalers believe that much of their food is obtained at about 200 fathoms (1,200 feet). They are definitely known to sound to that depth, and they commonly submerge for from forty to fifty minutes, while an instance of seventy-five minutes has been recorded.

It was observed long ago that sperm whales containing a large quantity of ambergris were either dead or much wasted and evidently in a sickly condition. It was thus indicated that the

substance is a morbid product resulting from some irritation of the digestive system, causing a biliary accumulation probably from indigestible substances in the main diet of squid and cuttle-fish. The exact causes of the formation and the nature of its peculiar qualities are unknown, but from chemical analysis ambergris is said to contain 85 per cent. of a fragrant substance named ambreine. The general appearance of ambergris, in my opinion, is suggestive of the fact that the dark substance from the ink-sacs of

octopus food has much to do with its peculiar substance and qualities.

THE APPEARANCE OF AMBERGRIS.

The comparative rarity of the substance is due to the fact that really large quantities are found only in sickly stranded or captured whales, or as smaller fragments washed up on beaches according to the set of ocean currents. As a morbid accumulation ambergris has no recognizable shape or texture, but varies in appearance according to whether it has been passed in small quantities, or has disintegrated from quantities left in the rotting whale carcase.

It is usually described as fatty or wax-like, but the raw kind may be sticky and blackish, resembling pitch, with a musty nauseating smell, and which would be covered with sandy shell-grit if washed up on a beach. It hardens with exposure and may range in colour from brownish-black to mottled greenish- or greyish-white. The general texture most nearly resembles that of dampish dried cow manure when broken apart, and the general aroma of the matured substance is suggestive of the sweetish bovine scent about milking yards, although it is generally described as slightly honey-like or faintly musky.

It does not crumble under pressure like fat, or make the fingers greasy, or become brittle unless stored for many years, and if slightly warmed can be moulded like plasticene or cobbler's wax, which it most resembles. A definite indication of ambergris is often provided by the presence of the small horny "beaks" of cuttle-fish embedded in it.

The most definite simple test is to pierce the supposed sample with a red-hot thin wire or needle, when a blackish-brown substance will coil and bubble out from ambergris and stick to the wire and one's fingers, leaving a small crater in the firm material, instead of flowing away as would melting fat or candle-grease. Other features are that, as well as being plastic when warmed, it floats in water and is soluble in ether and absolute alcohol; a piece about the size of a pea

will dissolve in a few teaspoonfuls of methylated spirit, which will then display iridescence.

WHAT AMBERGRIS IS NOT!

However, from the remarkable assortment of beach refuse submitted for examination at the Museum, no amount of written description will enable people to identify the substance, or remove their lingering hopes regarding the value of the "find". The most usual samples consist of perished animal-fats and suet discarded by steamers, and waste material from soap factories. Sometimes it is beeswax, possibly showing thread-marks, and latterly a thick oily sediment apparently jettisoned from oil-fuel tanks. After stormy weather marine growths such as deep-sea sponges and conjevoi are torn from their moorings, and after decaying ashore until acquiring a potency regarded as characteristic of ambergris are brought in for inspection.

Because of the natural difficulty in identifying an elusive material without means of comparison, it is probably most helpful to detail *what ambergris is not!* As a deposit forming inside the whale it does not consist of animal fat or fleshy tissue. Therefore, also, it does not have a definite shape like a conjevoi, or any surface skin or pumpkin-like rind, or internal structure like deep-sea sponges, or any bulbs or stalk attachments like sea-weeds. Finally, it is unlikely to have a decidedly offensive smell unless of the sticky black variety, but rather a sweetish though musty aroma which has been likened to caramel and mossy earth.

RECORD DISCOVERIES.

There are many accounts of huge pieces being found in various parts of the world, either washed ashore or taken from dead whales having their intestines clogged with the substance. Probably the most valuable single piece known was secured by Norwegians in our seas; this weighed 352 lb. and was sold in London for over £12,000. A piece found in New Zealand in 1929 weighed about 224 lb. and was valued at £9,000, while a Press report in 1937 mentions the taking of a 35 lb.

piece valued at £600 from a 55 ft. sperm whale harpooned near a South African whaling station. The price for best grey ambergris was quoted at about £5 15s. per ounce in 1921, ranging from 5s. per ounce for the raw, blackish, low-grade quality. The price is naturally affected by the amount of foreign matter amongst the ambergris, and lately it has been estimated that the price range has fallen by up to 50 per cent. owing to the more general use of synthetic substitutes in the manufacture of perfumes.

A small piece was procured by the Australian Museum in 1902 to assist in dealing with the frequent enquiries, and for comparison with samples which rarely prove to be the genuine article. It was the recollection of its characteristic scent—an unfailing guide when once recognized—which enabled me to identify a fine-grade piece at Lord Howe Island while engaged on Museum work in 1921; it weighed about 8 oz. and was sold in London for £28. The largest piece of which, in my experience, a sample was submitted to the Australian Museum weighed 18½ lb. and was of lower medium grade worth from about 13 to 16 shillings an ounce. It was found early in 1934 on a beach at Smoky Cape on the north coast of New South Wales by Mr. C. R. Sanders, who kindly presented his original ounce sample for the information of less fortunate Museum enquirers.

One hopes that this article and the samples exhibited in the Australian and Technological Museums may avert another tragi-comedy in the romance of ambergris such as was reported some time ago from New Zealand. It was stated that half of a large piece had been boiled down by the finder to make a paste for papering the walls of his home. According to the story, it was not until reading an account of another ambergris discovery in a newspaper that the unfortunate man realized that he had wasted a lump roughly valued at £500 as a glue! However true, the story is a good one, and as the pervading aroma in his home must have been fairly oppressive, one can only hope that there was a flowered wall-paper to sustain the "bouquet".

Although so few of the hundreds of specimens brought in or posted to the Museum have even slightly resembled ambergris, the supposed samples are always examined with interest, and information is gladly given, while specimens of various grades are exhibited in the public galleries. Much more could be written about this elusive and still rather precious substance, sought by "professional fossickers" and beachcombers throughout New Zealand, Tasmania and Australia, but it is hoped that this article may bring some reader a valuable prize in the seaside lottery.

The Great Barrier Reef

"ROVING CORAL SEAS", a film of the Great Barrier Reef, was presented at the Australian Museum on May 24 by Mr. T. C. Marshall, of the Queensland Museum, who knows the reef thoroughly and who made the film. "Roving Coral Seas", therefore, is no stereotyped travel film which shows much and tells little. Technically it is a piece of excellent colour photography, educationally it is one of the most informative films we have yet seen. The vividly brilliant waters of the Reef are faithfully shown, a point mentioned lest some may doubt the colour-rendering. Corals, and the animal life—fish and other denizens—which frequent

them are there in all their beauty. There are some fine studies of bird-life. One must not omit the turtle, seen from the egg and "chick" to the full-grown adult carrying an "equestrienne". Aborigines, engaged in their native arts, others making furniture, afford interesting illustrations of the native Australian.

As may be expected, there are many "shots" of enchanting scenery, possibly the finest being that of the Hinchinbrook Channel.

The film takes two and a half hours to screen, and there is not one uninteresting moment.

Mr. Marshall will be showing this film in New South Wales and Victoria.

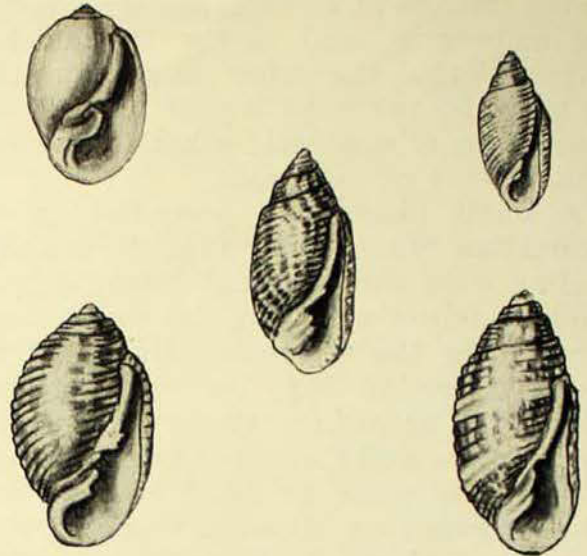
Australian Shells

Bubble and Allied Shells

By JOYCE ALLAN*

THE sub-order Tectibranchiata, to which the shells in this article belong, is an interesting group of families in which the shell is seen to disappear by gradual changes. From being solid shells, entirely containing the animal, they become thinner, more simple in construction, and more enveloped in the folds of the animal's mantle, until in some families the shell becomes quite rudimentary and is completely hidden from view within the body of the animal. In some species it is even missing altogether. In the few families mentioned in this article, the change from a strongly developed, sculptured, protecting shell to a more rudimentary one is only just commencing, but in a future article which will deal with other families of Tectibranchiata, such as the sea-hares, it will be seen in an advanced stage. The animals corresponding to the peculiarly changed shells will have acquired an equally strange structure to suit their unprotected existence.

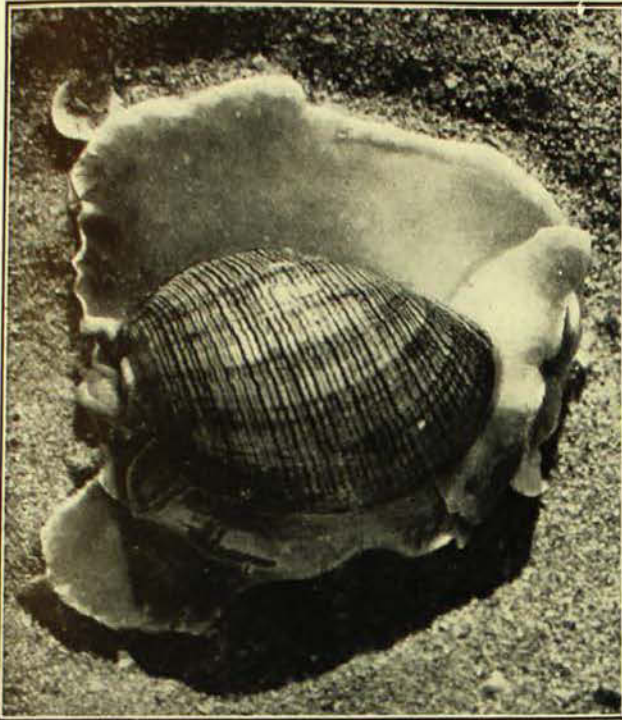
A main characteristic of the animals in the families under discussion here is a well-defined head disc bearing sessile eyes, and sometimes tentacles. This disc appears to be a tactile organ, and varies in many ways, furnishing good characters for classification. The shell in some species is solid and coiled with a normal spire, in others it has become partly uncoiled, with the spire absent or sunken, and the shell thin. There should be no difficulty experienced in identifying shells of this group, as the different species are well marked and have distinct shapes. They are most common in tropical and subtropical waters of the Indo-Pacific, and many handsome species are found round the Australian coast. They live as a rule in shallow, sandy or muddy water, amongst weeds.



The two shells in the top row, from left to right, are *Pupa nitidula* and *Pupa nivea*; in the middle row is *Pupa fumata*; and in the bottom row are *Pupa sulcata* and *Pupa solidula*.

In the family Pupidae are several attractive species which occur in Australia. The shells are small, the largest being about one and a half inches high, with the surface generally sculptured with spiral, punctured grooves. They are solid and capable of containing the entire animal. One species figured here is the common Sydney shell, *Pupa fumata*, a graceful, slender, white species, marked with wavy, narrow, close-set, longitudinal lines. It is sometimes covered with a yellow thin epidermis. This species also comes from the Indo-Pacific. Two somewhat similar, but larger, shells, both north Australian and Indo-Pacific species, are *Pupa solidula* and *Pupa sulcata*; the former has deeper, fewer grooves and the colour pattern is in revolving bands of dark stripes, while the latter species, which is subject to variation in form, size, and colour, has a more ragged type of marking. It has also more teeth on the columella than *Pupa solidula*. *Pupa roseomaculata*, a form of these two northern species, with beautiful red spots, has in recent years been dredged in

* Drawings by Joyce Allan.



When only partially expanded, *Hydatina physis* is a beautiful mollusc to behold. The folds of the great foot simulate in contour the petals of a rose. Natural size.

Sydney Harbour. One of the prettiest species is *Pupa nitidula*, a small, solid, smooth, shiny, pink shell about half an inch high, from the South Pacific islands and north-east Australia; it has a large, strong, spiral fold on the columella and a very slight one above it. Another species about the same height is *Pupa nivea* from New South Wales, but this is a much more slender, elongate shell. It is pure white and shiny, though covered when alive with a thin yellow epidermis, and is encircled with numerous very finely punctured striae.

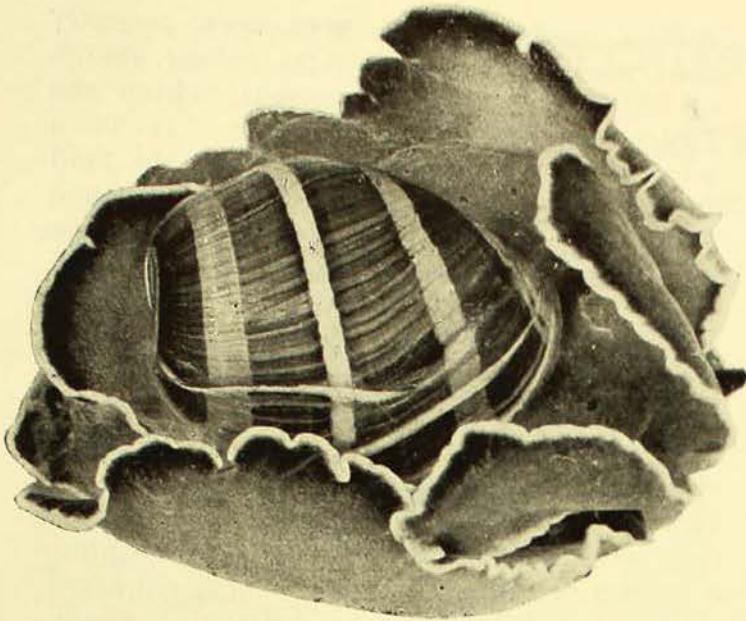
Another species which somewhat resembles these foregoing ones in shape is *Bullinula lineata*. This shell is very common in New South Wales, extending its range to the Indo-Pacific and Japan. It is whitish, marked with two distinct red spiral lines, and numerous rather zig-zag, longitudinal red lines, and can be easily recognized at sight. When protruding from the shell, the animal expands considerably round it. It is a delicate creamy-white, edged with turquoise blue, and is very beautiful. Miss Gertrude Thornley, a keen shell collector

and a reader of this MAGAZINE, recently sent me an excellent little colour sketch of this shell and its animal, which she had made whilst collecting. It is a wise plan for collectors when in the field to carry a small packet of sharpened coloured pencils and a note-book, as one never knows when an interesting animal will be encountered, and even a poor sketch can be helpful. There is a rarer species found round Sydney, *Perbullina errans*, which resembles it closely, but has a more rounded mouth. Only a single species, *Ringiculadda semisculpta*, from New South Wales, is figured here as a representative of the family Ringiculidae, a group of small, rounded, light coloured shells, which range over nearly all tropical and subtropical seas. The New South Wales species is only a few millimetres high and is pure white and shiny.

Undoubtedly the most attractive Bubble shells are those belonging to the family Hydatinidae, and several fine examples are found round Australia. The shells of the family are thin and globose, with large body whorls and a very large mouth opening. The animal is voluminous, with a large, flat foot and a pro-



The egg-masses of *Hydatina* are delicate in appearance and have numerous lobules arranged in the form of an eccentric spiral. About two-thirds natural size.



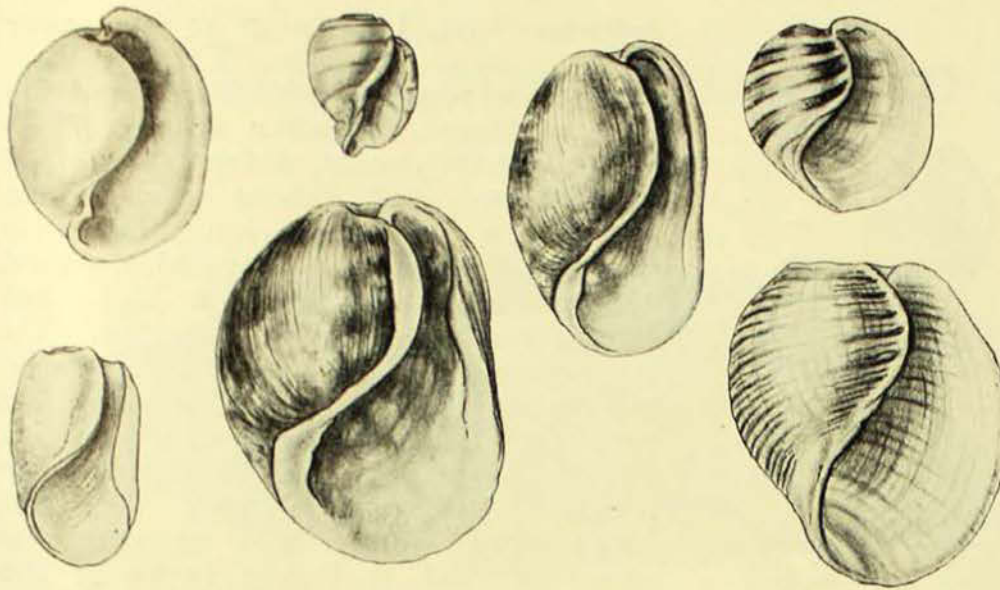
Hydatoria cinctoria is another New South Wales species which vies with its ally for beauty of colour. The dark brown and white bands of the shell render this mollusc a more striking object than *H. physis*.
Natural size.

Photo.—Thos. Dick.

nounced head disc. Fleshy lobes reflex over the shell, partly covering it, yet the animal is capable of retraction within the shell when necessary. The common Australian species is *Hydatina physis*, a species with an extremely wide range, inhabiting the Indo-Pacific from Africa to Japan and Australia. It is common on tidal flats round Sydney, where it lies sunken in the sandy mud at low tide, or amongst banked-up weed patches. The shell is cream, with dark black-brown fine revolving lines, varying in number and density of colour. I have seen specimens at Lord Howe Island with the lines quite thick and very black, contrasting beautifully with the light ground colour. Often the shell has a thin, pale yellow epidermis over it. The animal is adapted for a burrowing existence. It has a large shield-shaped tentacle-bearing head, and extremely broad, flattened foot to enable it to plough through and sink in the sandy mud. The animal is a most beautiful flesh pink colour, and when the large folds spread out round the shell, or extend over it, the effect is very striking. Round the edges of the animal is a narrow sky-blue border, and when it lies sunken just below the sand, or amongst

weed, it is very often only this border, contrasting against the surroundings as it peeps through, that indicates the presence of this shell. Alongside is frequently found, especially in spring and early summer, its equally handsome egg-girdle, delicate, creamy-white, resembling fluted tulle as it gracefully floats in shallow water or lies on sand or weed, to which it is attached at one end by a thin filament. Inside this gelatinous girdle are arranged strings upon strings of minute eggs which will eventually, under favourable conditions, hatch out; if they survive the many vicissitudes awaiting them, they will reach maturity in a short time.

A species of this family, not so common in Australia as *physis*, is *Hydatoria cinctoria*; as far as we know, it has extended its Indo-Pacific range in Australia only as far south as Port Stephens in New South Wales. This is as handsome as the former species, and is distinguished from it by its slightly smaller size and its striking pattern, four broad brown revolving bands alternating with creamy-white ones. This species also has a delicate pale epidermis over it, and the animal is similar in shape to that of *physis*, but is a brown shade, with blue borders. There is a smaller, more elongated species in this family figured here, *Aplustrum amplustre*. It is about an inch high, and the shell, when fresh, is covered by a fairly thick yellow epidermis, through which, however, can be seen the colour and pattern, striking wide bands of alternating white and pink, outlined with narrow black ones. It has a wide range through the Indo-Pacific to north-east Australia, reaching to northern New South Wales. The remaining species of the family Hydatinidae dealt with here is a very graceful, delicate shell, *Micromelo guamensis*, about three-quarters of an inch high. It is white and translucent, traversed by three well-defined narrow black lines, equally spaced, and several black undulating longitudinal lines; its range extends from the Indo-Pacific to Australia. A small, glassy shell, *Austrodiaphana brazieri*, from New



In the top row are *Atys naucum*, *Aplustrum amplustre*, *Quibulla botanica*, and *Hydatina cinctoria*; and in the bottom row, from left to right, are *Akera soluta*, *Quibulla selina*, and *Hydatina physis*.

South Wales, is included here as a representative of the family Diaphanidae.

TRUE BUBBLE SHELLS.

What are regarded as the true Bubble shells, the family Quibullidae or Bullariidae, are like those of the family Hydatinidae in shape, but are more solid in texture. The shells are uniform in colour or mottled, and have not the distinct patterns of the latter group. These species inhabit the shallow areas of sandy mud flats, where at low tide they can be lifted out from just below the surface where they have burrowed. The body is large and fleshy, and partially envelopes the shell by reflexing over it two wing-like body lobes. Copious mucus secreted by the skin of the animal keeps it moist while the tide is out.

The largest species of Bubble shell is *Quibulla selina*, better known as *ampulla*, a shell almost as large as a hen's egg, with pinky-grey mottling on a cream ground; its range extends through the Indo-Pacific to New South Wales. Two varieties of this species, *bifasciata* and *trifasciata*, are similar, except that the shells are encircled by two and three dark, very conspicuous bands, respectively.

The common Sydney species, which is found in numbers on the tidal flats at low tide, is *Quibulla botanica*; it is distributed round southern Australia. It is smaller and narrower than *Quibulla*

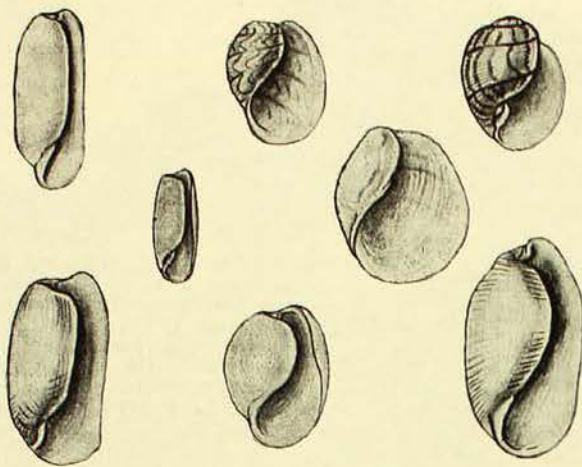
selina, and is easily recognized, but is not to be confused with a somewhat similar species, *Quibulla ovulum*, from New South Wales, which has characteristic dark spots over the usual mottling.

CANOE SHELLS.

Canoe shells are a group of light-coloured, scoop-like, gaping shells which burrow in the sand after food. There is no need to describe them fully, as their shape is quite characteristic and little difficulty should be experienced in identifying them from illustrations. Quite a number of species of Canoe shells are found in Australia, but only a few examples are included here.

The largest Canoe shell belongs to the family Atyidae. This is *Atys naucum*, a pure white, bubble-like shell, sculptured with engraved spirals, which has a distribution ranging from the Indo-Pacific to Queensland. *Aliculastrum cylindricum*, a species with the same range, is much narrower, with an elongated appearance. It is a little over an inch high, and for contrast a much smaller species, *Diniatys dentifer*, only five millimetres high, is illustrated. This species also comes from the Indo-Pacific and reaches Queensland.

In this same family are placed, according to modern classification, a small group of shells which previously went under the one generic name *Haminea*, but which has since been replaced by several names. The two species figured



The three shells in the top row are *Adamnestia peroniana*, *Micromelo guamensis*, and *Bullinula lineata*. In the middle row are *Adamnestia thetidis*, and *Philine angasi*; and in the bottom row, *Liloa cuticulifera*, *Penthominea wallisi*, and *Aliculastrum cylindricum*.

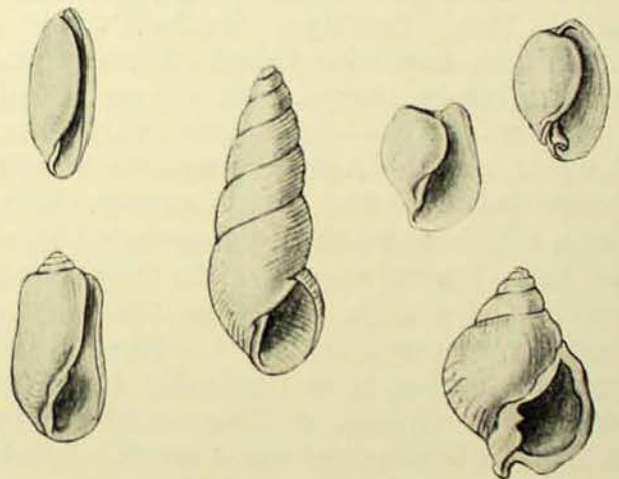
here are an easily recognized, thin, smooth, white, translucent shell from Australia, *Liloa cuticulifera*, which is about an inch long, and a smaller, more globular, pinky-yellow species from New South Wales, *Penthominea wallisi*.

Other Canoe shells dealt with here belong to the family Scaphandridae. These are very similar to those in the family Atyidae, which only in recent years have been elevated from the Scaphandridae to a family of their own. The shells are long and narrow, with a narrow mouth-opening as long as the shell, and the species are *Adamnestia peroniana* and *Adamnestia thetidis*, two well-known southern Australian forms; the former occurs in Queensland also.

One of the most graceful shells of southern Australia belongs to the family Akeridae, a family containing only a few species of fragile shells. This species, *Akera soluta*, is thin and papery, creamy-white to pale buff in colour, crossed by very fine, closely set revolving lines throughout its length, and has a peculiar, characteristic slit running round the sutures of the spire. The animals are similar in general shape to others mentioned here; the young ones are said to use the extended body lobes as swimming organs, flitting about like butterflies. The adults lead a more

sedentary life, burrowing in the sandy flats.

The few remaining shells figured are from southern Australian waters. These are *Volvulella parata*, which is white and canoe-shaped, and *Retusa apicina*, both only a few millimetres long; *Leucotina concinna*, narrow, elongated, several whorled, and half an inch high; and *Philine angasi*, a degenerate type. The last represents a form in which the shell has evolved into a more or less internal one, enveloped by the skin of the animal. *Philine angasi*, which belongs to the family Philinidae, is very thin and fragile, pure white, and so simple in structure that it barely turns in sufficiently to form a whorl. The outer edge is expanded considerably. It belongs to a soft, fleshy-white animal, an inhabitant of the sandy mud of tidal flats, where it can often be found by simply pushing a



Two small species are in the top row, *Volvulella parata* and *Diniatys dentifer*; in the middle row two others, *Leucotina concinna* and *Austrodiaphana brazieri*, and in the bottom row are *Retusa apicina* and *Ringiculadda semisculpta*.

finger just below the surface of the sand. It is a typical burrowing animal, with broad foot, shield-shaped head, and the shell hidden under the skin on the hinder part of the body. Beside it in the spring or early summer there may be seen frequently its peculiar balloon-shaped, gelatinous egg-mass, within which, a short time after laying, may be seen thousands of tiny eggs arranged in fine strings. This structure, which is about two inches long, is attached to its sandy base by a thin filament.

A Trumpeter with Two Mouths

By GILBERT WHITLEY



A Trumpeter (*Latris lineata*) with two mouths, from Dunedin, New Zealand.

FISHES with two mouths, one above the other, are extremely rare. Nevertheless several cases have been reported from our waters, and the Australian Museum recently received one from the Portobello Marine Biological Station, New Zealand. Caught off Dunedin, this fish was a Trumpeter (*Latris lineata*), and its isthmus or "chin", through some accident (or injury since healed) had separated from the lower jaw and dropped down so that a two-mouthed appearance resulted, as shown in the photograph. How well equipped this fish would be for "blowing its own trumpet", could it but tell us of its strange fate; or, as one person remarked, it has "one mouth for feeding, and t'other to spit". Apparently its freak face was no disability, since the fish was of fair size, albeit a trifle thin.

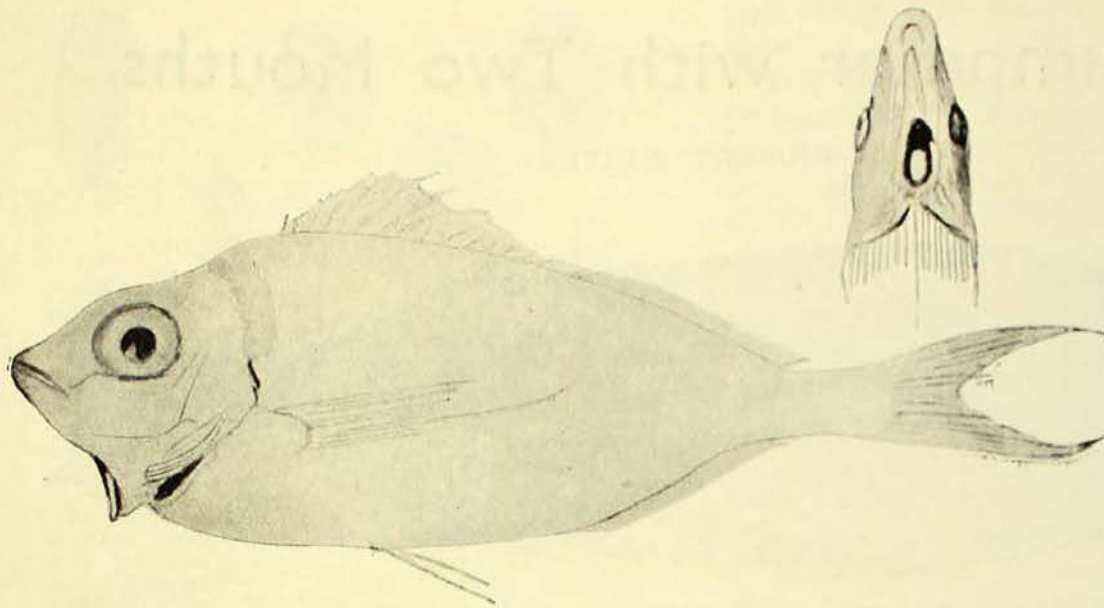
The first case of a two-mouthed Australian fish (apart from the two-headed freaks I discussed in an earlier MAGAZINE) was a Morwong (*Sciaenoides macropterus*) which, according to the Tasmanian geologist, R. M. Johnston [MS. quoted in *Proc. Roy. Soc. Tasm.*, 1928 (1929), p. 55, pl. iv, fig. 5],

was captured in the estuary of the Derwent on the sixth Feby. 1885. The ordinary mouth was perfectly sealed, and a new deformed mouth had been developed under the lower jaw at the base of the triangular area between

the lower mandibles near the junction with the gill-openings. The abnormal mouth was not armed with bony jaws or teeth, but the tongue was perfectly developed and protruded slightly. The tongue and mouth were of an inky black colour like the interior part of mouth and throat of the ordinary species. It is difficult to say whether the normal mouth was permanently sealed or otherwise, but it is quite possible that the aperture was accidentally formed under the jaw and under such circumstances that the necessity of existence rendered it necessary to close the normal mouth, and led to the formation of a new one at the accidentally formed aperture. The abnormally formed mouth seemed to answer its purpose satisfactorily, for the animal otherwise appeared perfectly formed, and was in a healthy condition.

A Butter Fish (probably *Coridodax pullus*) with two mouths was reported from New Zealand in 1899 by Drew (*Fourth Ann. Rept. Wanganui Public Museum*, p. 27), but he gave no details, nor even said whether butter would melt in either mouth.

R. M. Johnston [*Proc. Roy. Soc. Tas.*, 1908 (1909), p. iv] also noted a Mountain Trout (*Galaxias truttaceus*) with two mouths, from Tasmania. Unlike our other examples, this was a freshwater fish. Another Australian case occurred in January, 1938, when a Redfin, the introduced English Perch (*Perca fluviatilis*), was caught at Mungabareena, Albury, New South Wales, and was found to have two mouths. Mr. W. H. P. Kinsela kindly



R. M. Johnston's drawings of a two-mouthed Morwong from the Derwent River, Tasmania. From Proc. Roy. Soc. Tas., 1928 (1929), pl. iv, fig. 5.

drew my attention to a photograph of it in the *Albury Border Morning Mail* for January 21, 1938. Thus we now know of five cases of two-mouthed fishes in Australia and New Zealand, two of them from fresh water.

Turning to other countries, we find that Dr. E. W. Gudger, the great bibliographer of fishes at the American Museum of Natural History, New York, has gathered together all the cases known to him in the *American Museum Novitates*, No. 444, 1930. These include the earliest known record, that of a Mediterranean Angler Fish (*Lophius*) which was caught in 1806 and had a huge head with two ample mouths. Dr. Gudger also noticed a two-mouthed Perch (*Perca flavescens*) from Lake Erie, a Pout (*Gadus luscus*) from the Isle of Wight, Trout (*Salmo fario?*) from Sweden, and a two-mouthed Grayling (*Thymallus vulgaris*), also from Sweden. He gave pictures of some of

these curious creatures, and remarked on the feature common to all:

... the hyoid apparatus with attached gill-bars has been forcibly torn away from the mandibles and remains displaced at some distance from the lower jaw. This gives a functional lower mouth, but one which remains permanently open since it lacks any muscles which would bring it in opposition to the lower and inner edges of the mandibles. One can conceive that such a fish swimming along might automatically engulf quiescent organisms or bits of dead food. Certainly there can be no prehension by this lower mouth, and in fact any food prehended by the upper and lower jaws would, since there is no tongue to work with the jaws, fall into the enlarged buccal cavity and, if active, swim away. Presumably such a deformed fish must feed mainly by sucking in food by the action of its gill-covers.

In this connection it should be noted that three out of the five fishes described were taken on a hook—it is definitely stated that each was hooked in the lower mouth. This would seem to show that this aperture is the one most used in feeding.

The second mouth must be the result of some injury or accident, presumably in adult life, certainly long since hatching.

A GALLERY OF GUM TREES. By A. W. D'Ombraïn. (Australasian Medical Publishing Co., Ltd., Sydney; 1938.) 8vo, pp. 53, with 21 coloured plates. Price 12/6.

THIS publication, which was reviewed in this MAGAZINE, Vol. vi, No. 12, October-December, 1938, p. 422, is now available in a cheaper edition at the above price. The only difference between this and the first edition is in the cover, which is of stout board.

THE 1940 Session of Popular Science Lectures is now open, the syllabus of which is announced elsewhere in this issue.

These lectures, which were inaugurated many years ago, are but one of the Australian Museum's educational activities. Admission to them is free. The rich and interesting collections of the Museum are drawn upon to illustrate them, and these are amplified additionally by means of cinema and slides.