

*The*  
**AUSTRALIAN  
MUSEUM  
MAGAZINE**

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



**Charles Sturt, Explorer and Naturalist**

*W. A. Rainbow*

**Do We Eat Enough Fish? - - -**

*T. C. Roughley*

**The Bronze Cuckoos of Australia**

*K. A. Hindwood*

**A Termite Nest Exhibit - - -**

*Anthony Musgrave*

**Termite Cities of the Plains - -**

*Keith O. McKeown*

**The Teeth of Fishes - - - - -**

*G. P. Whitley*

**Mount Kosciusko in Summer and Winter**

*Anthony Musgrave*

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# The AUSTRALIAN MUSEUM

COLLEGE STREET, SYDNEY

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# THE AUSTRALIAN MUSEUM MAGAZINE

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the Secretary.



Model of nest of the Milk-Termite (*Coptotermes lacteus*), based on a cast taken at Matcham, near Gosford, New South Wales. An exhibit recently placed on view in the Australian Museum.

[Photo.—G. C. Clutton.]



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VOL. IV, No. 3.

JULY-SEPTEMBER, 1930.

## Charles Sturt, Explorer and Naturalist

By W. A. RAINBOW.

**S**TURT was one of the most intrepid and resourceful of Australian explorers and his various expeditions, which involved no small amount of hardship, added materially to our knowledge. To his zeal for geographical discovery was added an innate love of natural history, which was evident throughout his whole life.

Born in India in 1795 he was not yet twenty when he embarked with his regiment, the 39th Foot, for Quebec, a loyal province then being attacked by the Americans. In the fighting he very nearly lost his life. Napoleon's escape from Elba saw him next in France, his regiment forming part of the army of occupation. Whilst his brother officers were suffering from *ennui*, consequent upon the long spell of idleness in garrison, Sturt found much to interest him in natural history and drawing. He arrived in Sydney in 1827 and Governor Darling was not slow to perceive his many qualifications, appointing him military secretary. Staff duties occupied him for some little time but these had no

attraction, and it is not surprising to find him hankering to solve the problems that lay away in the unmapped interior. The Governor, in appointing him to the leadership of an expedition to continue Oxley's work on the course of the Murray, said: "Captain Sturt, from his scientific knowledge, appears to be fully competent to the undertaking . . ."

On his second expedition, the exploration of the Murrumbidgee River, 1829-1830, he was accompanied by George Macleay, then a youth, but who was later knighted and became a trustee of this Museum. Sturt's expeditions had impaired his health, but, being the soul of energy, he once more took on routine duties and was appointed to Norfolk Island, then a penal settlement where a minor insurrection had broken out. Though, as is well known, this station, even for its type, was undesirable, Sturt found opportunity to indulge his tastes, so whilst his comrades chafed under the irksomeness of their duties, Sturt's natural bent brought him solace. Having restored control, he



Captain Charles Sturt.

Member of the first committee of the Australian Museum and Botanic Gardens, 1836.

[After Crossland.]

returned to Sydney in January, 1832. His health was still far from being normal, his sight was in jeopardy, and he was so ill that in March he returned to England on sick-leave. Here he married, subsequently sailing for Australia in 1834 to take up a grant of 5,000 acres somewhat belatedly offered him by the Government. It was his intention to settle on the Hunter River, and to his brother William, in India, he appealed for seeds, plants, and various birds, such as jungle fowl, peacocks, ducks, pheasants, and so on. Had he adhered to this intention, instead of settling at Bargo, near Mittagong, it would have been better for his fortunes, but in 1837 he disposed of this property and took up residence at Varroville, near Minto, where he indulged his tastes for horticulture and natural history. It was here that the eminent ornithologist, John Gould, visited the explorer in 1838. He was greatly impressed by Sturt's fine water-colour drawings of Australian Psittacidae and was anxious to acquire them. But they had a value far in

excess of monetary considerations and the explorer would not dispose of them. However, they were subsequently stolen and, despite efforts, no trace of them has been discovered—a matter for regret. It was about this period that Sturt became associated with the Australian Museum, being on the first committee. A facsimile of the proclamation in the *Government Gazette* for 1836 is here reproduced.

Sturt attended but few of the committee meetings, probably due to the remoteness of residence, Bargo and Minto in those times not being linked to the metropolis as they are today. But, referring to the minutes of the meetings, it is not difficult to discern items which he doubtless sponsored. Thus on August 17, 1836, we find that the Museum Committee resolved: "That it be suggested to the General Committee the propriety of an application being made to the Government to direct the Commandants at Norfolk Island and Moreton Bay to employ a convict at each of those settlements to collect specimens for the Australian Museum, and to transmit such as may be obtained, & that Duplicates may also be sent. The Committee to supply Powder, Shot & Arsenical Soap &c." As indicative of Sturt's love for natural history, we find from the minutes of November 7, 1838, that "specimens of British birds were offered for sale by Mr. Drew to the Committee of the Australian Museum, but it is the desire of the committee that a communication should be made to Capt<sup>n</sup>. Sturt relative to his collection of British Birds previous to the committee deciding on the purchase." Unfortunately, it is impossible to say what was the outcome of this.

In 1844, Sturt led his Central Australian Expedition. Sir Ralph Darling, in urging upon Lord Stanley the importance of this exploration, said: "The undertaking is worthy of your patronage, and I know of no one better qualified than Captain Sturt to carry it into effect. . . . His mind appears naturally inclined to such researches . . . his scientific knowledge and disposition give the best assurance of his probable success. . . ."

The accounts of his various journeys contain numerous references to our

flora and fauna; when he was living on his various properties we find him writing his relatives and friends abroad beseeching them to remember his taste for specimens of natural history, plants and seeds; on his various journeys his thoughts were always for his family, and in contact with the natives he was ever careful to engender the best of feelings. The botanist, Robert Brown, associated his name with the genus *Sturtia*, which Mr. E. Cheel, of the Botanic Gardens, tells me the late Baron F. von Mueller placed in the genus *Gossypium* attaching Sturt's name to it specifically, but it is now known as *Cienfugosia gossypoides*. To the layman the attachment of his name to that beautiful flower, Sturt's Desert Pea, is familiarly known; and just recently Mr. T. Hodge-Smith, Mineralogist of this Museum, in remembrance of the fact that this year is the centenary of his Murrumbidgee-Murray River exploration, has named a new mineral from Broken Hill, Sturtite, Sturt being the first white man to enter the now famous mining centre.

*Colonial Secretary's Office,  
Sydney 14th June, 1836.*

**H**IS Excellency the GOVERNOR directs it to be notified that the following Gentlemen have been appointed "A COMMITTEE OF SUPERINTENDENCE OF THE AUSTRALIAN MUSEUM AND BOTANICAL GARDEN," viz.:—

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*By His Excellency's Command,  
ALEXANDER M'LEAY.*

## Do We Eat Enough Fish?

By T. C. ROUGHLEY.

**T**HE purpose of this article is to show that fish possess many virtues as a diet, and that a more liberal consumption of fish in Australia will be attended, in many cases at least, by a general improvement in the health of the people. But first let me dispel a popular misconception about fish being of particular value as food for the brain. Owing to its high phosphate content, the early investigators were led to assume that fish had marked virtues as a brain food, but we now know this to be incorrect.

Fish may, from the aspect of diet, be divided into fat fish and lean fish.

Fat fish include herrings, pilchards, and mackerel, while lean fish embrace such species as the snapper, bream, and whiting. The amount of fat may vary in different species from one to twenty per cent., and, whilst lean fish are more easily digested than fat fish, the latter are richer in the fat-soluble vitamins A and D, which occur in far greater abundance in some fish liver oils than in any other substance found in nature. The proteins of fish, although proportionately somewhat less than in beef or mutton, are in a form which satisfies the total protein requirements of the human body, and they are

almost completely digested. The fats, too, are abundantly assimilated. Fish, however, like most other forms of meat, are very deficient in carbohydrates.

Associated with the proteins are other substances which are of particular value in the human economy. First may be mentioned the high iodine content, which in salt-water fish is fifty times greater than in milk, eggs, or beefsteak. Although the body requires only about one part of iodine in 3,000,000 parts of the body weight, it nevertheless must obtain that amount, or sickness is certain to ensue. Food and drinking water in some parts of Australia and Tasmania do not contain sufficient iodine to satisfy the body's requirements, as a result of which people who dwell in these localities are prone to develop enlarged thyroid glands, known as goitre, accompanied by other body ills. A regular fish diet will prevent the development of goitre. Goitre is extremely rare in Japan, which is probably the greatest fish-eating country in the world. There the consumption of fish is about ten times greater than that of meat. Contrast this with the Australian consumption—here, we consume about seventeen times as much meat as fish. Indeed, Australia is probably the poorest fish-eating country in the world, our annual consumption amounting to only fourteen pounds per head of the population, while that of New Zealand and Canada is twenty-five pounds, and Great Britain about forty pounds.

#### FISH MEAL.

Not only are there belts in Australia where goitre occurs amongst human beings, but in these areas cattle also suffer from this complaint. With an added diet of fish meal, however, the cattle obtain the requisite amount of iodine, and goitre and its attendant ills are avoided. Fish meal, too, possesses other valuable nutritional virtues, and it has been shown that heifers whose ordinary feed was supplemented by fish meal, were found at the end of twelve months to be  $2\frac{1}{2}$  inches in excess of the standard height, and 300 pounds in excess of the standard weight. The iodine content of cow's milk also increases greatly on a fish-meal

diet, for it has been found that milk obtained from cows fed for eighteen months on an added diet of fish meal contained ten to fifteen times as much iodine as normal milk.

#### REFRIGERATION.

In view of the large amount of fish consumed in some form of preserved condition, it will profit us for a moment briefly to examine the principal methods of preservation. Fish may be preserved over long periods by cooling to a temperature which retards bacterial action and autolysis, and the question arises as to the quality of such cooled or refrigerated fish. There is not the slightest doubt that the refrigeration of fish as commonly practised in Australia, that is, air refrigeration, does cause marked deterioration, for the keeping qualities of such fish on defrosting are lowered appreciably, and the flavour is much poorer. It is all a question of the rapidity of freezing. Air, a bad conductor of heat, chills the fish but slowly, and large ice crystals form in the tissues which rupture them and lead later to rapid deterioration. If, however, fish are frozen in brine or by some other quick-freezing process, the temperature is lowered so rapidly that the ice crystals either do not form, or else they remain so small that the cells in which they occur are not ruptured. Such fish, when glazed by dipping in water, may be stored in refrigeration chambers for periods of six to twelve months without loss of flavour, consistency, or keeping qualities when defrosted. It is almost impossible to distinguish these fish, when eaten, from perfectly fresh fish.

#### SALTING.

It has been known from very ancient times that salt will preserve fish, but even now few people understand the preservative action of salt. Salt does not preserve fish in the same way as alcohol or formalin, for instance; it preserves solely by the extraction of water. By a principle called osmosis, the water leaves the fish when it is surrounded by strong brine, and a certain amount of salt enters the fish. With the loss of moisture,



the development of bacteria and mould is prevented. Fish preserved by salt is not so nourishing as fresh fish, for a considerable amount of protein substance is lost during treatment.

#### SMOKING OF FISH.

Enormous quantities of smoked fish are consumed throughout the world annually, and here again the fish are preserved by drying. Smoked fish are always first soaked in strong brine, which extracts some of the moisture; smoking itself may extract a further amount, and in addition, wood creosote is deposited in the tissues, and this further assists the keeping qualities. Kippered herrings are herrings which have been soaked in strong brine for about an hour, and then smoked for from six to sixteen hours.

Smoking of two types is in common use, hot smoking and cold smoking. In cold smoking, the fish are hung some distance from the fire and the temperature never exceeds 80° F.; in hot smoking, the fish are kept close to the fire, and are wholly or partially cooked. The time required for cold smoking may vary from a few hours to several weeks, whereas hot smoking is always completed within a few hours.

#### COD AND SHARK LIVER OIL.

Mention has already been made of the fact that the fat-soluble vitamins A and D occur in greatest abundance in some fish liver oils. Cod liver oil, for instance, has long been renowned for its great medicinal value in certain disorders, and this value is dependent on its high vitamin content. It was recently shown by experiments carried out at the Sydney University, however, that the oil from the livers of the whaler and tiger sharks, two of the commonest sharks captured on the New South Wales coast, is as rich in these vitamins as cod liver oil. When properly extracted, shark liver oil is colourless and is practically odourless and tasteless.

#### THE OYSTER.

The oyster, the world's greatest delicacy, has many virtues. For ease of digestion and palatableness, it probably has no

peer; it contains about two hundred times as much iodine as milk, eggs, or beef, and its mineral constituents are of great value to the human body.

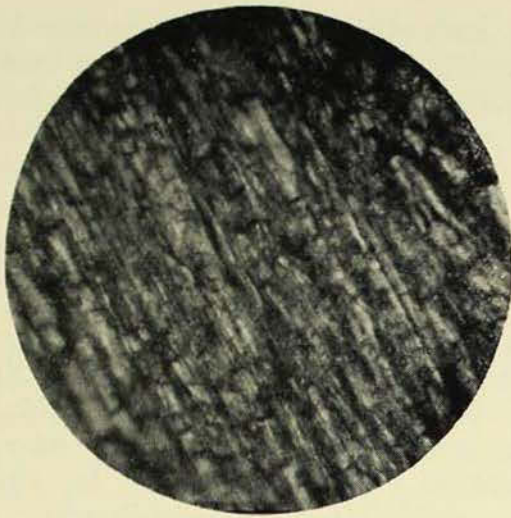
#### AUSTRALIA'S RESOURCES.

Clearly we in Australia do not eat enough fish. We should break away from our meat-eating habit and more often include fish on our menu. The human body responds to a change of diet, particularly when that diet has high nutritional qualities. Fish is rich in easily assimilated nourishment; it is rich in iodine and in bone-forming calcium phosphate; and it may be stated with confidence that the health of the Australian people generally will be improved by its more liberal consumption.

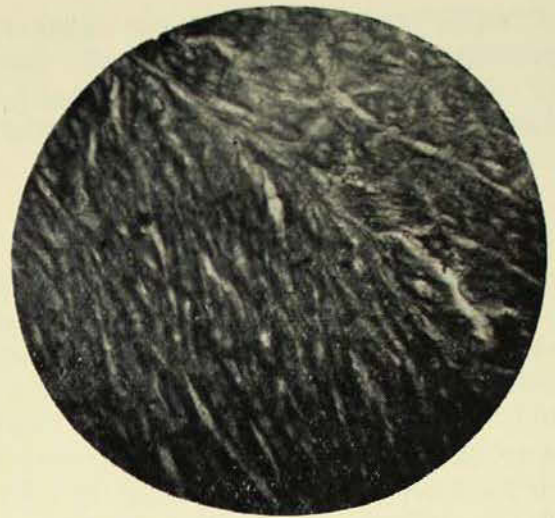
If, then, fish is such a desirable food, we may naturally inquire whether our Australian resources are capable of satisfying a largely increased demand, particularly in view of the fact that, even with our present low consumption, the value of the fish we import is greater than that which we catch. All the evidence we have leads us to believe that our resources are capable of supplying considerably more than our present requirements, but it is evident that in many branches of the industry much investigation will have to be carried out before these resources can be exploited fully and with a reasonable certainty of financial success.

Our resources are either sufficient or insufficient to meet our requirements. If they are sufficient, then it is to our great discredit that we are importing such huge amounts of fish; if they are insufficient, the quicker we determine the question the better, for then we shall no longer upbraid ourselves for our lack of enterprise. Careful investigation and systematic exploration alone will settle the question for us.

It is very gratifying to note that steps are being taken to prepare for a systematic survey of our marine resources, for it has just been announced that the Federal Government has decided to build an investigation trawler for this purpose. The extremely valuable work carried out



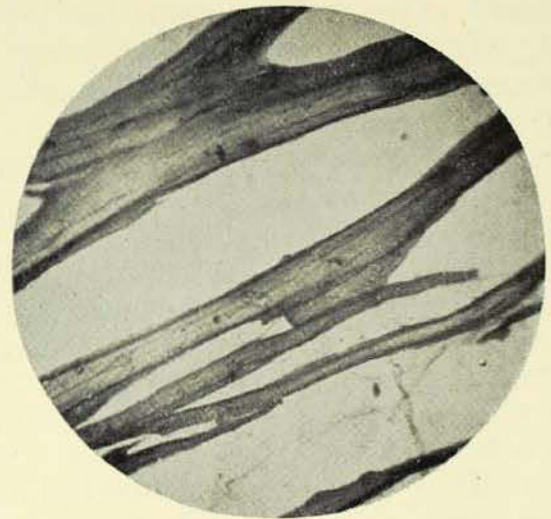
Snapper : Brine frozen, longitudinal section. ( $\times 70$ )



Flathead : Brine frozen, longitudinal section. ( $\times 70$ )



Snapper : Air frozen, longitudinal section. ( $\times 62$ )



Flathead : Air frozen, longitudinal section. ( $\times 62$ )

Microscopic sections of the flesh of the snapper and flathead ten months after freezing in air and in brine. The sections of air-frozen fish show the flesh badly ruptured by the formation of large ice crystals, while the brine-frozen flesh remains very compact.

[After Young and Empey.]

by the Commonwealth Investigation Trawler "Endeavour" from 1909 till 1914 will now be continued, and the fishing grounds round the Australian coast will be systematically explored. Two economic problems of outstanding importance face an investigation trawler: (1) The investigation of the habits and movements of trawl fish on the New South Wales coast, and (2) the capture of trawl fish for the Melbourne market. In the first case, investigation is necessary to rehabilitate an already established industry, for during the past twelve months it has been on rare occasions only that a full load of fish has been procurable on the New South Wales coast, the bulk of the fishing being carried on south of Gabo; and in the second case, the

Melbourne market is at present very poorly supplied with fish.

It is to be hoped, also, that early attention will be given to a survey of our pelagic fishery resources, for it appears to be from them that our greatest development may be expected. Although we know that at times on the eastern Australian and Tasmanian coasts such fish as the pilchard occur in enormous quantities, we have no pilchard fishery because of our lack of definite knowledge of the regularity with which they occur, and of the habits and movements of these fish. An intensive investigation of our pelagic fisheries is one of extreme urgency.

There is probably no more urgent work facing the primary industries of Australia

today than the making of a complete survey of our ocean fisheries. From vague data and nebulous hypotheses we must get down to hard facts and accurately compiled figures; we must penetrate the haze which today clouds our resources, and we must compute our potential wealth as the results of our investigations reveal it.

The whole of the investigation work of our projected vessel must be on a thorough scientific basis, yet it must be eminently practical. We must ever have as our object the rapid commercialization of the wealth in our waters, and so make

an abundance of Australian fish available to the Australian people, giving employment to thousands of Australian workmen, and replacing the huge imports from overseas, which today remain a blot on our initiative and enterprise.

We hail the advent of an investigation trawler with great satisfaction.

The photomicrographs illustrating this article are from a paper entitled "The Refrigeration of Fish," in the *Journal of the Council for Scientific and Industrial Research*, May, 1929, by Dr. W. J. Young and Mr. W. A. Empey, to whom I am indebted for the loan of the blocks.

Recent visitors to the Museum included His Excellency Lord Stonehaven, P.C., G.C.M., G.D.S.O., Governor-General; Dr. R. J. Tillyard, F.R.S., Chief of the Division of Economic Entomology, Canberra, F.C.T.; Dr. W. D. MacGillivray, of Broken Hill, who, on his return from the Great Barrier Reef, spent some time studying our collection of birds; Mr. Donald F. Thomson, of the Walter and Eliza Hall Institute, Melbourne, seeking information regarding venomous snakes; Mr. H. H. Scott, Curator of the Queen Victoria Museum, Launceston, Tasmania, who examined our collection of fossil marsupials; Mr. J. S. Falkiner, Falmouth, Tasmania, an authority on Tasmanian stone implements.

\* \* \* \*

The Australasian Association for the Advancement of Science (Australia and New Zealand) met at Brisbane, May 28 to June 4. Dr. J. R. M. Robertson (Trustee) and Dr. C. Anderson (Director) attended as delegates from the Australian Museum. The gathering was very successful both as regards numbers in attendance and the interest and importance of the addresses, papers, and discussions. During and after the sectional meetings various excursions to places of interest were attended by a large number of members.

\* \* \* \*

Mr. H. O. Fletcher, Assistant in Palæontology, who was a member of Sir Douglas Mawson's recent Antarctic Expedition, returned on April 12, greatly invigorated by his stay in the South.

During the Expedition, Mr. Fletcher was employed in general biological work and in skinning birds and seals. Sir Douglas Mawson speaks highly of his services on the expedition.

\* \* \* \*

Mr. W. W. Thorpe, Ethnologist, has recently paid two visits to Murrumbidgee, near Bateman's Bay, New South Wales, where he collected a large series of aboriginal flaked implements.

\* \* \* \*

The Boy Scouts' and the Girl Guides' Associations occasionally seek the assistance of Museum officers, and recently Mr. J. R. Kinghorn, who is an examiner for Naturalist, Bird Lover and Kindness to Animals badges, has put numbers of Scouts and Guides through the prescribed tests.

\* \* \* \*

During May, Mr. J. R. Kinghorn gave a lecture to the members of the New South Wales Naturalists' Society on faunal problems.

\* \* \* \*

Dr. C. H. Kellaway, Director of the Walter and Eliza Hall Institute, Melbourne, has presented a fine series of snakes, including Death Adders, Copperheads, and Tiger Snakes.

\* \* \* \*

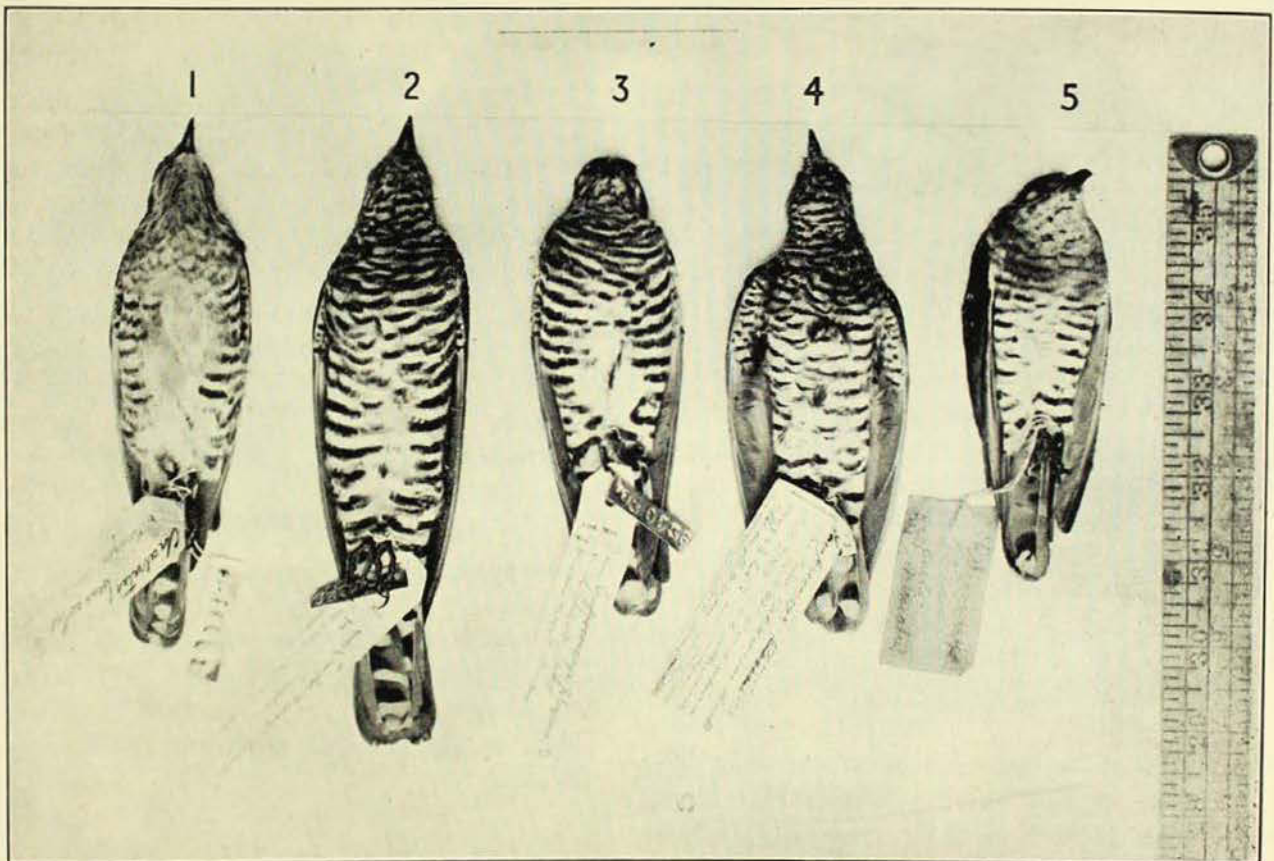
From Mr. David G. Stead we recently received a valuable collection of reptiles and amphibians from Australia and various Pacific islands and a fine series of fishes mainly from the Hawaiian Islands.

## The Bronze Cuckoos of Australia

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

SCARCELY any group of birds is less appreciated than, and so generally misunderstood as, cuckoos. We are inclined to think of them as callous murderers, wanting the finer impulses and the parental instincts exhibited in the delightful care which most birds bestow upon their young; at best they are considered lazy outcasts of birdland.

all, cuckoos are extremely fond of hairy caterpillars which few other birds eat. On examination, the stomach wall of a caterpillar-eating cuckoo is seen to be so thickly perforated with their fine hair-like bristles as to have the appearance of fur. The quantity of injurious leaf-eating larvæ consumed by a single bird is often prodigious. An American yellow-



The Bronze Cuckoos of Australia.

1. The Horsfield or Narrow-billed Bronze (*Chalcites basalis*).
2. The Shining Bronze (*Lamprococcyx lucidus*).
3. The Golden Bronze (*Lamprococcyx plagosus*).
4. The Little Bronze (*Lamprococcyx minutillus*).
5. The Rufous-breasted Bronze (*Lamprococcyx russatus*).

[Australian Museum collection.

[Photo.—K. A. Hindwood.

However, cuckoos perform two important functions in nature; the action of the nestling cuckoo in ejecting the rightful occupants from their nest is one of many natural checks on the too rapid increase of any species; secondly, they have, to a considerable degree, specialized in their feeding habits. Most, though not

billed cuckoo (*Coccyzus americanus*) was found to contain 217 web-worms, and another 250 tent caterpillars. Australian species are no less partial to such food and in consequence are very useful birds economically.

Among the thirteen species of Australian cuckoos are several kinds which keep much

to the outer foliage of trees. Were it not for their increased activity and rather disquieting voices during the spring and summer months they would be seldom noticed. These are the five bronze cuckoos: all are beautiful birds and have a general resemblance, inasmuch as the upper plumage is a striking metallic bronze green, full of lustre and varying with the species. Below they are variously marked with dark transverse bars. Only two of the five species are found about Sydney, the Horsfield or Narrow-billed Bronze and the Golden Bronze. Some doubt exists regarding the identification of these two birds in the field. If it is remembered that the Golden Bronze has most of the under-surface distinctly barred, while on the Narrow-billed Bronze the markings are much fainter and appear only on the sides of the body and the throat is flecked, there should be no real difficulty in correctly placing them.

A knowledge of their call notes is the surest way of avoiding confusion. The Narrow-billed Bronze utters a single plaintive note dropping in tone, whereas the Golden Bronze gives a series of from six to a dozen or more notes resembling the sounds "whe-e, whe-e, . . ." Both birds sing from some prominent position, generally a dead branch or the topmost part of a tree.

#### THE HORSFIELD OR NARROW-BILLED BRONZE CUCKOO.

A remarkable and no doubt very necessary performance is enacted by the hen cuckoo during the breeding period. It is then that much of her time is spent in watching her intended dupes building. Such is a proved fact, and it would seem that by this means cuckoos eliminate the distinct possibility of failure following the deposition of an egg in a chance nest. By keeping several nests under observation until they contain eggs, cuckoos are able to place an egg in each of the respective nests at such a time as will ensure their hatching slightly before or about the same time as the other eggs in the nest.



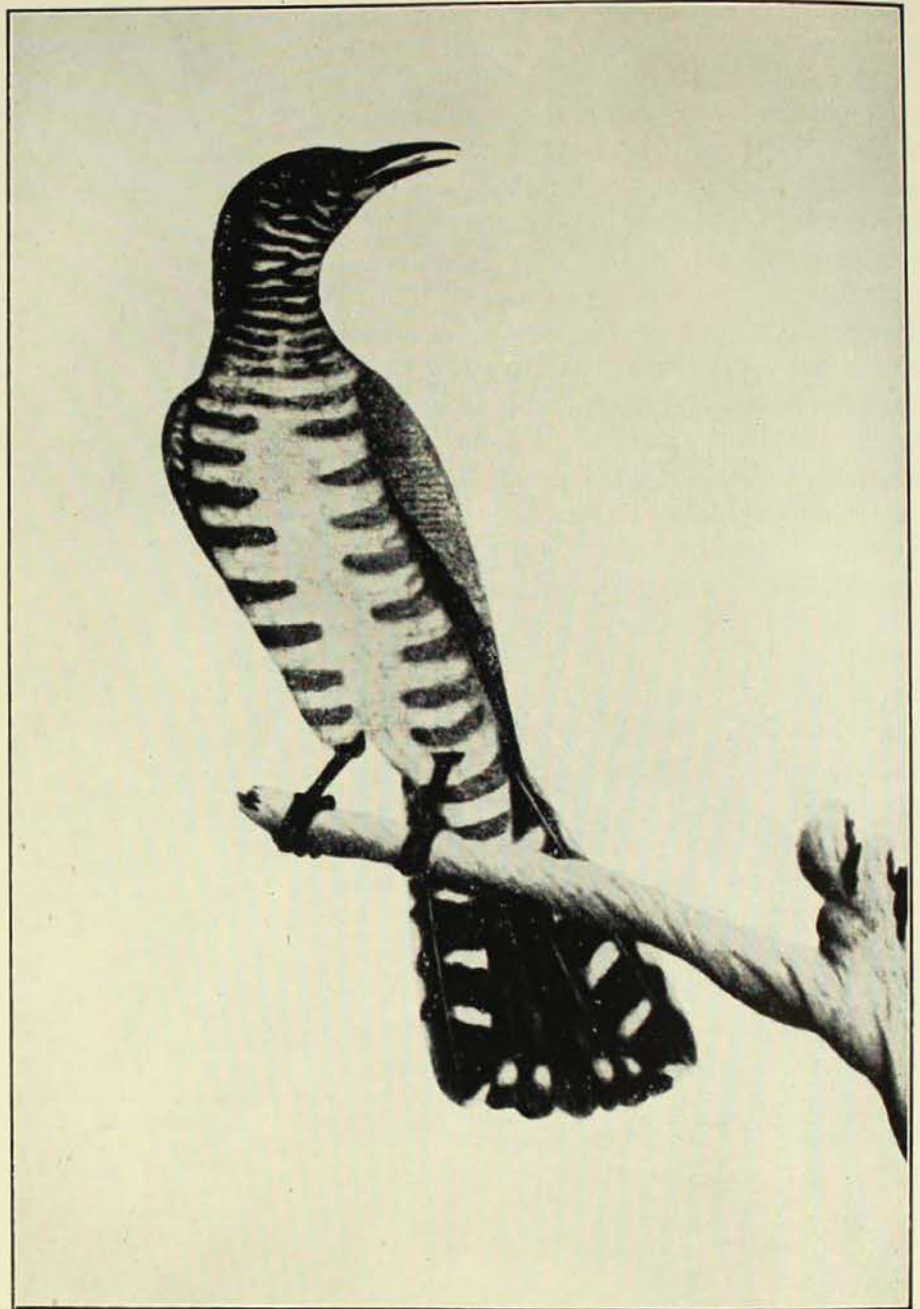
A nestling Horsfield or Narrow-billed Bronze Cuckoo (*Chalcites basalis*) in a Brown Thornbill's nest. "With persistent cries and gaping mouth it would anticipate the arrival of the active and hard-working Thornbills."

[Photo.—K. A. Hindwood.]

Recently I witnessed an incident bearing on the cuckoo's habit of visiting the nests of their intended dupes. While searching for the rarely found nest of the shy and diminutive Emu Wren (*Stipiturus malachurus*) in an area of swampy ground near Cape Banks, Botany Bay, I was surprised to see a Narrow-billed Bronze Cuckoo (*Chalcites basalis*) fluttering about on top of the stunted vegetation. From events that followed it seems that the bird was disturbed by my presence and had temporarily misjudged its whereabouts. She was peering into the tea-tree clumps, obviously looking for a nest. Retiring I watched her from cover. Unable to find her objective she flew to what was possibly an observation tree and there stayed, preening her feathers

for several minutes, then with a short gliding flight she alighted on a small thicket, and, after moving about for a few moments, disappeared. Reappearing within a minute she flew away and out of sight. Hastening to the spot I was overjoyed, for there, well concealed, lay the small-domed Emu Wren's nest for which I had so diligently searched — revealed by a cuckoo. Though empty the nest appeared to be ready for eggs. Alas! neither the emu-wrens nor the cuckoo used it, for on the following day the top was flattened. This damaging of nests has frequently been noticed, and it is apparent that cuckoos are sometimes responsible. It is equally certain that at other times birds will destroy their homes because of undue interference; especially is this so if the nest is not yet completed. That a cuckoo's egg is often found in a partly built nest, or even in an old structure, would indicate that no suitable nest was available to the cuckoo at the time of ovulation.

Narrow-billed Cuckoos seem to favour the nests of wrens and thornbills in which to place their eggs. Towards the end of last year I located a young Narrow-billed Cuckoo in the nest of a Brown Thornbill (*Acanthiza pusilla*) by hearing its thin, but penetrating squeak. Two heavily incubated eggs of the foster-parent were on the ground some twelve inches below the nest. On these being replaced the nestling cuckoo did not attempt to eject them. It seems that the instinct to cast out other objects in the nest is lost after the second day. This young cuckoo stayed in the nest for some fifteen days from the date of hatching, during which time it grew apace and to such a size that before



The Golden Bronze Cuckoo (*Lamprococyx plagosus*) from a collection of drawings of Australian birds in the Mitchell Library. Painted about 1790.  
[Reproduced by courtesy of the Trustees of the Mitchell Library.]

venturing forth into a strange world it almost filled the nesting chamber. With persistent cries and gaping mouth it would anticipate the arrival of the active and hard-working Thornbills.

The egg of the Narrow-billed Bronze Cuckoo has a white ground thickly freckled with pink or burnt umber spots, in fact it is not unlike those of the wrens (*Malurus*) other than in shape, which is the same at both ends.

Immature birds are quite unlike their parents. Above they are a dark brownish-grey with a slight overlying sheen of bronze-green, the underparts are light grey

inclining to white, without any trace of the transverse bars apparent on the adult cuckoo.

#### THE GOLDEN BRONZE CUCKOO.

The Golden Bronze or Bronze Cuckoo (*Lamprococcyx plagosus*) is more conspicuously marked than the preceding species. The rich copper of the head feathers and mantle and the green of the back are colours of rare beauty. Although ranging throughout Australia and Tasmania it is not anywhere common. Withal it is extremely useful to the vitiiculturist, for it eats large numbers of the destructive Vine Moth (*Agavista glycine*), and also the various caterpillars infesting orchards.

It has often been asserted that birds chase and attack cuckoos because of their supposed resemblance to hawks. This can scarcely be the truth, for most small birds seek cover when hawks are about; then again, cuckoos are seldom assailed except during the breeding season. While it is difficult to interpret many of the actions of birds, it seems that in an instance of this nature the cuckoo is recognized as a pest and an interloper, and as such is hounded away.

I remember watching a pair of Buff-tailed Thornbills or Bark Tits (*Acanthiza reguloides*) bringing food to a hungry nestling Bronze Cuckoo, when an adult cuckoo of the same species alighted on a branch about forty feet from the nest. The Thornbills soon espied him and their agitation and excitement did not abate till he was driven away. We frequently observe the different cuckoos being harried or hotly pursued by smaller birds.

Fledgeling Bronze Cuckoos, being pale lemon-yellow below and bronze-green above, lack the distinct markings of their parents. However, the delicate colours of adolescence, like the first faint blush of dawn, give ample promise of a resplendent maturity.

The egg of the Bronze Cuckoo is most unusual; the general colour is an olive-brown, which can be removed by moisture, disclosing a light blue hue underneath. Though the egg of this cuckoo has no resemblance to that of the Narrow-billed Bronze Cuckoo, the species of birds utilized as foster-parents are much the



A nestling Golden Bronze Cuckoo (*Lamprococcyx plagosus*) about ten days old, taken from the nest and photographed.

[Photo.—K. A. Hindwood.]

same, and are invariably smaller than the cuckoos themselves, the total length of which is slightly more than six inches.

A young cuckoo is fed by its foster-parents for some time after it has vacated the nest. This is due, in part, to its never-ceasing cries for food. So strong is the appeal that other birds, of a different kind, are often affected to the extent of bringing food to birdland's gourmand.

On rare occasions the Shining Bronze Cuckoo (*Lamprococcyx lucidus*), a New Zealand bird, has been secured from the environs of Sydney. It is hardly to be distinguished from the Golden Bronze Cuckoo other than by its slightly larger bill, more robust body, and greater length. Likewise the burnished copper colour on the back of the New Zealand bird is more extensive and pronounced, though in a wild bird it would be impossible to notice these differences.

The probable origin of the parasitizing of nesting birds by other species has for long exercised the minds of naturalists,

but despite many assumptions and considerable speculation there is still much that is obscure. From the distribution of the various unrelated groups practising the habit (cuckoos, cowbirds, some weavers, honey-guides and certain kinds of ducks) it seems obvious that parasitism has evolved separately in each instance.

With the cowbirds (*Molothrus*) of North and South America every stage from normal nesting to partial or complete parasitism is manifest in the different species. There is a fairly clear case that with these birds the habit probably had its beginning in the lack of attunement between the nest-building and the egg-laying instincts.

While the evolution of the cuckoos may have been along similar lines we have nothing like the evidence afforded by the cowbirds. Apart from two isolated normal-nesting species occurring in America and the sub-family Centropodinæ (Coucals), all members of the family have reached a stage of complete parasitism.

The several processes and adaptations necessary for the successful parasitizing of other birds have been so highly developed in cuckoos that most of the existing species, many of which are now restricted to small areas in different parts of the world, must have descended from an ancient stock.

Undoubtedly the most notable of all instincts possessed by cuckoos is that influencing the young cuckoo when but a few hours old to eject the other occupants from the nest. It is inconceivable that the cuckoo is then conscious of what it is doing. Yet the act anticipates an almost essential future need, for the greedy appetite of the cuckoo requires the undivided attention of both foster-parents. Likewise does its comparatively large bulk necessitate the sole occupancy of the nest.



Nest of the Buff-tailed Thornbill or Bark Tit (*Acanthiza reguloides*) which contained a young Golden Bronze Cuckoo (*Lamprococcyx plagosus*).

[Photo.—K. A. Hindwood.]

In attempting a solution of such a point, fanciful explanations are so much mental lumber. If we accept as the controlling factor a process of gradual evolution, then the action must have evolved by stages, from the time when the nestling cuckoo knowingly threw out the other young in the nest, to the present stage, where, not long after its emergence from the egg, its movements seem to be controlled by some inherent impulse.

The secrets of many things in Nature are hidden in the past, and so it is with much pertaining to cuckoos.



## A Termite Nest Exhibit

BY ANTHONY MUSGRAVE.

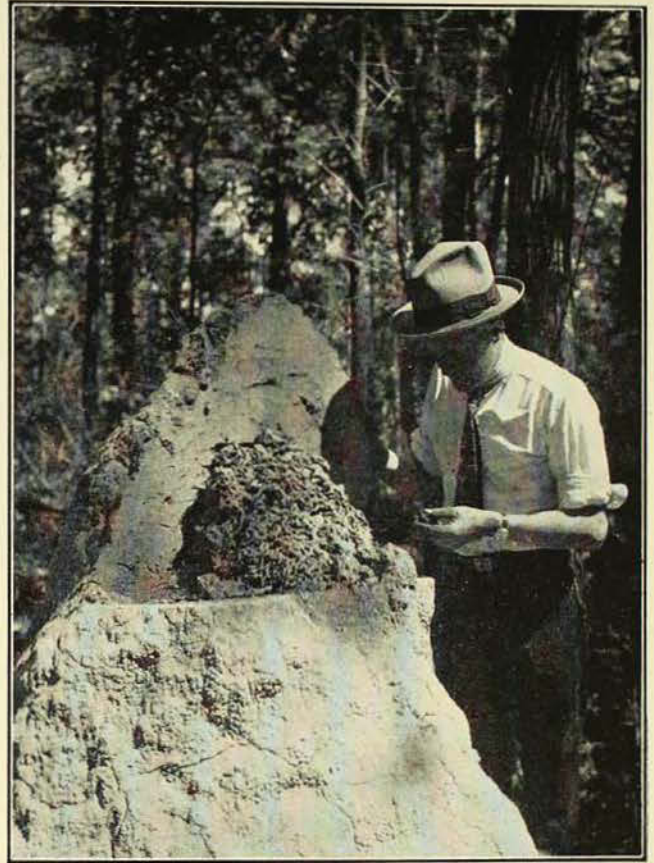
SOME time ago I visited the Gosford district with a cinematographer of Australasian Films, Limited, who took moving pictures of a large nest or *termitarium* of the Milk-Termite, *Coptotermes lacteus*, and its internal structure. It was then decided that a replica of one of these nests should be installed in the Museum so that the city dweller might have some idea of the largest type of white-ant nest found in New South Wales. Accordingly, accompanied by Messrs. G. C. Clutton and J. Kingsley, I travelled to Matcham, near Gosford, in order to take a plaster mould of a typical nest and to secure material for the exhibit.

Making an early start we selected a nest over six feet in height situated on the side of a steep hill, and our first task was to convey a supply of plaster and water to the site. Stakes were driven into the nest to act as guides for the thickness of the mould and plaster was then poured over the nest. This was reinforced by a layer of fibre, over which more plaster was poured, the whole being then allowed to set.

A colony of Hopper Ants, *Myrmecia nigrocincta*, which had their nest at the foot of the *termitarium*, gave a spice of excitement to the proceedings, until they were subdued by the simple expedient of pouring a little plaster down the nest opening.

When the plaster had set it was sawn into sections and carried on poles to the farm of Mr. Taranto, who had given us every assistance in the work. There the sections were packed in cases, and next day Mr. Taranto brought them into Gosford, whence they were shipped to Sydney.

From the moulds a cast was prepared at the Museum by Messrs. Clutton and Kingsley, and there remained only the colouring of the exhibit and the obtaining of accessories to be placed in the vicinity of the nest. Two more trips were made to Matcham to secure the necessary



When a section of the upper part of a nest is removed the thick sandy clay walls and woody galleries of the nest are exposed.

[Photo.—A. Musgrave.]

materials, Miss E. A. King accompanying the party in order to make colour sketches as an aid in her work of colouring the exhibit.

### THE INTERIOR.

A white ant's nest is usually built over a log or stump, the walls, which are about six to eight inches thick, consisting of sandy material. The interior of the Milk-Termite's nest consists of chewed-up wood, and through this the galleries of the colony run in every conceivable direction. In the exhibit a square has been cut in the sandy walls to show the appearance of the inside of the nest.

When such a nest is broken into and a section of the brittle woody interior exposed, the members of the different social castes may be met with. The most

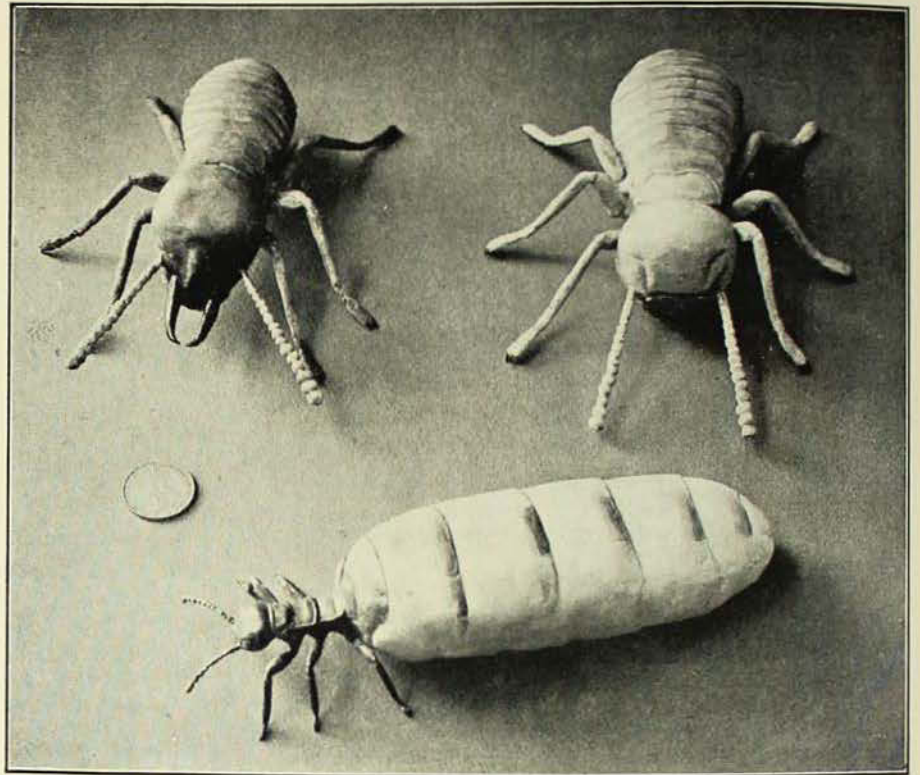
numerous are the soldiers and workers, which move actively through the ramifying passages, the former, with their hard heads and long sabre-like jaws, ejecting from the front of the head droplets of creamy fluid, while the latter, fragile larva-like creatures, endeavour to escape to the darkest recesses of the block. Sometimes heavy-bodied supplementary queens may be seen moving among the smaller workers and soldiers, but the true queens live in cells far down in the nest. Attempts to cut into the lower part of the nest to secure the queens proved abortive owing to its being placed over a large stump, the hardness of the wood resisting our combined efforts.

Sometimes nymphal forms are encountered; these later develop wings and become the males and females, the sexual forms of the colony. These winged forms usually leave the *termitarium* about dusk on a warm summer's day or after rain.

#### ANTS AND TERMITES.

The Milk-Termite, *Coptotermes lacteus*, is a not uncommon species in the vicinity of Sydney. The sexual or winged forms are identified by the smoky-black colour of their wings, and this character enables them to be readily distinguished from the winged forms of *Coptotermes acinaciformis*, another common species, which has yellow wings. These termites have been identified for us by Mr. Gerald F. Hill, of the Division of Economic Entomology, Canberra, F.C.T.

Though popularly termed white ants, termites are not to be regarded as akin to the true ants, which are members of the large order Hymenoptera, white ants being placed in the order Isoptera. The groups resemble one another in their highly evolved social communities and by their unremitting toil, but structurally they are very distinct. When a comparison



Models of Soldier, Worker and Queen Milk-Termite prepared by Mr. J. Kingsley. A two-shilling piece affords an indication of the size of these models.

[Photo.—G. C. Clutton.]

is made between a true ant and a termite differences are at once apparent. In the true ant the head is attached to the thorax by a narrow neck, whereas in the termite the head is broadly joined to the thorax; similarly, the abdomen is, in the ant, attached to the thorax by a narrow waist, but in the white ant the waist is broad.

The life history, too, presents marked differences. In the termite there is no pupal stage and the young after leaving the egg develop by a series of moults until maturity is reached; in the ant there is first a helpless grub state, and then a pupal or chrysalis condition, from which the insect arrives at the adult stage.

Termites are considered by Dr. R. J. Tillyard to be a "highly specialized offshoot of the original stem of the Orthoptera, and are rather closely related to the cockroaches; in fact, they may well have been derived from some ancient form of blattoid ancestor which took to living in communities under logs."

## TERMITE MODELS.

The small size of the soldiers and workers makes them useless for purposes of exhibition, only the queens, with their abdomens distended with eggs, being large enough to permit of any structure being seen with the naked eye. Therefore, Mr. J. Kingsley, Assistant Preparator, has, with his usual skill, constructed enlarged models of this tiny, but very

interesting group of insects. These models consist of a soldier and a worker enlarged about twenty-five times, and a queen enlarged about ten times, and these are placed, with a jar containing some queens preserved in spirit, at the rear of the nest.

In front of the termite's nest in the exhibit is placed a nest of the Gravel or Meat Ant, *Iridomyrmex detectus*, a widely distributed species.

## Termite Cities of the Plains

BY KEITH C. MCKEOWN.

IN dry summer months, on the plains of south-western New South Wales, when the grass has been eaten off or trampled by sheep and cattle in search of fodder and water, one may sometimes find the surface of the ground over wide areas covered with a close network of galleries spreading in all directions, and constructed of sand grains closely fitted and cemented together. The galleries are very fragile, the walls breaking at the slightest touch; a dust-storm will destroy them and the ground will be bare again, but by the next morning they have been reconstructed. What artisan is responsible for their construction? What is their purpose?

Break down the fragile wall of one of these passages and you will find no Cretan minotaur in the labyrinth, but numbers of curious soft-bodied creatures, insects of a white or cream colour, some with rounded heads, others with their heads brown and horny and produced into a pointed beak. They are all hurrying busily about, but promptly fall into a panic when the strong rays of the sun shine upon them, and search anxiously for the nearest cover, into which they rapidly disappear. Those with the round heads are soon out of sight, but those with the brown heads remain clustered in the breaches of the galleries. They are Termites or "White Ants" (*Eutermes* sp.); those with rounded heads are of the

worker caste, artisans and masons; those with the sharp awl-like beaks are warriors. The purpose of the galleries is to enable the termites to travel over the surface of the ground in their search for food, secure from their enemies and sheltered by day from the heat and sunlight which are abhorrent to them. Their food is vegetable matter, mainly the stems and roots of grass, and from the covered ways above ground, which may perhaps be described as "prospecting galleries," shafts are driven through the soil to tap their food supplies, while others again lead to the nest. In seasons of drought the undigested vegetable matter contained in the droppings of sheep, cattle, and horses is also exploited. Stores of short lengths of cut grass stems may be found in the nests; an insurance against lean years.

Although related to the Great Mound-nest White Ant (*Eutermes pyriformis*), a species found in North Australia, which constructs large nests, rising to a height of as much as eighteen to twenty feet above the ground, the *Eutermes* of the plains does not make a typical "white ant" nest built over some log or stump, but their colonies may be found under logs; these nests consist of an irregular series of tunnels adapted more to the space available than constructed according to any particular plan. These nests are small and usually contain only a relatively

small population, though if the population of an individual nest is limited the colonies are numerous.

It is not proposed in this article to discuss "white ants" generally, nor the organization of the nest, as these aspects have been dealt with already in the *MAGAZINE*,<sup>1</sup> but with one species only and the little that I have been able to discover with reference to its habits.

Let us watch what happens when the wall of one of the galleries is breached. After the first panic on finding themselves exposed to the sunlight has subsided, the gap in the wall is filled with a bristling rampart of the sharp, pointed beaks of the soldiers and their waving antennæ; suddenly their serried ranks open and a worker emerges and hurriedly places in position a grain of sand which is promptly cemented with a dab of plaster secreted by the insect itself. One worker retires only to be succeeded by another on a similar errand; this continues until the breach is entirely closed. Permanent repairs will be effected after nightfall.

In addition to its sharp bayonet snout, the soldier termite has additional armament in the form of an opening above it from which it can eject a milky fluid, which would appear to have irritating properties to judge from the behaviour of any true ant which may have received the full force of this milky jet. Means of defence are absent in the worker; its jaws are large and powerful, but are useful only in its occupation as navvy or bricklayer. The whole defence of the nest is carried out by the soldiers.

Sometimes one is surprised to see the plain, a day or so before smooth and level, bristling with small towers a couple of inches in height; some of them are single, while others are forked or branched, and present somewhat the appearance of small branched sponges to be picked up on our ocean beaches. A large area covered at close intervals with hundreds of these towers presents a remarkable sight and brings to mind the pictures of the termite nests on Cape York. These miniature towers are also the work of the



A small section of a termite "city," showing the towers formed by a species of "Eutermes" rising from the surface of the ground.

[Photo.—K. C. McKeown.]

termites, but are not nests comparable with Cape York structures, or that on exhibition in the Australian Museum, which are complex in construction, house the whole colony, and contain a network of tunnels, storehouses, the royal chamber, and nurseries for the eggs and young. If one carefully breaks off one of our little towers one will usually find a few termites, workers and soldiers, but seldom more than half a dozen at the most; a few will probably escape down the tunnel in the ground upon which the tower is based. The structure itself is a simple or branched tube extending upward from the underground galleries and closed at the upper end. If at some later date we examine the termite city we may find the towers filled with a bustling crowd of workers, soldiers, and winged termites. This condition is usually to be found before rain, or toward dusk when atmospheric conditions are otherwise suitable. Given favourable conditions the workers make openings in the tops of the towers, and through these the winged termites pass out into the outer world.

<sup>1</sup> Musgrave: THE AUSTRALIAN MUSEUM MAGAZINE, Volume I, No. 1, April, 1921, pp. 11-13.

It is a curious sight to see thousands of these dusky-winged insects streaming from the tops of the towers and forming a great cloud in the air, and one is reminded irresistably of smoke pouring from the smoke stacks of some miniature industrial district.

The winged termites are males and females and are setting off on their marriage flight. The towers seem to be built solely for the purpose of this flight and soon disintegrate, leaving no trace, and they are not reconstructed until a further flight takes place.

Many enemies await the travellers, birds, bats, and other enemies prey upon them as they flutter feebly through the air. There are few survivors from this host of winged termites which have left their home stirred by the urge to found new colonies and reproduce their kind, but some few there are which mate, and crawling beneath some log or stone, divest themselves of their now useless wings and form a new nest, and so their life goes on, the cycle being endlessly repeated.



A near view of some of the termite towers showing structure. A matchbox gives an indication of their size.

[Photo.—K. C. McKeown.]

## Book Review

A CHECK-LIST OF THE FISHES RECORDED FROM AUSTRALIA. By (the late) Allan R. McCulloch. (*Australian Museum Memoir V.*) Sydney, 1929-1930. Price: £2 4s. 0d.

The late Allan R. McCulloch, who was a member of the Museum staff for nearly twenty-seven years, and who died at Honolulu, September, 1925, at the early age of forty, had planned a work which was to include, as far as possible, a description and figure of every species of fish recorded from Australian waters. With this in view he had prepared a card-index to every accessible work on Australian ichthyology and a manuscript list of the genera and species.

Mr. G. P. Whitley, who for some years was McCulloch's assistant and who succeeded him as ichthyologist, has revised

this list, making the necessary alterations and additions, and it has now been published as *Australian Museum Memoir V*, 1929-1930. It has been issued in four parts and runs to 534 pages, constituting an enduring memorial to McCulloch's ability and industry, and a fine tribute to his memory by his one time assistant.

Mr. Whitley, who is a leading authority on systematic ichthyology, has performed the difficult work of revision in a very thorough manner, adding references to literature and also an indication of the distribution of each species. For the sake of completeness all species, over 2,000 in number, recorded from Australia up to the end of 1929 have been included. This *Memoir* forms a very valuable contribution to ichthyology, and will be the basis of all future work on Australian fishes.

# The Teeth of Fishes

BY G. P. WHITLEY.

**S**HARP cruel fangs, blunt molars, teeth of horses or dogs in miniature, fine bristles, grindstones, hinged canines, saw-edged shears, roughened surfaces, or parrot beaks; all sorts of teeth are to be found in fishes. The variety is bewildering and the number and arrangement of teeth in many different species suggest that there are no rules and regulations to be followed by these creatures; they seem privileged to grow teeth just where and how they please. Closer study shows, however, that the teeth of fishes are primarily outgrowths of the skin of the jaws or mouth, and that they are usually conical in shape. Sometimes they are strengthened by similar outgrowths of underlying bone which approach them or are inserted in their cores to support them, but the teeth and the jaw-bones are either quite separate or have a bone of attachment between them.

The principal kinds of teeth in true fishes are distinguished by special names. *Cardiform* teeth are long, separate, and acutely pointed; *granular* teeth are small and blunt like grains of sand; small or velvety teeth, close-set in patches or in bands, are said to be *villiform*; and hair-like or bristle-like teeth, often arranged as in a brush, are known as *setiform*. Cutting teeth in the front of the jaws are called *incisors*, and grinders at the back are known as *molars*. Although there is a succession of teeth, there is no definite dentition comparable

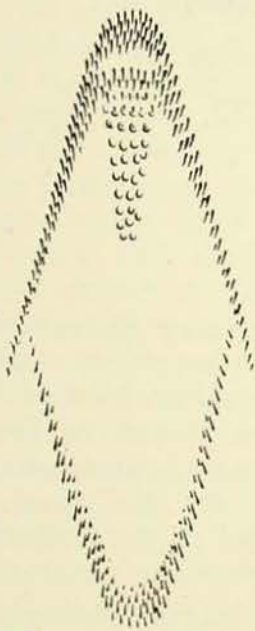
to milk teeth or wisdom teeth in higher animals.

The *canines* of fishes are pointed and longer than the other teeth. In some parrot fishes there is a *posterior canine* at the back of the beak-like jaws. Fishes' teeth may be movable, as are the incisors of some seaweed-eating forms, they may fold back on the roof of the mouth as in certain marine eels, or, as is more usual, they may be fixed immovably, like the teeth of the Snapper. Teeth are usually developed on the jaw-bones (premaxillaries, maxillaries, and mandibles) and are often present on the bones roofing the mouth (vomer, palatines, and sometimes the pterygoids), but they may also occur on the tongue, in the pharynx, or even on the gill-rakers. Some of the anchovies have long toothed jaws reaching far backward of the mouth, so that instead of being armed to the teeth they may almost be said to be toothed to the arms!

The teeth of mammals<sup>1</sup> are coated with specially developed enamel, rest in special bone-sockets and have their own nerves and blood-vessels, but fishes have not attained such a degree of specialization; they thus generally avoid having their teeth set on edge and are spared the agonies of toothache.

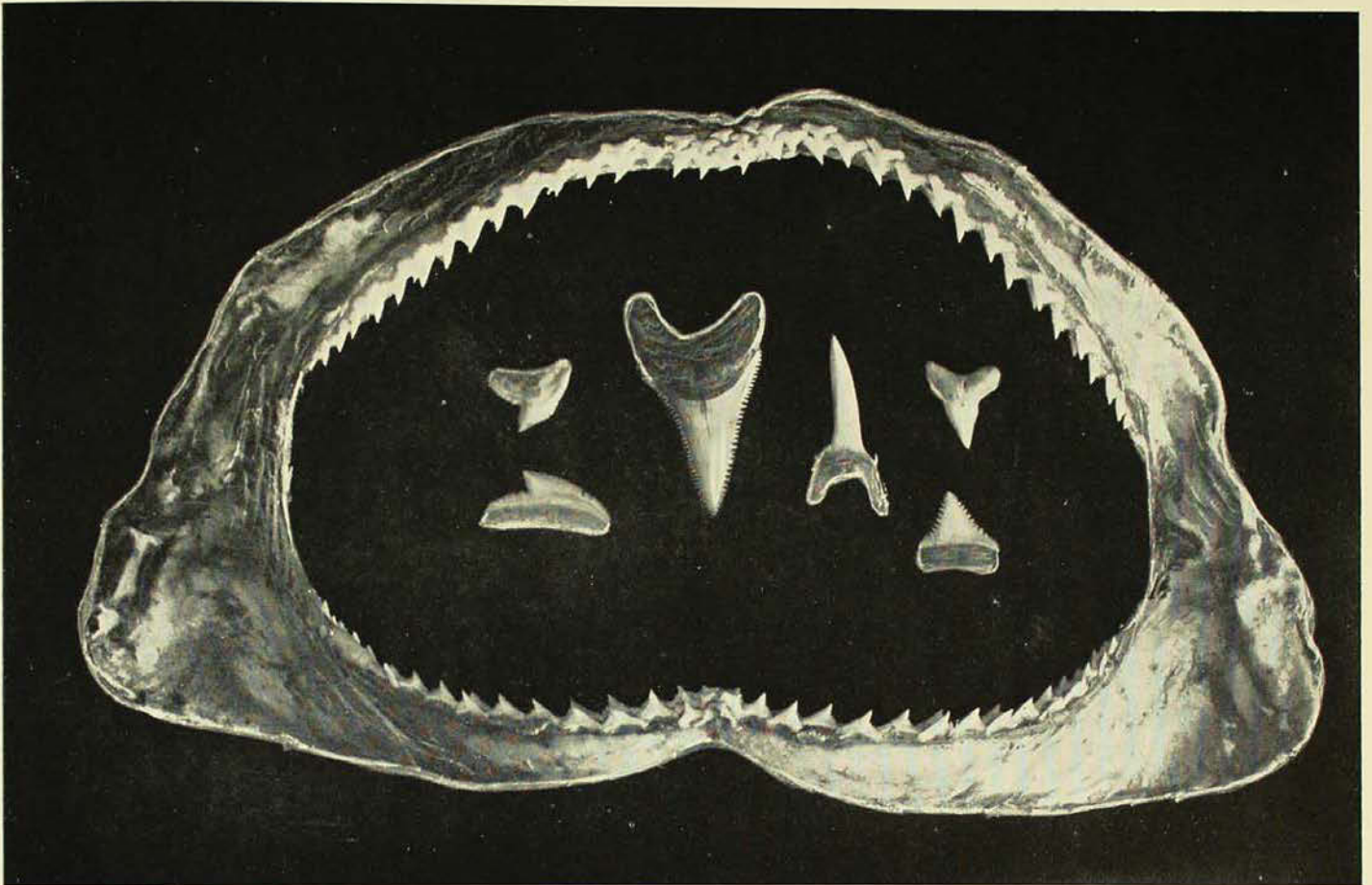
## VORACITY.

Fishes can hardly be termed sweet-tooths, as they scarcely masticate or taste their food but merely use their teeth to catch or hold it before they swallow it either whole or in large chunks. Their voracity is at times amazing. A Cucumber Fish (*Chlorophthalmus nigripinnis*), for instance, was found in the stomach of a 22-inch Tiger Flathead (*Neoplatycephalus macrodon*). The Flathead had evidently tried to swallow its victim tail first, but the Cucumber Fish must have objected vigorously and poked its head through the Flathead's pharynx



Dentition of Conger Eel (*Congermuræna howensis*). On each side of the upper jaw is a band of maxillary teeth, joined anteriorly by a group on the premaxilla; these embrace a median series of cardiform and molariform teeth on the vomer. The lower jaw has continuous bands of mandibular teeth.  
[A. R. McCulloch del.]

<sup>1</sup> Anderson, THE AUSTRALIAN MUSEUM MAGAZINE, Vol. III, 1929, pp. 389-396.



Teeth of New South Wales Sharks.

Two Tiger Sharks' teeth on left, serrated tooth of White Shark in centre, then a long Grey Nurse tooth, and a pair of Whaler teeth on right; the whole surrounded by the jaws of a Long-nosed Sea Shark (*Carcharhinus cyrano* sp. n.).  
[Photo.—G. C. Clutton.]

and gill-arches, thereby revenging itself in this extraordinary duel. The Cucumber Fish is commonly caught by the trawlers when fishing for flathead, and is so-called because it has a smell somewhat similar to that of a cucumber. Well might the Flathead have quoted, as its swan-song, the anticlimax from the *Ingoldsby Legends*:

There's somewhat on my breast, father,  
There's somewhat on my breast! . . .  
It's that confounded cucumber  
I've ate and can't digest.

#### TEETH OF SHARKS AND RAYS.

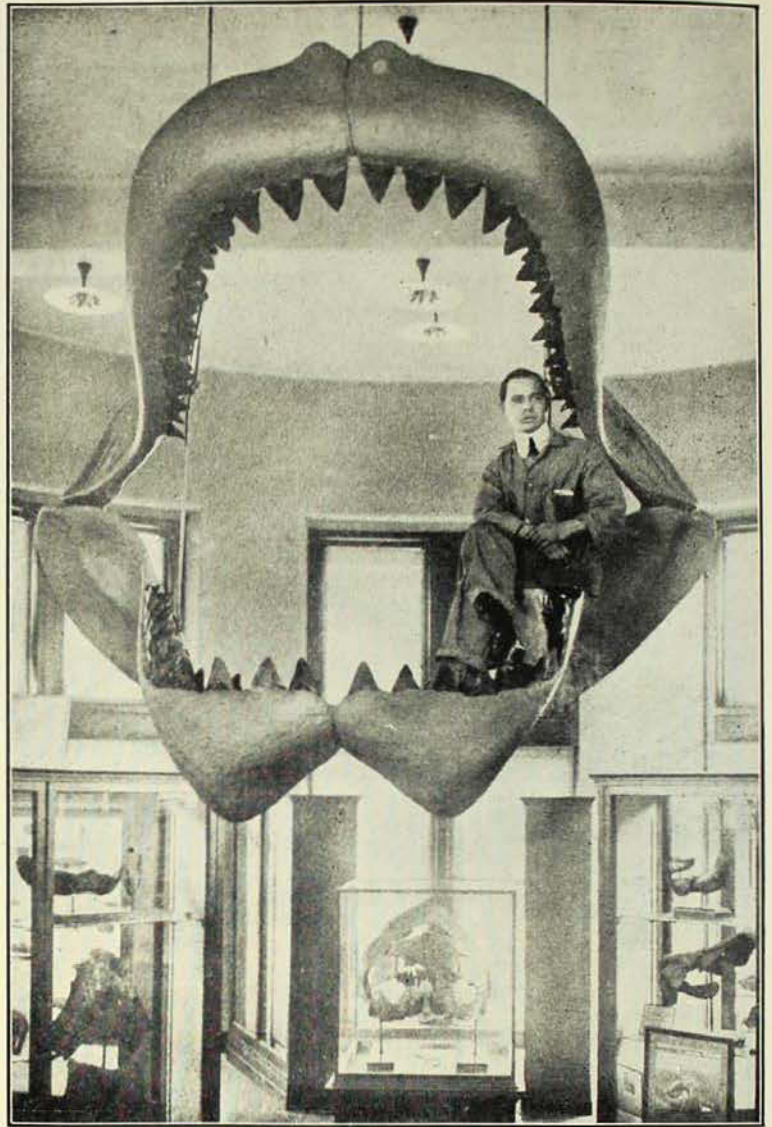
The teeth of sharks are really highly specialized denticles similar to those which occur all over their bodies and cause the rough surface of shagreen. Each denticle on the shark's skin consists of a cone of dentine capped by enamel and develops, with growth, a basal plate of bone-like substance. When the denticles occur around the jaws, they are enlarged, sharp, often serrated, and thus form

various kinds of teeth, but these, however different in appearance, are homologous with the shagreen of the shark's body. To quote Baskett's *Story of the Fishes*, the shark may often "be said to escape injury, not by 'the skin of its teeth' but by the teeth of its skin, rather."

In the Port Jackson Shark family there is a division of labour amongst the teeth; they are sharp in front for catching prey and form grinders in the back of the jaws for crushing it before it is swallowed. In most sharks, teeth grow in rows and new ones are continually being developed behind the functional teeth in each jaw. When a front tooth is broken or shed, another advances to take its place from the series behind it, and the shark is thus assured of a complete set of teeth throughout life; a vast improvement, it would seem, on the unsatisfactory dental methods employed by human beings, with their tooth-picks, dentrifices, and bridge-work.

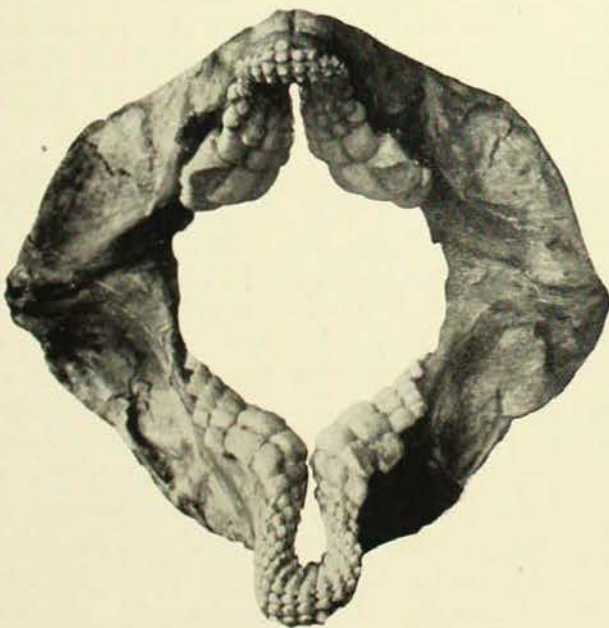
Sharks' teeth often assume strange shapes, and some of the Australian forms are here illustrated. The Grey Nurse has long, curved, pointed teeth, each with two tiny, sharp, basal cusps. The arched teeth of the Tiger Shark are saw-edged and notched, and are so sharp that it is possible to shave with them. Many species have serrated triangular teeth, which, as in the case of the Whaler, may be slightly different in the upper and lower jaws. Teeth similar to those of the White Shark (*Carcharodon*) have been found fossil or trawled from ocean depths and show that sharks of enormous size must have roamed the ancient seas: "man-eaters" far larger than any living fish or shark at present known to man.

South Sea islanders used sharks' teeth as surgical instruments or fixed them to handles to make fighting weapons. Some people still collect them as curios or ornaments, but the demand nowadays is less than it was. Some years ago, firms on the Continent actually manufactured artificial sharks' teeth for export to curio shops in Pacific countries.



Reconstruction of the jaws of an enormous extinct shark exhibited in the American Museum of Natural History. Note the large teeth, specimens of which have been found fossilized in many parts of the world.

[From *The American Museum Journal*.



Jaws of Port Jackson Shark (*Heterodontus philippi*) with sharp teeth in front and scroll-like grinders behind. The latter are somewhat worn down from crushing the hard objects upon which this shark feeds.

[Photo.—G. C. Clutton.

In rays, the teeth evolved from the dermal denticles often retain their primitive arrangement in tessellated "pavements" and, in the case of the Eagle Rays<sup>1</sup> and their allies, form flattened millstones for crushing their food. The teeth of male and female skates show marked differences; in the male they have sharp points, but they are smooth and flattened in the female.

Besides the more or less inconspicuous teeth in its jaws, the Sawfish, a relative of the sharks and rays, has a long, blade-like snout armed on both sides with a single series of prominent teeth implanted in sockets. These rostral teeth grow from

<sup>1</sup> Illustrated in THE AUSTRALIAN MUSEUM MAGAZINE, Vol. II, 1925, p. 280.



persistent pulps and are not shed or replaced, a most unusual arrangement in fishes. It is supposed that they may have been developed by the coalescence of numerous skin-denticles on the sides of the snout.

In the curious Ghost Sharks, the jaws are beak-like and fused to the cranium.

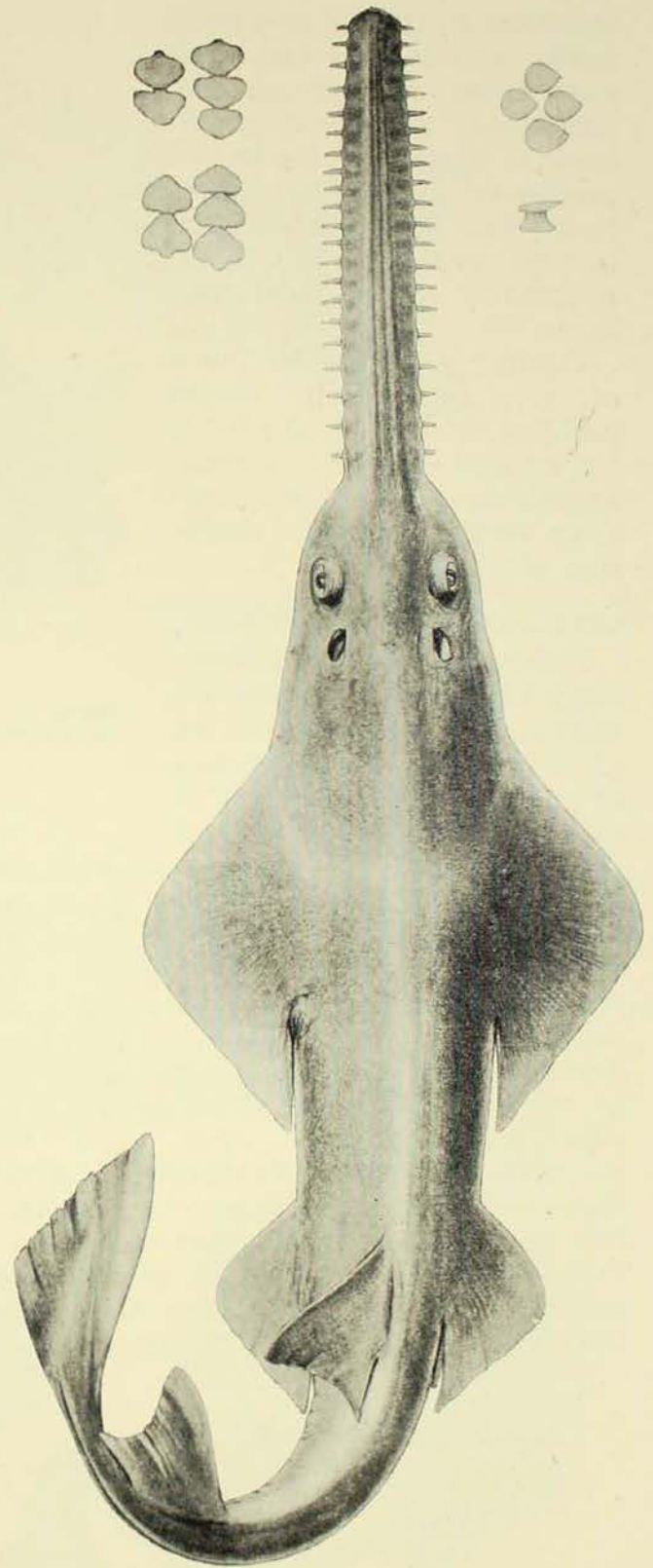
#### FOSSIL TEETH.

Sharks' teeth are commonly found in a well-preserved state in some fossil deposits and were known to the early naturalists as glossopetræ or "tongue-stones." In the eighteenth century, the subfossil pharyngeal teeth of parrot fishes were called serpents' eyes, and the stud-like teeth of ancient pycnodont fishes were known as toadstones, the jewels which the "ugly and venomous" toads were supposed to carry in their heads. We cannot, however, afford to smile at the misidentifications of our predecessors, as even nowadays fossil teeth of various kinds are found which defy all efforts at classification. Small dental remains called conodonts, for instance, have been assumed to be the tooth-like structures of fossil lampreys, but some palæontologists regard them as portions of prehistoric worms, others as crustacean appendages, and still others as molluscan fragments.

For a long time, curious dental plates of crescent shape and deeply indented, were practically all the clue palæontologists had as to the existence in prehistoric waters of the wonderful fish *Ceratodus*, but, sixty years ago, the Queensland Lungfish (*Neoceratodus*), a modern survivor of this ancient family, was made known from Australia and proved to have the same type of dentition. The crescentic dental plates were shown to have developed from the fusing of several smaller separate teeth into a complex whole.

#### LAMPREYS.

Lampreys are eel-like creatures, with no jaws, which attach themselves by their sucker-like mouths to live fishes. They have hardened processes around the mouth-opening which bear horny tooth-like structures; these are more like pointed corns than true teeth and have no genetic relationship to teeth in other



Sawfish (*Pristis clavata*) from Queensland. Whole animal showing tooth-bearing snout; also, on the left, some of the teeth from the mouth, and, on the right, a few scales from near the middle of the body. [After S. Garman.]

animals. The arrangement of these "false" teeth varies in different kinds of lampreys, but the use is much the same: to rasp holes in the sides of living fishes

and bore their way into their flesh. It has been suggested that fusion of these corn-like structures might lead to organs like the beaks of turtles or even the bills of birds, but this is mere conjecture, which, besides being unproven, seems most unlikely.

Coming now to the teeth of true fishes, it would perhaps be as well to take a few typical examples of some Australian species and consider very briefly the dentition of each.

#### TEETH OF AUSTRALIAN FISHES.

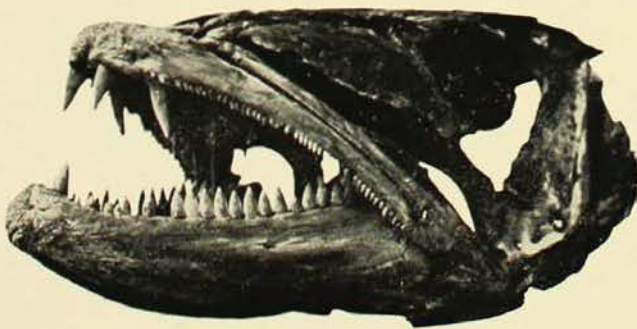
Fishes with hollow poison-fangs like those of snakes are unknown, but the marine eel or moray has been accused of possessing venom which is said to flow from a palatal gland through the mucus covering the long depressible fangs in the upper jaw. It seems probable, however, that the mucus itself is of a septic nature. The teeth of eels are often fang-like and capable of inflicting nasty wounds. These fishes are very savage and may sometimes be seen in coral waters swimming along with their mouths open and with particularly vicious expressions. Fresh-water eels have broad patches of small fine teeth and no fangs, but their larvæ, the glass eels, frequently possess long teeth, which are shed before they reach the elver stage. Catfishes usually have



Skull of Queensland Lungfish (*Neoceratodus forsteri*) to show (A) vomerine, (B) palatopterygoid, and (C) splenial teeth. These form comb-like crushers at the back of the mouth. [Photo.—G. C. Clutton.

fine or granular teeth in dense groups or bands on the jaws or the roof of the mouth, but some have peg-like or molariform teeth. Certain fishes, like some of the mullets and trevallies, are toothless, at least in the adult stages, and feed on soft material. Most of our food-fishes are well equipped with teeth. Often these are small and of delicate design, as in garfishes and flying fishes, but they may be large and dagger-like in the more voracious fishes like the Tailer and Barracouta. Snapper and Bream have thick, conical incisors for holding or levering up shellfish, crabs, and other hard-bodied animals, and rows of button-like molars in the back of the mouth for crushing them.<sup>1</sup>

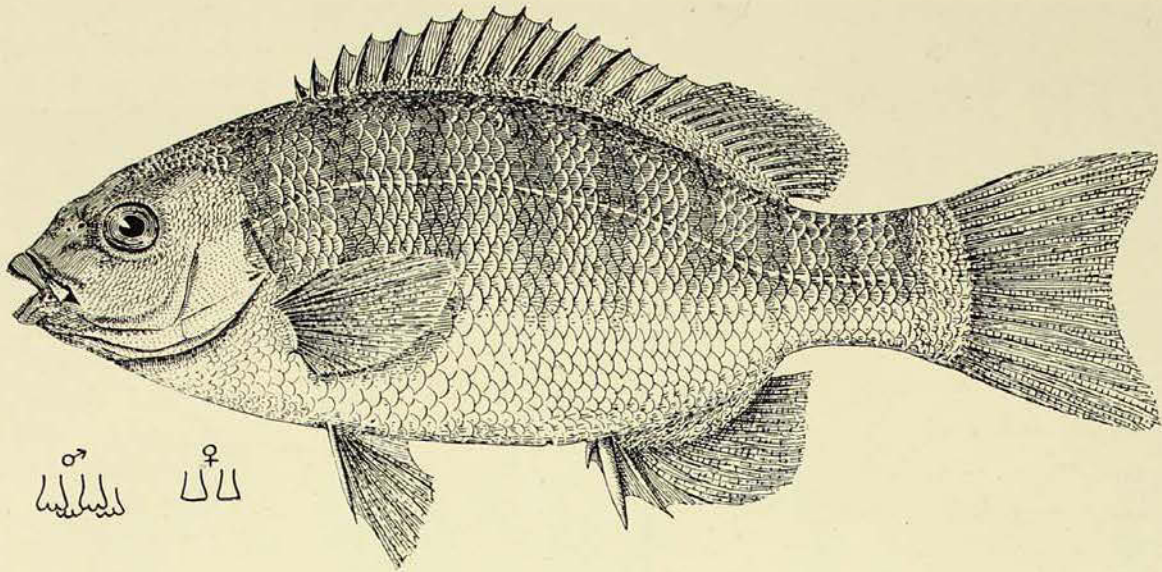
The Blackfish (*Girella tricuspidata*) is a common Australian food-fish which provides much sport for fishermen. It is a vegetarian, feeding on sea-weed, and has rows of incisor teeth in each jaw. The teeth of the outer series in both jaws are three-lobed in males, whilst almost all of them are bluntly chisel-edged in females, and for a long time the two forms were regarded as representative of two distinct species.



Skull of Barracuda (*Sphyræna*) from Fiji, showing the long dagger-like teeth of this fierce and voracious fish. An allied species has been known to attack man.

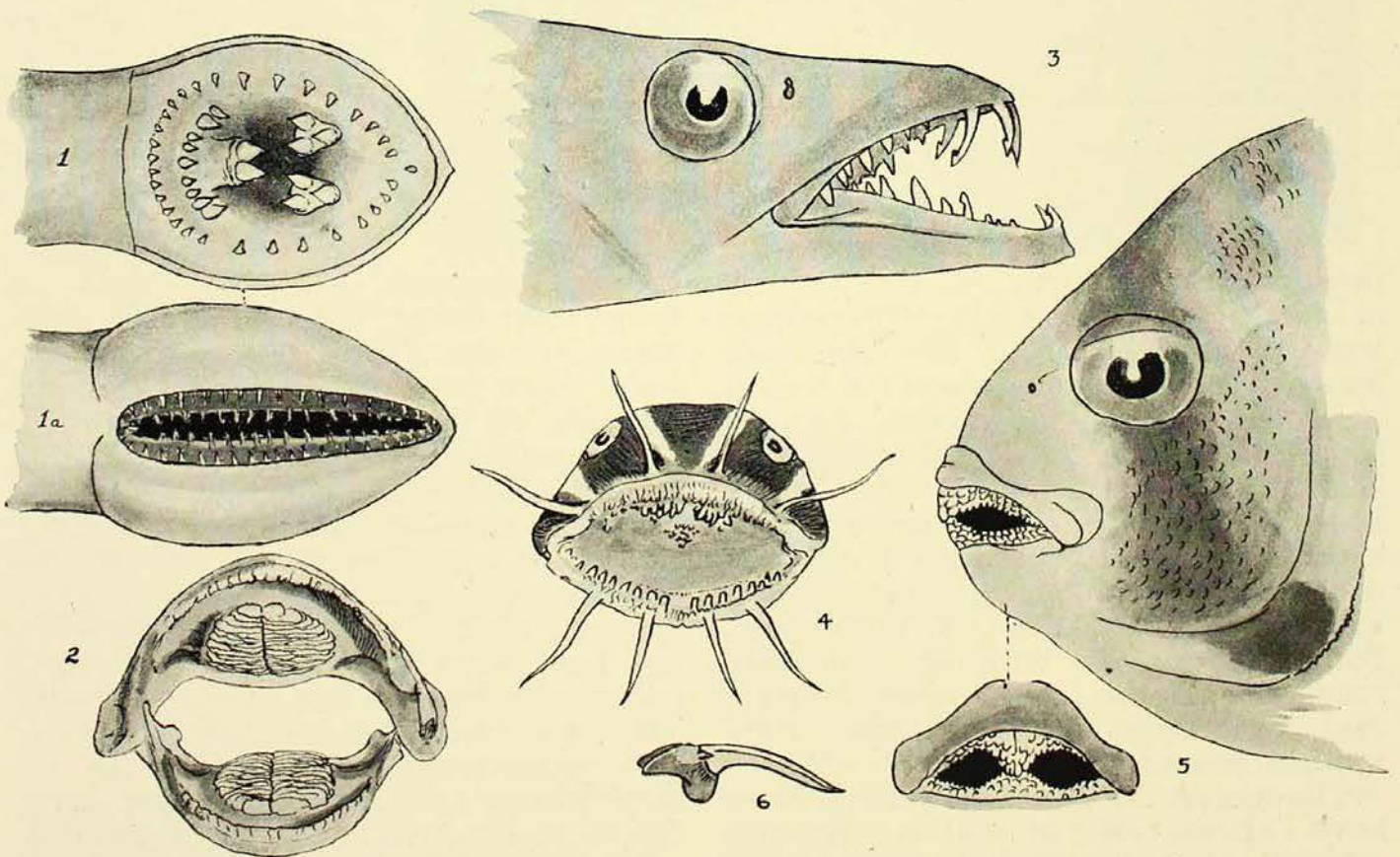
[Photo.—G. C. Clutton.

<sup>1</sup> Illustrated in THE AUSTRALIAN MUSEUM MAGAZINE Vol. II, 1925, p. 280.



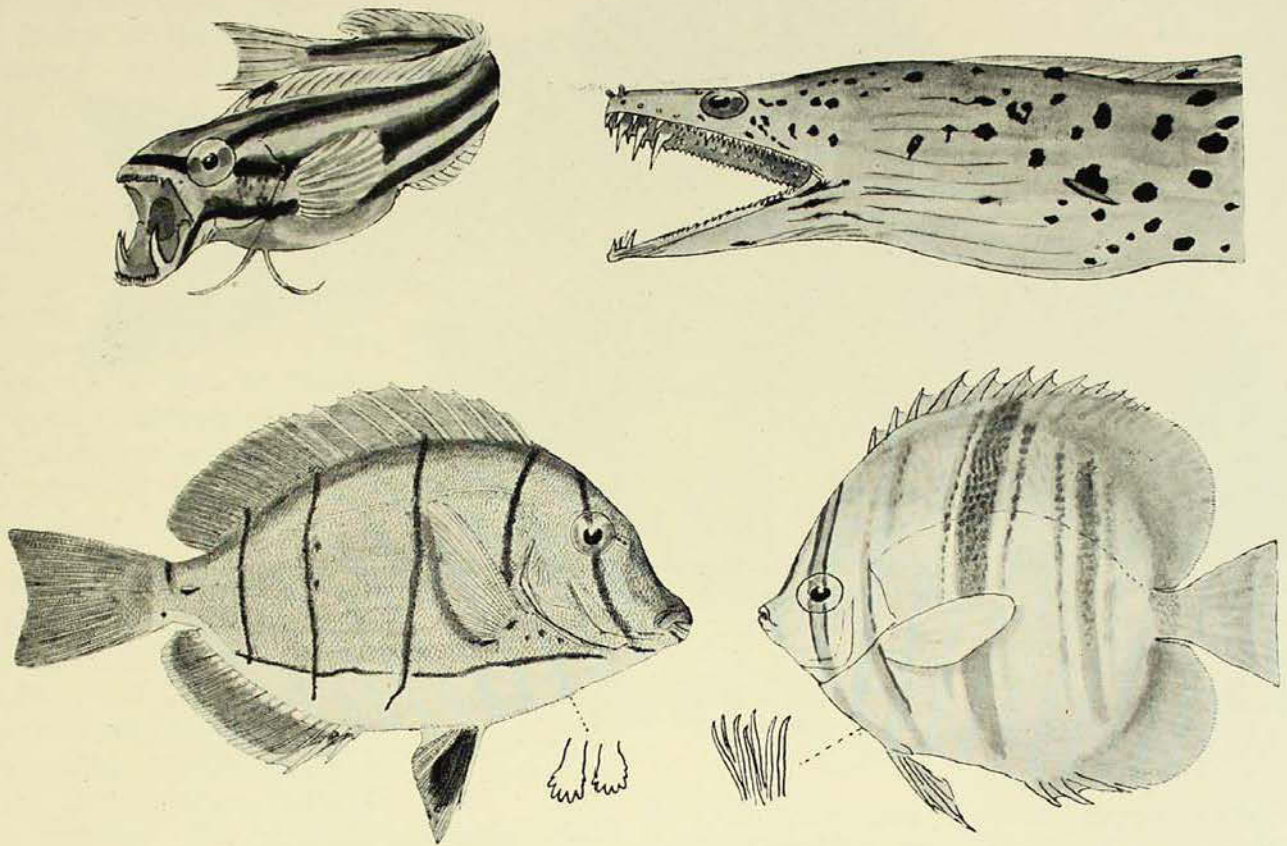
Blackfish (*Girella tricuspidata*) from Eastern Australia, with enlarged sketches of teeth in the male (♂) and female (♀).

[E. R. Waite del.]



Types of teeth in various Australian fishes. 1 and 1a. Lamprey (*Caragola mordax*), lower surface of head to show horny teeth-like structures around the mouth; the sucking disc is shown open and closed. 2. Jaws of Porcupine Fish (*Diodon*) with grinding plates behind the beak-like jaws. 3. Hairtail (*Trichiurus coxii*), with fixed canines, some of which are barbed. 4. Front view of Catfish (*Plotosus anguillaris*) showing blunt teeth on jaws and vomer. 5. Knifejaw (*Oplegnathus woodwardi*) with teeth fused into a beak. 6. Side view of tooth from a Grey Nurse Shark (*Carcharias arenarius*) showing lateral cusp near base.

[Fig. 1 modified from Richardson and Fig. 2 from Tomes' *Dental Anatomy*.  
[G. P. Whitley del.]



Teeth of Queensland Coral Fishes.

Above, Striped Blenny (*Petroscirtes grammistes*) with sabre-like canines and Spotted Reef Eel (*Gymnothorax melanospilos*) with hinged fangs on the vomer. Below, magnified drawings of the hand-shaped incisors of Troughton's Surgeon-Fish (*Teuthis troughtoni*) and the bristle-like teeth of the Butterfly Fish (*Chaetodon rainfordi*), with specimens of the fishes themselves.

[G. P. Whitley del.]

Long canine teeth, barbed near their tips, are characteristic of the Hairtail or Frost Fish (*Trichiurus*). These long, tent-peg-shaped teeth fit into the space between the mandibles when the mouth is closed. Many predaceous deep-sea fishes have long needle-like fangs for holding their prey, whilst most Angler Fishes have brushes of long pointed teeth which are hinged so that there is one-way traffic only—down their capacious throats.<sup>1</sup> Young Swordfishes have teeth in the jaws, but these are lost with age and only rough areas in the jaws of adults indicate that Swordfishes are descended from toothed ancestors.

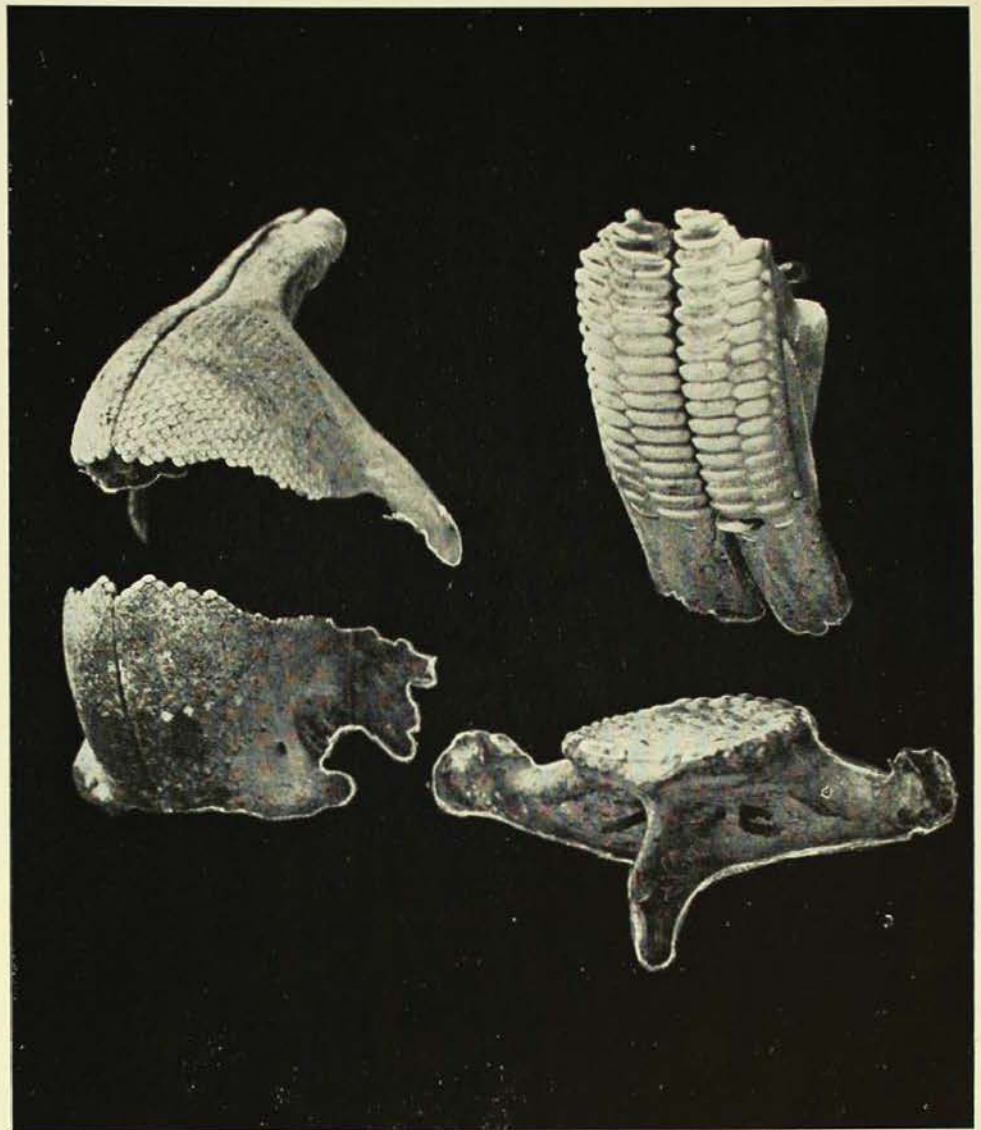
The Great Barrier Reef fishes often have curious teeth as well as elaborate colours. Butterfly Fishes of the genus *Chaetodon* have movable bristle-like teeth for extracting polyps from their coral

cups. Surgeon Fishes have scalloped incisors, strangely like little hands in shape, for biting their vegetable food. Many of the Parrot Fishes have the teeth fused into a solid bony beak for breaking off whole pieces of coral, which they crush with another set of grinding teeth situated in the pharynx. A similar beak is developed from the fusion of many smaller teeth in the southern and western Australian Knifejaw (*Oplegnathus*). Toadoes, Porcupine Fishes, and Sunfishes also have beaks, but theirs are developed from the fusion of a less number of teeth. Their near relatives, the Leatherjackets, still have separate teeth; these are very strong, and have earned for them the name Hookbiters amongst fishermen.

The pharyngeal bones of Parrot Fishes (*Pseudolabrus*) and the beak-like jaws and grinders of Porcupine Fishes (*Dicotylichthys*) are sometimes unearthed in aboriginal kitchen middens and their discoverers are frequently puzzled as to their identity.

<sup>1</sup>THE AUSTRALIAN MUSEUM MAGAZINE, Vol. I, 1921, p. 49; IV, 1930, pp. 22-24 (Deep Sea Fishes); and Vol. III, 1927, pp. 103-107; IV, 1930, pp. 25-27 (Angler Fishes).—Illustrations showing teeth.

Little fishes known as Blennies, which skip about rock-pools and even over rocks out of water, are noted for their curious teeth. Generally these form a comb-like row of small, even incisors, but there are also sometimes long lateral or posterior canine teeth as well. A larval Blenny from the New Hebrides, shown in the accompanying sketch, has remarkable hooked teeth, but these give place, in the adult, to the fine incisors. In the Striped Blenny (*Petroscirtes grammistes*), of which a Queensland specimen is illustrated here, the canines give an appearance suggesting that of a sabre-toothed tiger. The Oyster Blenny of New South Wales has similar teeth. It is sometimes found curled inside empty oyster shells and is very pugnacious. It has been known to draw blood from its captor's fingers when being handled.

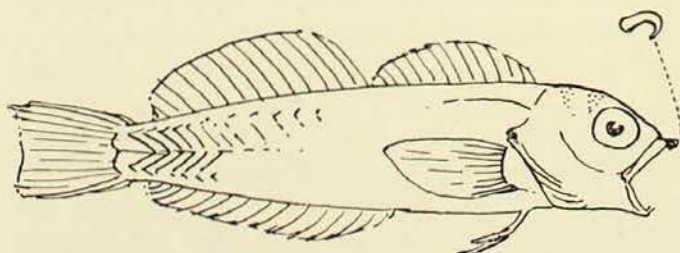


On left, the beak-like jaws, formed by the fusion of once separate teeth, of a Parrot Fish (*Scarus*). On right, the grinding teeth from the pharynx of the same specimen.

[Photo.—G. C. Clutton.]

#### USES OF FISHES' TEETH.

Except as curios, fish teeth are of little use to man. As long ago as A.D. 1655, "a tooth from a salt-water fish" was catalogued as one of the ornaments in the famous Library of the House of Fugger in Ausberg.

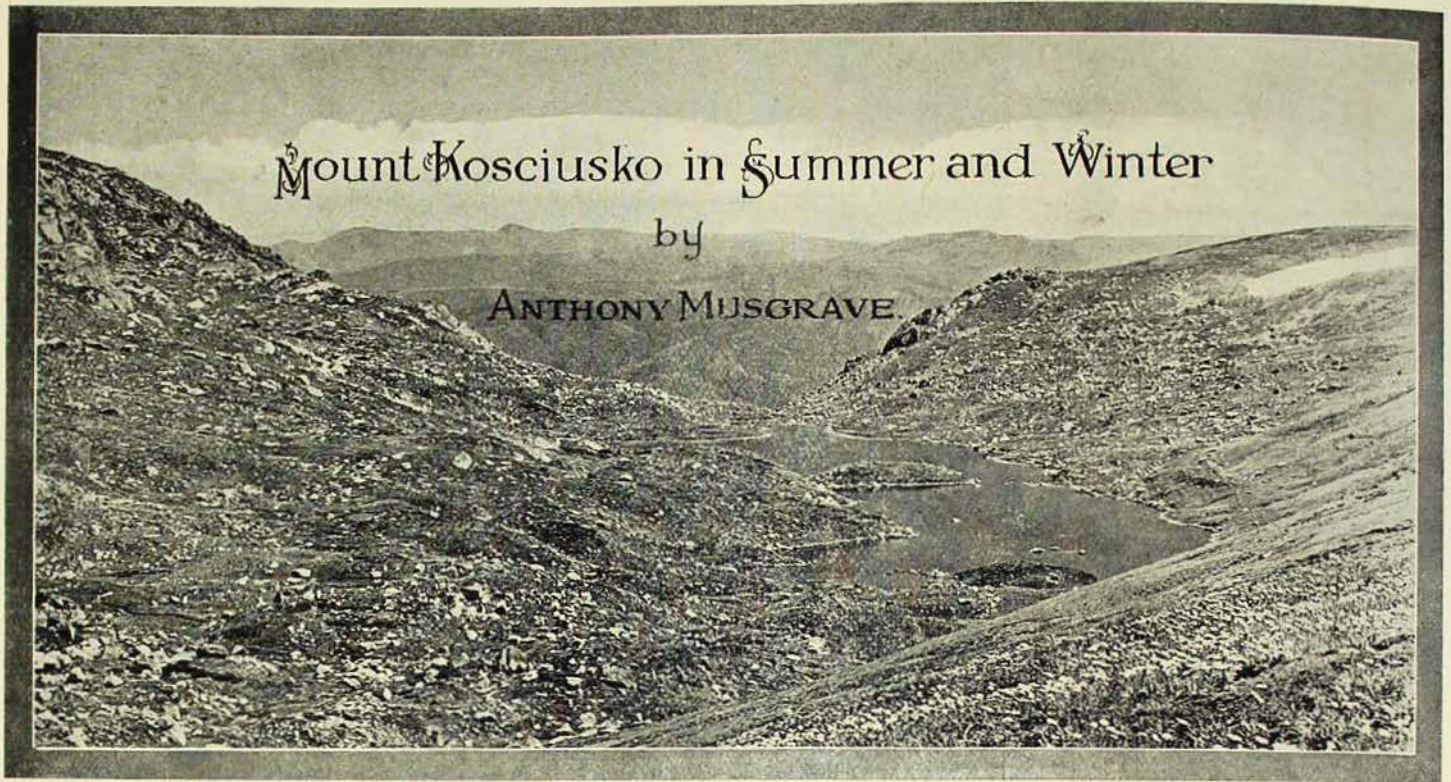


Young Blenny (*Salaria*) from the New Hebrides with the temporary hooked teeth which give place to comb-like rows of teeth in the adult.

[G. P. Whitley del.]

There is, in the Australian Museum, an example of fish-teeth currency, from Bougainville Island, in the Solomons. In this specimen, teeth of the Island Snapper (*Lethrinus*) are attached at regular intervals to a coiled fibre string, six feet in length, which was used as native money.

From the above brief outline, it will be seen that the study of fishes' teeth presents a vast field, full of variety, and of importance to those who would understand better the dentition of higher vertebrates, including man. If, after considering all these forms of teeth carefully, the angling reader fails to obtain some really good bites, he will be unlucky indeed.



Lake Albina, the most picturesque of all the mountain lakes, is situated 6,340 feet above sea-level. Patches of snow daisies along the hill-sides form a welcome colour relief to the dark rocky landscape.

[Photo.—A. Musgrave.]

FIFTY miles south-east of the town of Cooma near the Victorian border lie the granite-clad summits of the Muniong or Snowy Ranges.

To an area on which is situated the peak or group of peaks, the name of Mount Kosciusko has been given. On this area, or plateau as it has been termed, the snow lies deep throughout the winter and persists on the higher peaks in the form of reddish-tinted drifts far into the summer.

The Kosciusko Plateau has been likened to a cone or triangle with the apex pointing in a S.S.W. direction. One side, formed by the Ram's Head Range, stretches for about twenty-two miles from Ram's Head Peak to The Creel on the Thredbo or Crackenback River, another side extends from Ram's Head Peak to the Bull's Peak on the Great Dividing Range, while the base line links Bull's Peak and The Creel.

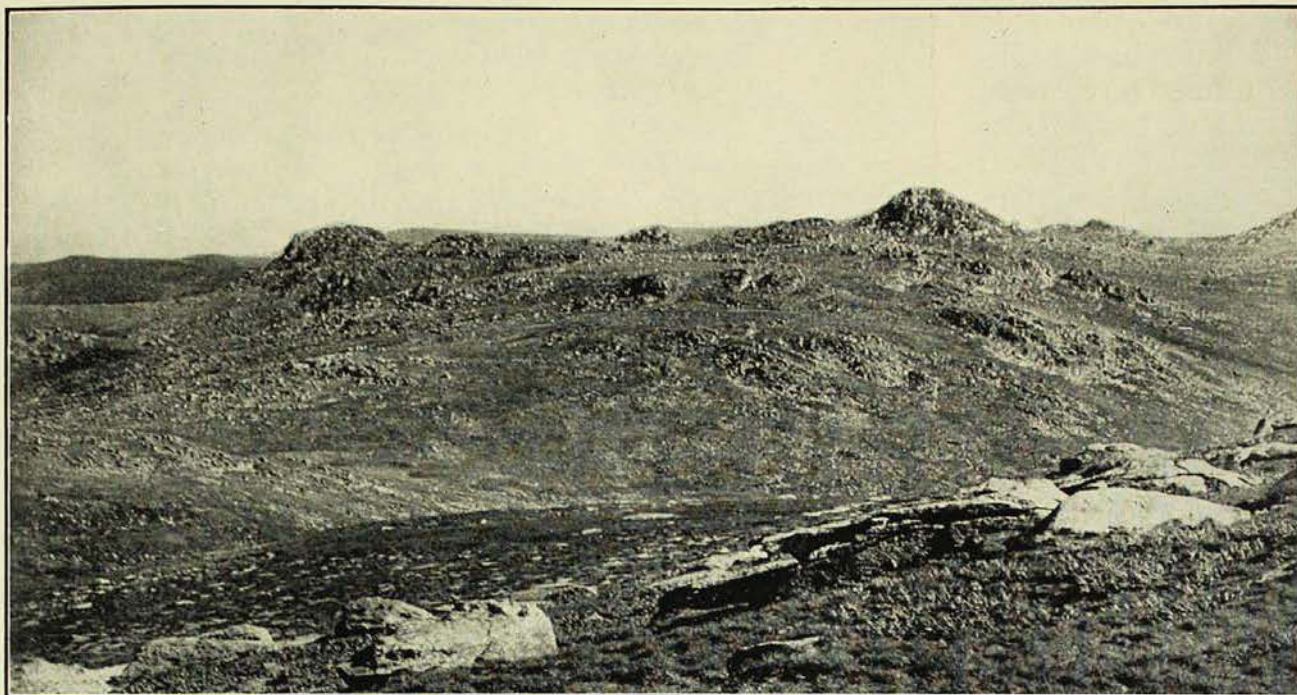
The late Richard Helms, on the other hand, considered that "the Kosciusko Plateau when approached from the east commences at Pretty Point, a height above

the sea of about 5,700 feet," this would mean a smaller area, but the part to which I intend to devote myself comes well within his limits, so therefore there is no occasion to raise the question of the actual limits of the Kosciusko Plateau.

Prior to the advent of the white man and even so late as 1860 the aborigines of the different tribes every year used to foregather on the summits of the Snowy Mountains for the purpose of feeding on the Bogong Moths, *Euxoa infusa*, which swarmed in the crevices of the rocks. These they gathered in bags after smoking them out, after which they were poured out on to hot ashes and moved about until all the wings and scales were removed. When cool they were eaten.

#### HISTORICAL.

In 1840 came the first white man, Sir Paul Edmund de Strzelecki, usually known by his Polish title of Count de Strzelecki. He ascended the Muniong Range from the Victorian side and named what he considered to be its highest point, Mount Kosciusko, after its resemblance



The granite-topped peaks of the Etheridge Range viewed from the summit of Mount Kosciusko appear desolate and grim.

[Photo.—A. Musgrave.]

to the tumulus over the grave of the Polish patriot at Krakow. The peak actually ascended by him has been stated by some authorities to be the one now called Mount Townsend.

In 1846 and 1847 Mr. T. S. Townsend, Deputy Surveyor-General, ran a traverse along the summit of the Dividing Range. During the fifties the Rev. W. B. Clarke, "the father of Australian Geology," and Baron von Mueller, who did so much for Australian botany, visited the region. Then came a lull, and in 1885 Dr. R. von Lendenfeld ascended the mountain and some of the important points to which he attached names are Lake Albina, Mount Clarke, Abbott Range, Mueller's Range, Wilkinson Valley, and Mount Townsend (now Mount Kosciusko).

A year or two later, 1889–1893, Richard Helms visited Kosciusko Plateau and found evidences of glaciation previously noted by Clarke. The next five or six years saw considerable activity and interest in this region. In 1896 the Rev. J. Milne Curran, a well-known geologist, in company with the late Charles Hedley and Dr. Jas. Petrie made an exploratory trip. About this time Helms gave to certain of the

more conspicuous features of the plateau such names as Etheridge Range, Guthrie Range, and so on. The flora, which von Mueller had previously investigated, received further attention from the late J. H. Maiden in 1898.

For some time there was considerable controversial activity among geologists regarding the evidences of past glacial action in the country towards the summit, and this continued until about 1901, when Professor T. W. Edgeworth David, Messrs. R. Helms and E. F. Pittman, in company with Mr. F. B. Guthrie, examined a large area of the Kosciusko Plateau and found much clear evidences of ice action as places the former existence of glacier-ice at Kosciusko beyond dispute.

#### NOMENCLATURE.

In the past confusion existed as to the actual peak ascended by Strzelecki in 1840. Prior to 1896 it was the fashion to regard the peak now known as Mount Townsend as that from which the first explorer had looked down into the Murray Valley. A cairn was built upon it, and tourists were given to understand that it was Mount Kosciusko. When Dr. von Lendenfeld visited the mountain in 1885, he found that this peak was called Mueller's Peak, a local name established by Mr. Spencer.

There are probably few mountain peaks whose names have been so altered as have those of the Kosciusko Plateau; for example, the peak Dr. von Lendenfeld, called for the first time Mount Clarke, and whose geographical position on his maps leaves no room for doubt, we find, on consulting the map issued by the Tourist Bureau, to be called Mount Alice Rawson, and the name Mount Clarke transferred to a peak which, on a map issued by the Lands Department, is called Mount Northcote, this latter map giving Mount Clarke its original setting. Dr. Schlink has alluded briefly to this confusion in an interesting article in *The Australian Ski Year Book*, 1928, and has suggested that an effort be made "to re-establish the old euphonious aboriginal names for the various peaks and ranges." According to Helms, "The natives of that time no doubt had names for every spur, ridge, rivulet, and valley, as well as for the highest prominences," and he suggests that the peaks which we call today Mount Townsend and Mount Kosciusko were called Muniong and Quitong respectively, though the latter name may have been applied to Mount Clarke.

#### THE COUNTRY NEAR THE SUMMIT.

In January, 1929, a party consisting of Mr. H. O. Fletcher, Mr. W. Boardman, and the writer visited Mount Kosciusko and camped within the crumbling walls of a stone hut situated in Rawson or Cootapatamba Pass at the foot of Mount Kosciusko itself. Here we spent a few days exploring and collecting for the Museum.

Before we pitched our tent, we visited the Summit. We found it impossible to drive the car to the top, as a snowdrift lay across the road, and so the rest of the



From Mount Carruthers we looked back to the Etheridge Range, with the motor road winding along its side to Rawson Pass, at the foot of Mount Kosciusko (centre of horizon), while on the right showed the peak of Mount Townsend. [Photo.—A. Musgrave.]

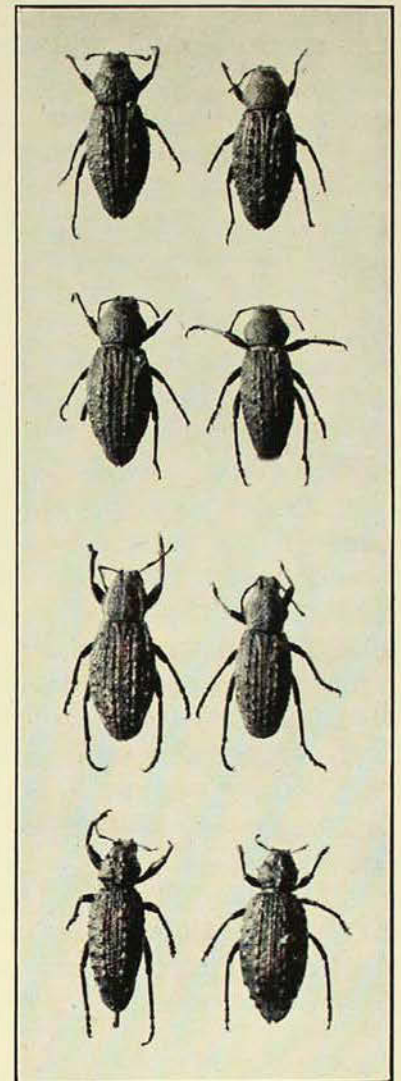
journey had to be made on foot. These patches of melting snow constitute quite a feature of the Kosciusko highlands during the summer months. They appear reddish in colour, and this has been stated by Helms to be due to the presence of a snow alga and also to dust from the Riverina. The rounded hill which distinguishes Mount Kosciusko from the neighbouring elevations of the Plateau is somewhat flattened at the top, and here a cairn of stones surmounted by a post is to be seen. The summit is stated to be 7,308 or 7,328 feet above sea-level. Here also is a concrete block, on which is set a copper plate with arrows indicating the principal topographic features for the benefit of visitors, who have shown their appreciation by so mutilating it by scratching their names upon it that it is barely possible to make out the original place names. From the summit we look north to Mount Townsend, and in the distance can discern the walls of Lady Northcote's Canyon. The path to the beautiful Lake Albina lies on the right, while snowdrifts cling to the side of the hill o'erlooking the Lake. From near the summit one looks south to the



Etheridge Range, its rugged peaks of broken granite rising above the general level. Along the northern side of this range runs the motor road, which can be seen extending beyond the Range as far as the Guthrie Range near Charlotte's Pass, while beyond lies the Perisher Range.

A day of our visit was spent in a walk from our camp to the Blue Lake and across the Snowy River to Charlotte's Pass and back to our camp. There is a well-defined bridle track to the Blue Lake, which took us through fields of Snow daisies and other beautiful alpine plants. About two miles from our camp we came upon the most charming of all the mountain lakes, Lake Albina, situated at an elevation of 6,340 feet above sea-level, and said to be a quarter of a mile long by three to five chains in width; it owes its name to Dr. von Lendenfeld. The track winds on over slaty ground until we reach Mount Lee and Mount Carruthers, with Club Lake, or Harnett's Lake, or Gerrard Tarn, as it has been called at different times, nestling in its south-eastern side.

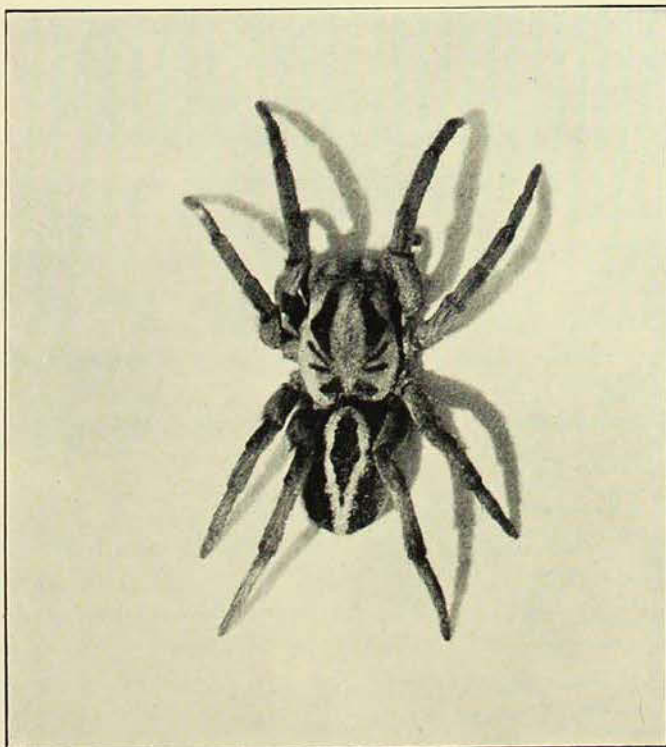
On the northern slopes of Mount Lee we looked down into the Lady Northcote Canyon, and from the summit of what we took to be Carruthers Peak we looked back to the rocky peaks of the Etheridge Range in the south-west, the rounded summit of Mount Kosciusko, and the pointed peak of Mount Townsend. Then the track winds downhill until the Blue Lake or Lake Merewether (as it was called originally by Helms) is reached. This lake, which was sounded in January, 1906, by Professor T. W. Edgeworth David from a flimsy coracle, was found by him to be from 70 to 75 feet in depth, and it is situated at an altitude of 6,150 feet above sea-level. In February, 1906, the late Charles Hedley dredged in the lake, and secured a number of new species of worms. The water from the Blue Lake flows out, to pass eventually into the Hedley Tarn and thence to the Snowy River.



Living among the Snow grass tussocks were hard-bodied Amycterid weevils. These wingless, short-snouted weevils are found chiefly on the east and west sides of the Continent, and many forms exist only at high altitudes. Six species have been recorded from different elevations on the mountain.

[Photo.—G. C. Clutton.]

Having viewed these places of interest, we crossed over the hills to the Snowy River and up the steep escarpment on the other side to the motor road, finishing up with a five-mile walk back to the camp.



An apparently new species of *Lycosa* or Wolf Spider made its lair among the Snow grass on the sides of Mount Kosciusko.

[Photo.—G. C. Clutton.]

## ANIMAL LIFE NEAR THE SUMMIT.

On the south-western side of Mount Kosciusko, and about half a mile from our camp, is situated a lake which enjoys the distinction of being the most elevated body of water in Australia. Lake May, Lake Cootapatamba, or Lake Kosciusko, as it has been termed at various times, is about a quarter of a mile long and has a maximum depth of 17 feet, and "is bounded at its lower end by a very well-marked terminal moraine," according to a description. On the shores of this lake, and on the banks of the streamlets which flowed into it from the melting snowdrifts, we made our collections. In small pools near the lake tadpoles were numerous, and adult frogs later submitted at the Museum to Mr. J. R. Kinghorn proved to be *Crinia signifera*, a small frog with a wide distribution over Australia and Tasmania, and already represented in the Museum collection from the Mountain by specimens collected in 1889 by Helms and in 1900 by Professor T. H. Johnston and the late Chas. Hedley. Near Lake Cootapatamba, and in the lake itself, Fletcher and I came across the quaint Isopod crustacean, *Phreatoicus australis*,



Snow daisies (*Celmisia longifolia*), seen as white patches against the dark Snow grass, constitute one of the most charming features of these wind-swept altitudes.

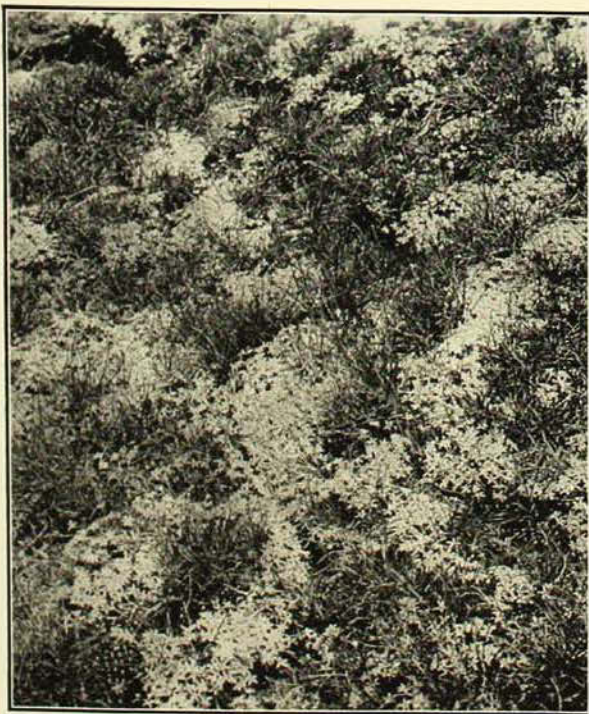
[Photo.—A. Musgrave.]

which was collected for the first time in March, 1889, by Mr. R. Helms at an elevation of 5,700 feet in puddles near Piper's Creek. These crustaceans seem to occur for the most part in water on the summit of mountains, and another species, *Phreatoicus shepherdi*, has been collected on the Barrington Tops, New South Wales, at an altitude of 4,800 feet.

A small muscoid fly similar in appearance to the house-fly made life a misery in camp and on our walks, and a species of March fly, *Tabanus froggatti*, occurred also in numbers at this altitude. They invaded our shelter and wandered over everything, thrusting their sharp proboscides into fabric of any description and even into our blankets.

In our rambles Fletcher and I found two distinct species of Wolf spiders of the genus *Lycosa*, one making a simple hole in the ground sometimes surmounted by a turret; the other making a tunnel and covering the opening with a web or else living under stones. The spiders were got out of the burrows by cutting them out with a tomahawk.

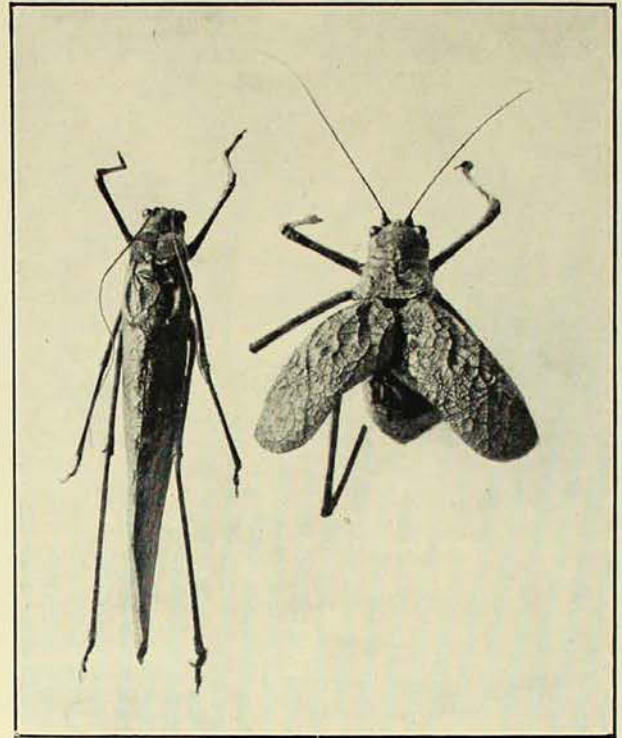
We also secured specimens of what appears to be a new species of Aviculariid



The richly perfumed *Stackhousea pulvinaris*, with its star-shaped flowers, was met with by us at various points near the summit.

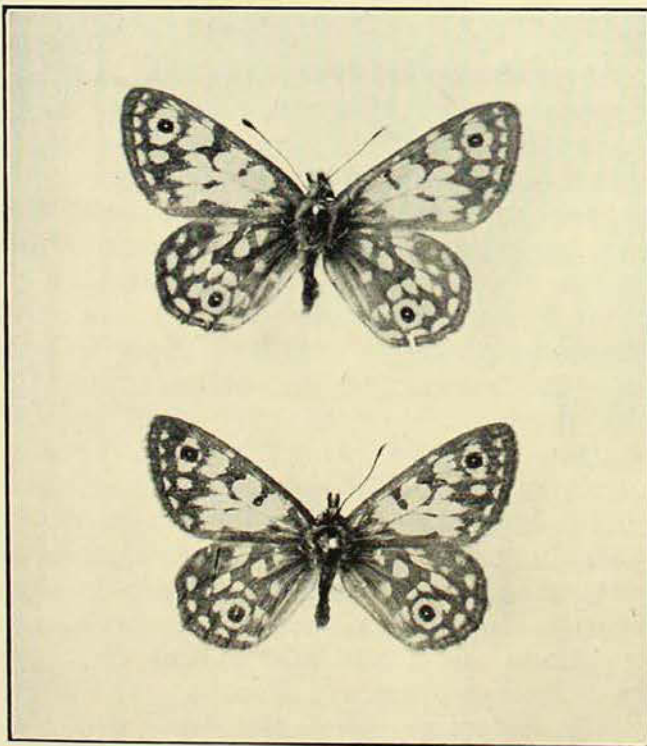
[Photo.—A. Musgrave.]

spider of the genus *Atrax*. I need hardly mention that this is the genus in which our local poisonous "funnel-web" spider (or "trap-door" spider as it is more popularly but less aptly termed), *Atrax robustus*, is included. The spiders of this genus are all pugnacious and will "get on their hind legs" and strike at all who attempt to interfere with them. The males, as I pointed out in an article in this MAGAZINE, are easily distinguished from the females by the presence on the second pair of legs of a spur or group of spines, a character lacking in the females. We came across a number of males lying dead on the Snow grass, some without any sign of injury; whether they had been slain by the females or died from natural causes we could not determine. *Atrax* spiders do not make lids to their burrows or retreats, which are usually placed under logs, or stones, in stumps, or in rotting logs, so here above the tree-line we searched for them under stones and were rewarded by catching a large female with her egg-sac, and a male. These were caught at some distance



The Mountain Grasshopper (*Acricpeza reticulata*). The completely winged male (left) measures about two inches in length; the female (right) is stout, without wings, and measures a little over an inch, the short wing covers concealing an abdomen spotted with red, blue, and white.

[Photo.—G. C. Clutton.]



The Little Mountain Brown (*Oreixenica orichora*), a frequenter of the flowers of the epacrids at Daner's Gap and the Plains of Heaven.

[Photo.—G. C. Clutton.]

from one another. The male of this species has a group of spines on the under-surface of the second pair of legs, in which respect he resembles *Atrax venenatus* from Tasmania.

#### ALPINE PLANTS.

Above Charlotte's Pass at an altitude of about 6,000 feet we meet with the last Snow gum, and here during January the barrenness of the stark rock-crowned hills is relieved by the exquisite beauty of the alpine flowering plants.

The vegetation of the Kosciusko Plateau has been treated from its œcological aspect by Dr. John McLuckie, Assistant Professor of Botany in the University of Sydney, and Mr. Arthur H. K. Petrie, Senior Demonstrator in Botany in the University of Melbourne. In a joint paper published in the *Proceedings of the Linnean Society of New South Wales* for 1927, they deal with the plant communities of this region and a

consideration of the plant communities led them to recognize three unit-areas:

"(1) The montane zone, from 3,000 to approximately 5,000 feet, comprising the lower slopes of the Plateau.

(2) The sub-alpine zone, from approximately 5,000 feet, to the tree-line at 6,000 to 6,500 feet.

(3) The alpine zone, from the tree-line to the highest elevations."

In the alpine zone they found two plant consociations. The first had as its dominant plant the Snow grass, *Poa caespitosa*, which occurs also in the sub-alpine zone. The other consociation has as its dominant plant the Snow daisy, *Celmisia longifolia*, which frosts the landscape near and far with the bluish tinge of its leaves. The flowers themselves are white with yellow centres. These alpine meadows with their large patches of Snow daisies set among the dark green of the Snow grass make charming impressions.

Our camp in Rawson Pass was situated in the midst of a *Poa-Celmisia* association. Running down from the melting snow-drifts on the slopes of Mount Kosciusko itself were many small streams which flowed between the granite boulders and the tussock grass on their way to the Snowy River. These little streams had their banks clothed with beautiful alpine plants of every description.

Messrs. McLuckie and Petrie in their paper point out that "the extreme shortness of the vegetative season at these high altitudes results in every species flowering at the same period; consequently there is a wealth of floral production unmatched in other regions of the State, more especially as the flowers are mostly large and brightly coloured." The truth of this contention was proved by Fletcher who returned to the Mountain early in February and found no flowers at all.

High up near the Summit we found flowering the quaint plant called Mountain Celery, *Aciphylla glacialis*, with spiny palm-like leaves and white flowers.

The most fragrant of all the alpine plants was first met with by us on our way to the Blue Lake from Carruthers Peak. This plant was a small mat herb with yellow star-shaped flowers called *Stackhousea pulvinaris*, and it grew in

great abundance among the Snow grass and was so richly performed that, like the scented sails of Cleopatra's barge, "the winds were lovesick with it." The strong northerly winds brought this delectable odour to our nostrils long before we had an opportunity of discovering whence it came, the scent being suggestive of perennial fock, so it was maintained. We later met with it near Lake Cootapatamba and the Etheridge Range.

In addition to the plants I have enumerated buttercups and daisies of various kinds abounded by the runnels from the snow-banks.

The country about the Summit is leased during the summer by graziers, and these "snow leases" as they are termed provide rich pasturage and abundant water for stock. In the country between Charlotte's Pass and Lake Cootapatamba we saw many sheep and cattle in splendid condition.

The fierce northerly winds eventually forced us to beat a retreat, and on Tuesday, January 8, we broke camp and drove down the mountain to Sawpit Creek, situated at an elevation of 3,800 feet and about six miles from the Hotel Kosciusko.

#### DANER'S GAP AND PRETTY POINT.

From Sawpit Creek we paid visits to other parts of the mountain. One day we spent at the Summit and on the Etheridge Range, while another was spent in the neighbourhood of Daner's Gap. This spot, so well-known to the winter visitor, is situated at an elevation of 5,560 feet and divides the watershed of Digger's Creek from that of Piper's Creek. On the western side of Sunrise Hill, which rises above the Hotel Kosciusko, lie the Plains of Heaven, and here we spent a morning collecting butterflies, which hovered over the flowers of the epacrids. About twenty-five species of butterflies have been recorded from Mount Kosciusko, chiefly between the elevations of 3,000 and 5,000 feet, and about half of these are members of the sub-family *Satyrinae* (The Browns) and some of these are confined to the mountain.

On the Plains of Heaven, Fletcher and I secured numbers of a small brown butterfly, *Oreixenica orichora*.

Here in the vicinity of Daner's Gap the most conspicuous plant is the Snow gum, *Eucalyptus coriacea*, a species I had first encountered at Barrington Tops, and which at Kosciusko is the last tree one sees after leaving Charlotte's Pass on the way to the Summit.

Returning to Daner's Gap we had our lunch on Piper's Creek, and here we met a shepherd who asked me if I knew of a queer insect, which he described and which, he said, occurred usually between the tussock grass and the granite boulders. From his description I was unable to place the insect, but,

when he drew back the grass growing beside a rock, he exposed to view an insect with which I was quite familiar in our Museum cabinets but which I had not seen in its natural state. This was the Mountain Grasshopper, *Acripeza reticulata*, a species which occurs in mountainous districts in other parts of the State and not uncommonly in the Blue Mountains.

After lunch we walked to Pretty Point, a distance of two miles from Daner's Gap. Here fine views are to be had looking out over the Valley of the Thredbo or Crackenback River either south-east or north to the mountains near the Summit. This range, the Ram's Head Range, forms the eastern side of the triangle which forms the Kosciusko Plateau.

One day we drove up from our camp on Sawpit Creek to the Hotel Kosciusko, where we hired horses and rode down Digger's Creek to the Snowy River, a spot beloved of the trout fisherman.

Digger's Creek has proved a happy hunting ground for many entomologists. Here it was that Dr. Tillyard made one of his most interesting discoveries. On November 31, 1921, he exhibited at a meeting of the Linnean Society of New South Wales, the larvæ, pupæ, and adults



At Daner's Gap in winter time the snow lies thick on the ground, covering the epacrids and Snow grass, and only the Snow gums remain to relieve the whiteness of the landscape.

[Photo.—A. Musgrave.]

of two new species of *Blepharoceridæ*, called popularly net-veined midges. One species was taken at Digger's Creek, Mount Kosciusko, the other at Wentworth Falls, Blue Mountains, and he pointed out that, except for a single specimen taken at Kuranda, North Queensland, the family had not been recorded from Australia, and had been supposed to be absent from the temperate parts. The species found at Kosciusko was the largest and most archaic yet discovered. To it he gave the name of *Edwardsina australiensis*. This interesting group has already been touched upon in this MAGAZINE<sup>1</sup>; the species pass their entire life on or near the face of a waterfall, the adults flying in the spray.

Here for the first time I saw and collected examples of a fine bronze-green cockroach, *Polyzosteria viridissima*, which were sunning themselves on tree-trunks, logs, or twigs of bushes near the side of the bridle track; one form was quite green, while another was a bronze-brown colour.

The Snowy River itself we found to be a fairly wide stream, its cooling waters

<sup>1</sup> See Musgrave and Campbell, "With the R.A.O.U. to the Barrington Tops District," THE AUSTRALIAN MUSEUM MAGAZINE, Vol. III, Pt. 1, January-March, 1927, pp. 26-34.

flowing over granite boulders in true mountain torrent style or else forming deep pools.

#### WINTER.

To see the Mountain at its best it is necessary to visit it in the winter months when snow covers the ground; then it is truly sublime.

The early explorers did not venture into the Snowy Ranges during the winter months, and there was no occasion for the pastoralist to do so, since March was the latest he could leave his stock on the snow pastures with safety. Therefore it is not surprising that the first winter ascent was made as recently as 1897; on August 19 of that year a party, of which the late Charles Kerry was the leader, succeeded in reaching the Summit.

On December 8, 1897, a meteorological station was erected at the Summit and was in operation until July 1, 1902. To those who visit the Hotel Kosciusko during the winter months and enjoy the warmth and comfort it affords, it is interesting to read of the temperatures recorded by the instruments at the little hut on the Summit some two thousand feet above the present site of the Hotel. Dr. H. I. Jensen, in an article in the *Lone Hand*, June 1, 1909, page 145, states: "The lowest temperatures recorded were those read on the 'terrestrial minimum' thermometer on bright starry nights. Thus on the night of August 9, the air temperature was about 24° F. but the terrestrial instrument read 0·6°. This thermometer fell to -5°, and once to -15° F.; and these are the degrees of cold which a man sleeping on the ground would have to endure." At the Hotel Kosciusko where readings have been taken for the past eighteen years, the lowest temperature recorded is 6·8° F., while at Kiandra, where records have been made for twenty-three years, the lowest recorded was -9° F. on June 16, 1916.

In 1909 the Hotel was erected, and in July, 1910, the first winter ascent by

the Hotel route was made. Since then parties have visited most of the peaks near Mount Kosciusko, and have made their way over from Kiandra to Kosciusko, the first being accomplished in July, 1927. The Hotel Kosciusko has proved to be so popular that the management is forced to turn away many guests owing to the limited accommodation.

The snow season is from June to September, but the snow is a fickle thing and as unstable as the water into which it melts. My first winter visit to the Mountain was in July, 1928, when all in the party were disappointed with the snow conditions. The weather was very mild, and one was forced to carry one's skis up the hill to Daner's Gap.

Towards the end of July, 1929, I again visited the Mountain, to find it and the country almost from Cooma to the Hotel under a heavy mantle of snow, and the road near the Hotel made passable only by means of a snow-plough operating from the Hotel.

In an article such as this one can give at best but a sketchy reconnaissance of the subject, for these wonderful highlands can supply an illimitable amount of interesting material. We of the staff of this Museum are knit by the most irrevocable links to the Mountain, for, when we come to examine a map of the area, names such as those of Etheridge Range, Hedley Tarn, Helms Moraine, Mount Clarke, and Mount David recall to us men who, in the past, were associated with this institution and who endeavoured to glean some scientific knowledge of the Plateau. I therefore make no apology for choosing a subject that has served to inspire so distinguished a coterie.

In conclusion, I would express my indebtedness to Mr. P. M. A. Speet, Manager of the Hotel Kosciusko, and Mr. R. Henry, of the Tourist Bureau, Sydney, for assistance rendered me when on visits to Mount Kosciusko in summer and winter.