

*The*  
AUSTRALIAN  
MUSEUM  
MAGAZINE

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Native Hen.

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HYDE PARK, SYDNEY

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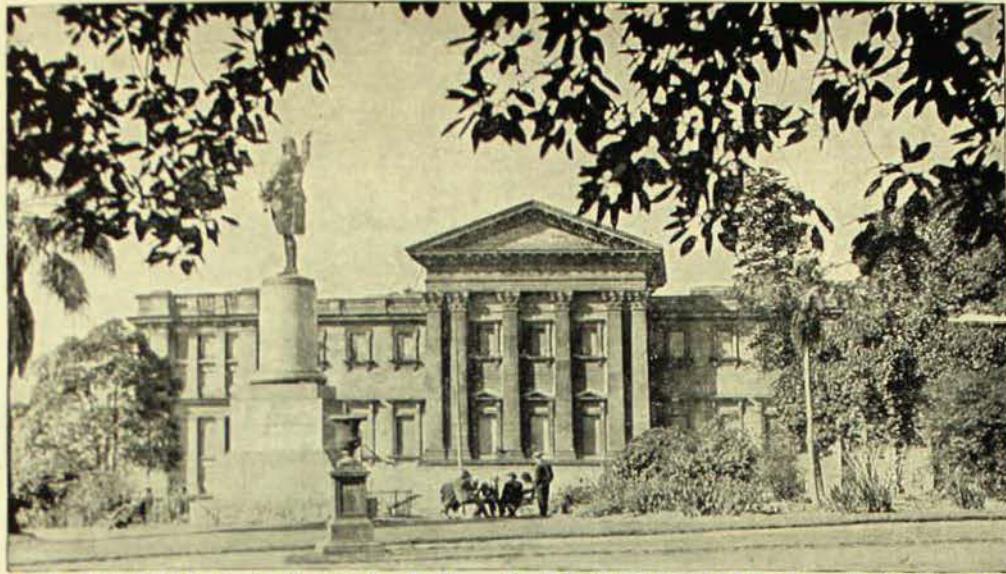
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(Photography, unless otherwise stated, is by G. C. Clutton.)

● OUR FRONT COVER. The Native Hen (*Tribonyx mortieri* Du Bus) is by Lilian Medland. It is one of a series of post cards issued by the Australian Museum.

The Native Hen is confined to Tasmania, where it represents the Water Hen of the mainland. It came into prominence nearly one hundred years ago, when it was found that, although the bird was fully equipped with wings, it did not use them for flight. It is evidently in the first stages of that degeneration which many of the Rails—the family to which it belongs—have undergone, flightless Rails being common, especially on small islands. Concurrently with the loss of flight, it would appear to have increased in size, and is one of the largest of its group.

The Native Hen frequents the banks of streams and swamps, but is a terrestrial rather than an aquatic bird. It is a vegetarian, and is said to cause considerable damage amongst crops, more especially potatoes.

The nest is made upon the ground of coarse herbage, and five to eight eggs are deposited, cream with brown blotches. The cry of the bird is, according to Campbell, a loud "crake-crake".

The Rails have a world-wide distribution, and form a distinct group of swimming or wading birds with peculiar bills, and without webbing to the toes, though these are sometimes curiously compressed and flanged for swimming.



**Jivaro Head Trophy.**

(See page 243.)

# THE AUSTRALIAN MUSEUM MAGAZINE

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DECEMBER, 1940-FEBRUARY, 1941.

## Administrative Changes

THE closing months of 1940 brought a severance of the services of the two executive officers of the Australian Museum—Dr. C. Anderson, Director, and Mr. W. T. Wells, Secretary—both of whom had contributed greatly to the advancement of the institution.

Dr. A. B. Walkom succeeds Dr. C. Anderson as Director, the latter having retired on 31st October, 1940.

### DR. A. B. WALKOM.

Dr. Walkom was born at Grafton, New South Wales, and received his education at Fort Street Model School and the University of Sydney.

In his early days he became interested in natural history, and many years ago was accustomed to attend the meetings of the New South Wales Naturalists' Club, accompanying his father, who was keenly interested in conchology.

He obtained the degree of B.Sc. in 1910, obtaining First Class Honours and Medal in Geology, together with Second Class Honours in Chemistry. In 1918 he was awarded the degree of D.Sc. with Medal. He was a Linnean Macleay Fellow in Geology for a year, resigning to become Lecturer in Geology at the University of Queensland. The latter position he held from 1913 to 1919.

The late Mr. J. J. Fletcher, M.A., B.Sc., was the first Secretary of the Linnean Society of New South Wales, and later a Trustee of this Museum. Dr. Walkom succeeded him in this important position, carrying on the work ably and upholding the fine traditions of the society for the past twenty-one years.



Dr. A. B. Walkom.

Notwithstanding the heavy demands of his official positions, he has found time for a very considerable amount of honorary work both in science and in sporting activities. He was President of the Royal Society of Queensland for 1918-19, Honorary Secretary of the Australian National Research Council from 1937 until quite recently, Editor-in-Chief of *Australian Science Abstracts* for several years. He has been one of the mainsprings in achieving the success of Science House. At various times he has been Chairman, Honorary Secretary and Honorary Treasurer of the Science House Management Committee.

His name is well known in all the States and New Zealand as the efficient and courteous Honorary General Secretary of the Australian and New Zealand Association for the Advancement of Science, a position he has held since 1926. Had it not been for the postponement of the Adelaide meeting this year, he would by this time have taken a chief part in the arrangements of meetings in all the capital cities in Australia, as well as at Auckland, New Zealand.

His chief papers in science deal with the Mesozoic Sediments of Eastern Australia and with palaeobotany, of which he is the leading authority in Australia.

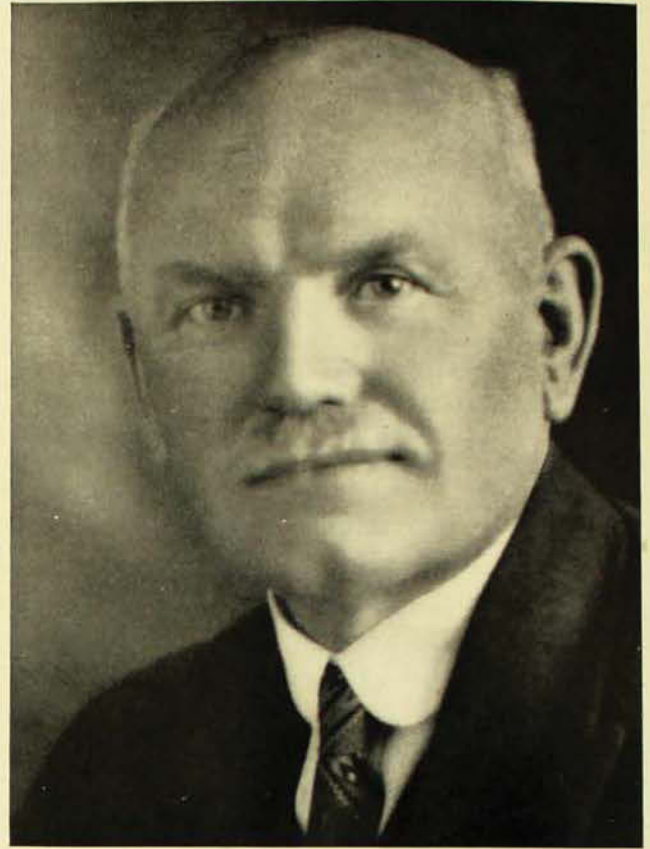
His general all-roundedness is shown also in the keen interest he takes in the organization of outdoor sports. He himself is a keen tennis player, and for some years was a Vice-President of the Tennis Association.

Dr. Walkom's attainments generally are of a high order, and we can look forward with confidence to his marked success in his new position.

#### DR. C. ANDERSON.

Owing to the passage of time, it has become necessary for Charles Anderson, M.A., D.Sc., C.M.Z.S., to retire from the directorship of the Australian Museum, although his general appearance would suggest that he has yet far to go to reach the age of retirement.

Dr. Anderson was born in the Orkney Islands on 5th December, 1876. His



Dr. C. Anderson, M.A., C.M.Z.S.  
(Falk, Sydney.)

education began at the Stenness Public School, where he won two bursaries. From this public school he entered the Kirkwall Burgh School. From Kirkwall he proceeded to the University of Edinburgh, at which centre of learning he won medals in Chemistry, Crystallography, Geology, Mineralogy, Physics, and Zoology. He also won the Hope Prize Scholarship for the most distinguished pass in the Chemical Laboratory. Even as though it were not sufficient to monopolize so many medals, he obtained distinction in English Literature, Latin, and Senior Mathematics. Sir John Flett, who was in Australia early in 1939, spoke in the highest terms of his old student, "Charlie" Anderson, as he called him, and expressed great pleasure at seeing him again. It may be of interest to note that the mention here of Sir John Flett's name calls to mind the important position which the Kirkwall School occupies in English education. It is one of the oldest schools in Britain, and holds a splendid

record by reason of the large number of its pupils who subsequently attained eminence, particularly in the domain of science. Among these may be mentioned Sir John Flett, Director of the Geological Survey of Britain; John Tait, Professor of Physiology, McGill University, Montreal; Ernest Shearer, Professor of Agriculture, University of Edinburgh; James Gunn, Professor of Pharmacology, University of Oxford; John Gunn, Professor of Pharmacology, University of Cape Town, South Africa; R. C. Wallace, President of Queen's College, Canada; George W. Scarth, Professor of Botany, McGill; the late James W. Bews, Professor of Botany, University of Natal; Stanley Cursiter, Director, Scottish National Gallery. Most of these notables were Anderson's contemporaries.

Prior to his appointment to the Australian Museum, Anderson was in charge of the Ben Nevis Observatory.

He was appointed Mineralogist to this Museum on 22nd July, 1901, and, for a period approximately of twenty years his writings were confined mainly to mineralogy and crystallography. For research in this field he was awarded the Doctorate of Science by the University of Edinburgh. At different periods he has delivered lectures in these subjects at the University of Sydney.

He was Acting Assistant Curator of the Museum for a year before he was appointed Director on 14th February, 1921. It was shortly after this that he began to devote most of his spare time to the study of vertebrate palaeontology. In this department of study he has achieved international recognition, especially in connection with his detailed taxonomic work on the extinct chelonian *Meiolania*.

In 1911 he visited Europe and studied the more important museums, together with their methods. He noticed that habitat groups were becoming an important feature in museum display. Most of the fine groups in the Australian Museum, which are so generally admired, were constructed under his direction.

Dr. Anderson has been President of the Royal Society of New South Wales, of the Linnean Society of New South Wales, and of the Anthropological Society of New South Wales. In addition to these honours, he has received the important one of Corresponding Member of the American Museum of Natural History.

Few men possess such a wide knowledge of so many branches of science, and few indeed they are who have given so freely of their knowledge, not only to the museum staff, but also to other workers in science generally. In addition to his scientific attainments, he has a very good working knowledge of several languages, and he has assisted his colleagues frequently in the translation of various scientific descriptions contained in foreign periodicals.

Anderson is very popular among his friends, and is well known as an excellent raconteur, especially on the humorous side. Moreover, he does not hesitate to relate an anecdote which may be against himself.

Dr. Anderson will long be remembered at the Museum, and the whole of the Trustees and of the staff hope sincerely that a long life of further usefulness and happiness is in store for both him and his family.

MR. W. T. WELLS.

Mr. W. T. Wells retired on 18th November from the position he had occupied as Secretary to the Australian Museum for the past sixteen years.

Mr. Wells was born in Melbourne. He received an extensive training in accountancy in Victoria, and in that State also he gained a very considerable commercial experience. He came to New South Wales in 1914, and, from that date onwards until 1924, he held several important commercial positions, including that of Accountant and Manager of the New South Wales State Bakery and Flour Mill. In connection with this appointment, the Hon. W. J. McKell, then Minister of Justice, wrote: "Of all the officers with whom I worked, not one showed more ability nor was more con-

scientific in the carrying out of his duties. . . . I regard Mr. Wells as one of the finest officers in the Public Service and one whom the State might feel proud to possess. He is a highly qualified Accountant, a clever organizer. . . ." Mr. G. J. Evatt, Resident Commissioner of the Irrigation Commission on the Murrumbidgee Areas, also stated that Mr. Wells, in his capacity of accountant under the Resident Commissioner, "showed marked ability, not only in accountancy, but in certain important secretarial work . . . his integrity is beyond question."

At all Board and Committee meetings of the Museum Mr. Wells could be relied

upon to furnish any information required at a moment's notice dealing with Australian Museum procedure. His general relations with the Trustees indicate that his departmental work was always up to date and of highly satisfactory nature. His retirement will be a distinct loss to the Museum, as he has always carried out his duties in a markedly efficient manner, thereby rendering most valuable assistance to the Trustees. After his long and meritorious career in the service of the State, Mr. Wells retires with the best wishes of all the Trustees for a long, useful and happy life.

G.A.W.  
E.C.A.

## Presentations to Dr. Anderson and Mr. W. T. Wells

**A**T the meeting of the Board of Trustees of the Australian Museum on 10 October, the last meeting to be attended by Dr. Anderson, the following resolution was unanimously adopted:

That on the occasion of the retirement of Dr. C. Anderson the splendid services rendered by him to the Australian Museum as an officer and Director over a lengthy period be placed on record in the proceedings of the Trustees.

The Trustees expressed their deep appreciation of his services, throughout which the credit and reputation of the Museum had been maintained.

Dr. Anderson was presented with a portable typewriter, as an aid to the writing of his researches which it is his intention to continue. From the staff he received a wristlet watch, suitably and simply inscribed.

On 14 November the Board of Trustees resolved:

That on the retirement of Mr. W. T. Wells, owing to his having reached the age limit, from the position of Secretary to the Australian Museum, which office he has held since 1924, the Trustees place on record their appreciation of his faithful and valued services. The Trustees gratefully acknowledge the assistance he has so capably and efficiently rendered in the conduct of the affairs of this Museum and the devotion and high sense of duty he has at all times displayed.

In presenting him with a chiming clock, the President, Mr. F. S. Mance, remarked on the efficiency and ability with which he had handled problems of administration.

From fellow officers he was the recipient of a travelling case.



# The Stone Axes of Australia

By FREDERICK D. McCARTHY

**A** GREAT deal of interest is always evinced by civilized nations in the axes of less advanced peoples and in those of prehistoric times. The science of prehistory has been advanced considerably as a result of curiosity in the history of this artifact. The inquiry has been assiduously pursued by trained research workers throughout the world, and today the story is known in some detail.

Two factors which have played an important part in the production of the

Pleistocene times, when it formed the principal tool of the Lower Palaeolithic peoples. In England and France the discovery of eoliths has taken this ancestry back still further into the Pliocene period of several million years ago.

Stone axes were believed to be "thunderstones" and in Europe were kept as sacred objects before their true purpose was known; today the natives of India, China and Malaya and other peoples still hold this belief.

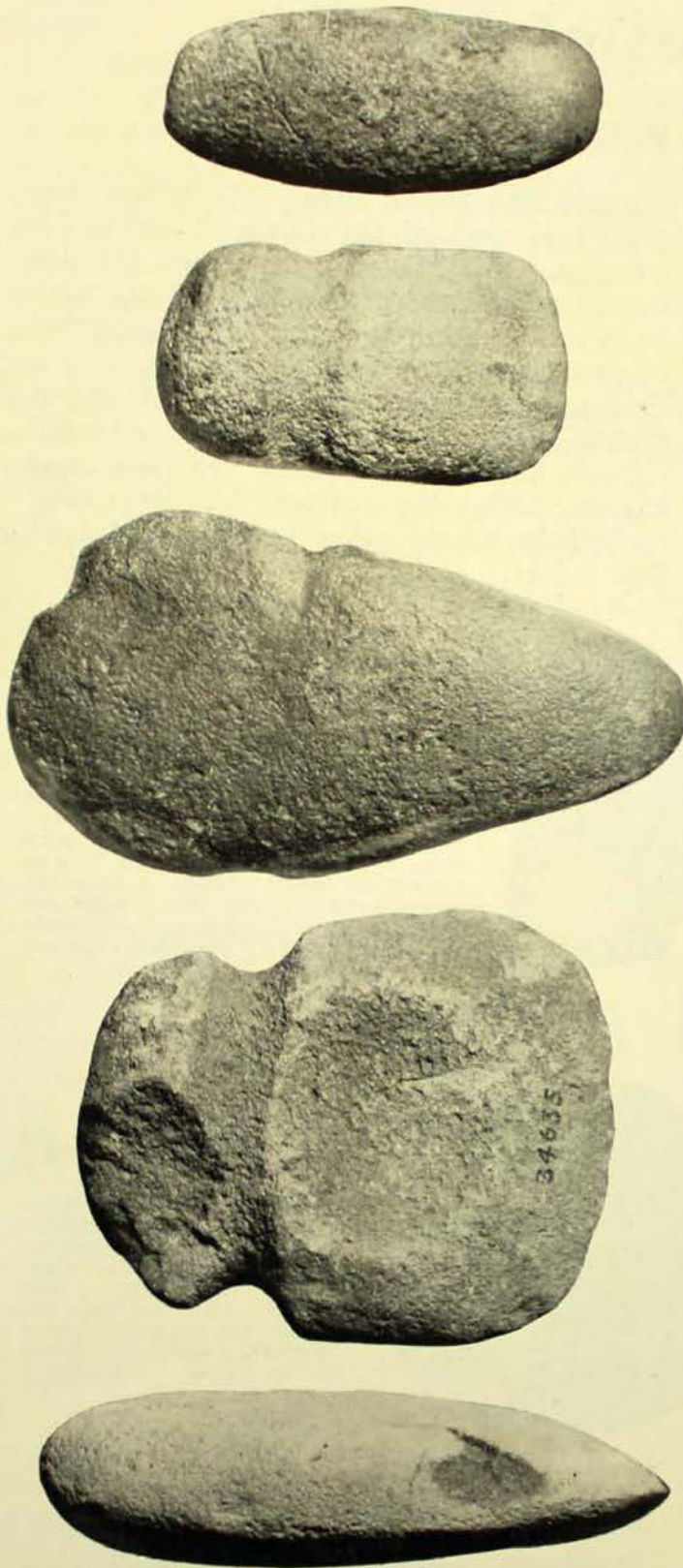


Top row: Hoabinhien type axes. Sumatra hand-axe (left) from Yamba, N. S. Wales; ground-edge sumatras also occur in eastern Australia. Ground-edge axe (centre) made from a water-worn pebble (note the percussive indentations), Sydney. Ground-edge axe (right) roughly chipped to shape, N. S. Wales.

Bottom row: Lenticular axe (left), partially polished, Kimberleys, Western Australia. Discoid lenticular axe (centre), Boulia, Queensland. Tanged axe (right), north-west Queensland. One-third nat. size.

great variety of stone axes in existence are the invention of various manufacturing methods and their wide diffusion into many parts of the world, and the modification of form and technique by local craftsmen. In Europe, Asia, Africa and Java the chipped hand-axe or coup-de-poing has been traced back to early

Available evidence indicates that Australia has had a comparatively short prehistoric period, limited entirely to the stone age, and the axe forms one of the principal criteria in its elucidation. The story begins with a chipped hand-axe in the beginning of the mesolithic period, which commenced about 10,000 B.C. At



Hammer-dressed axes (top to bottom): 1. Rock Flat, N.S.W. A common type in eastern Australia. 2. Wilcannia, N.S.W. Grooved form common in western N.S.W. 3. Type with transverse and median grooves, Rushworth district, Victoria. 4. Axe with groove and mortar-like depression, Rushworth district, Victoria. 5. Polished adze, Murtee, N.S.W. One-third natural size.

this time a kitchen-midden or shore-dwelling people lived in south-east Asia and the Malay Peninsula. Their hand-axe was made by chipping one surface (partly or wholly) of an oval water-worn pebble. This implement is known as the *Sumatra*-type, and is characteristic of the Hoabinhien I culture of Indo-China. It spread through Malaysia into eastern Australia and Tasmania, and it is thought that it was brought by the now extinct Tasmanians:

Other types of chipped hand-axes form an integral part of recent flake industries, but one type from the southern end of the Coorong in South Australia is of special interest. It is made of a bluish-black flint, and varies from a coup-de-poing to an oval lenticular form. Many examples have weathered for a sufficiently long period to bear a white patination (surface film) and some are also iron-stained. They are associated with flakes and ground-edge axes, and it is probable that they belong to the second phase of the Hoabinhien type culture in Australia.

A great change took place in the Hoabinhien II axes of the mesolithic period in south-east Asia. They are chipped and shaped on both sides, and at one end an improved blade was added by grinding on the two faces. Thus the ground-edge axe is a mesolithic prototype of the polished products of the neolithic era. The proto-neolith occurs in Malaya, New Guinea and Australia, but we cannot say whether it was brought by the aborigines (it was not used by the Tasmanians), or whether the technique spread southward as a result of the contact of peoples. The ground-edge axe is found throughout the continent except in south-west Australia. There are two mesolithic varieties. One is made by grinding a blade at one end of a water-worn pebble, which may be chipped along one or more edges in addition. An interesting form has a narrow blade and a pear-shaped body, although oval pebbles were usually selected. The second variety is shaped by chipping a lump of stone from an outcrop; some examples have a



The large hammer-dressed axe from the Bellenden Ker Ranges, Queensland, illustrates the variation in the size of ground-edge implements in Australia when it is compared with a knife (lower), Western Australia, and a chisel (upper), N.S.W.

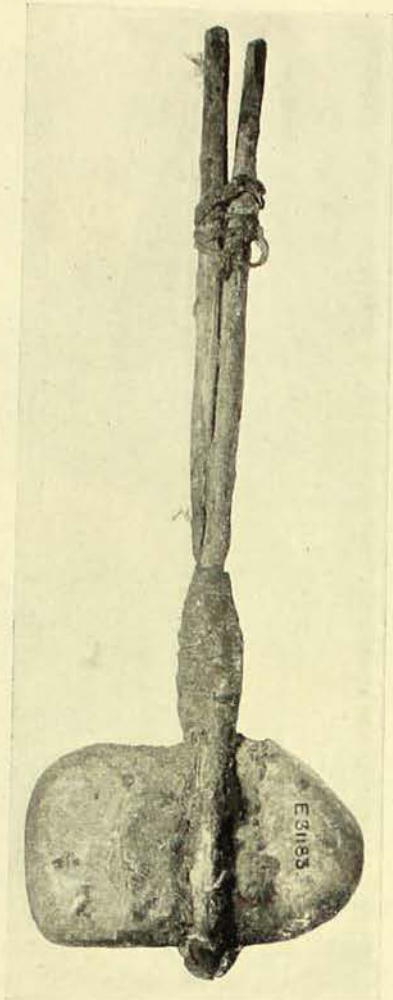
very attractive grain, others a high polish on the blade, and a wide range of rocks are utilized.

A highly developed ground-edge axe of the early neolithic period is known as the lenticular axe. It is convex on both surfaces, with an edge all round its periphery. The chipping is skilfully done and the implement is usually perfectly symmetrical. The type is well polished in New Guinea, the Massim axes forming an excellent example. It is believed that the lenticular axe was brought into north-west Australia by immigrant Papuans, who introduced a number of other customs. It spread in a south-eastward direction across the continent. The rectangular variety of north Australia and the discoid form of western Queensland are both polished over the greater part of both surfaces; in north-eastern New South Wales the oval and round specimens have the ground edge only. The large western Queensland examples form one of the outstanding axe types of Australia.

Another early neolithic axe technique, known as hammer-dressing, was introduced into Cape York from Papua, and

thence spread throughout eastern and central Australia. The chipped or pebble blank is hammered until all unevenness is removed, thus producing a pecked or punctured surface. Hammer-dressed axes vary from round to oval in section. Outstanding local variations among them are the large flattish examples made from pebbles along the eastern Australian coast, the discoid type from western Queensland, and the elongate rounded form of New South Wales and Victoria. The hammer-dressing technique is employed throughout Oceania for shaping stone artifacts, and, in fact, has a world-wide distribution. The workman does not require skilled craftsmanship to use it, merely a capacity for sustained and monotonous labour. For this reason it is impossible to distinguish morphologically between many Australian and American Indian hammer-dressed axes. Shape and thickness are simply controlled, and the pecked surface provides an excellent grip for the hand.

Another type of hammer-dressed axe has a transverse encircling groove either round its middle, above or below it; in exceptional instances two parallel



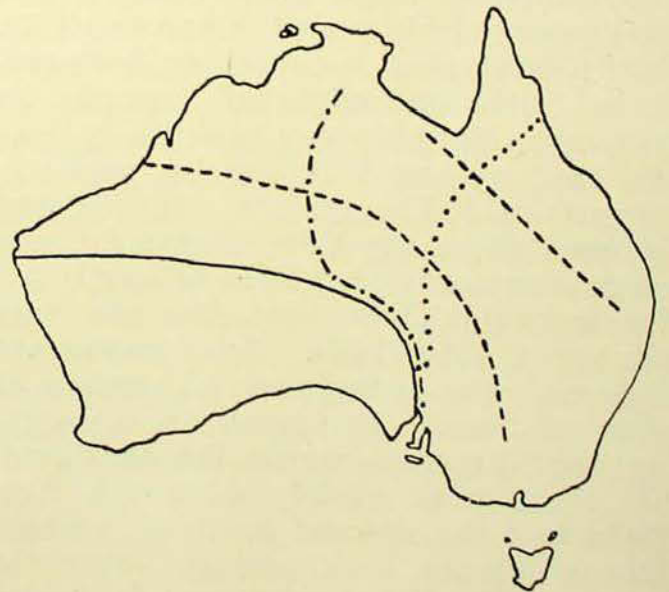
Hafted axe from Clarence River,  
N. S. Wales.

grooves are present. The haft fits into the groove and makes a stronger joint than on the plain axes. This groove is seen on polished axes in Melanesia and Polynesia, and also on hammer-dressed axes in New Guinea. The grooved axe is found in eastern and central Australia, and its local types are similar to those of the plain hammer-dressed axe. The buff-coloured quartzite axes from the Darling and Paroo Rivers form a notable local variety. They are always well made, with a rounded butt, wide and deep groove, and the blade may be polished. Two unusual types of grooved axes come from Victoria. The first one has a varying number of median and diagonal grooves extending across the butt from the transverse groove. The second one has a deep depression on one surface between the groove and the edge of the

blade, and specimens are often heavily weathered.

The tanged axe is an interesting type made in western Queensland, whence it is traded to the Lake Eyre district. The curved blade is broad and highly polished. Flakes are struck off both sides to produce the tanged shape. It is thought to be related to large tanged artifacts found in eastern Australia and Papua, which probably derive their shape from the tanged axe of the bronze period in Malaysia.

The polishing of axes is not very highly advanced in Australia. Technically, polishing is limited to the body of the artifact and should not be confused with the ground-edge blade. In the Oceanic region three techniques—chipping, hammer-dressing and polishing—are employed in making a stone artifact in that sequence, and this practice is followed in Australia. The hammer-dressing is usually omitted on the lenticular axes, notably in the Massim area, and in north Australia and New South Wales. In western Queensland,



Approximate distributional limit of axe techniques.

- Ground-edge, north and east of line, not made in South-west Australia.
- - - - - Hammer-dressed axe, east of line.
- ..... Tanged implements, and adzes, east of line.
- ..... Lenticular section, between broken lines. Note how this form, in its diffusion from north Australia, has cut across the hammer-dressing technique spreading from north-east Australia.



Many people are puzzled when they find grooves about one foot long and several inches wide on outcrops of stone in various parts of Australia. They were made by the aborigines in grinding axe blades. This example is an outcrop of sandstone in the bed of a creek on Mangrove Mountain, N.S.W.

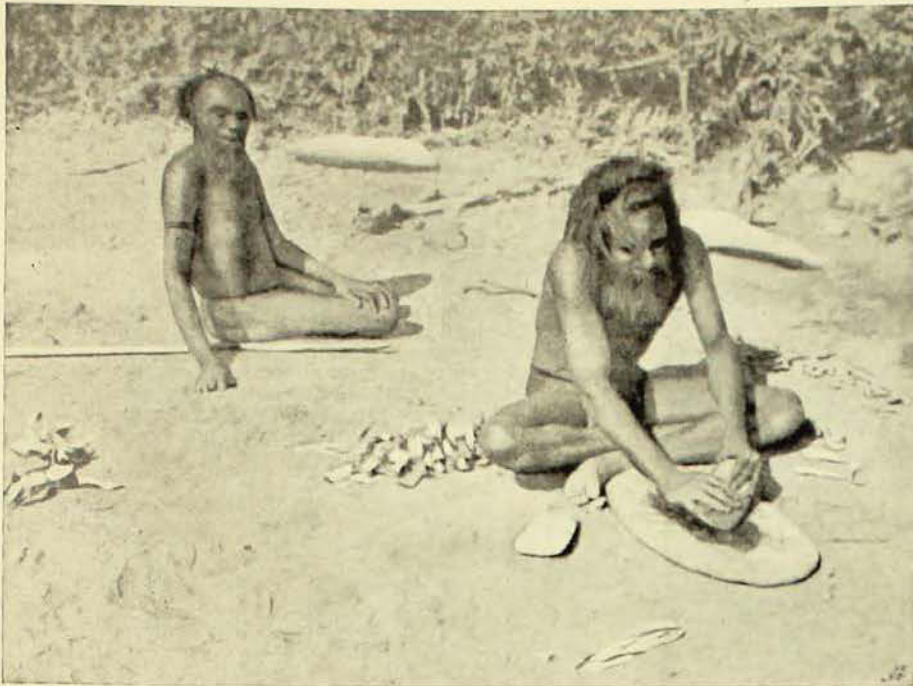
Photo.—F. D. McCarthy.

where the south-eastward spread of this axe type crosses the westward diffusion of hammer-dressing, all three techniques are used on the discoid lenticular axes.

Several interesting points about ground-edge axes might be mentioned here. The weights vary from a few ounces to more than seven pounds. The axes of the Cairns district are the largest in Australia, and many big specimens have been collected in western Queensland, New South Wales and Victoria. The majority of Australian axes are less than seven inches in length, but specimens up to twelve inches long are known. Many Australian axes bear percussion marks due to hammering with their butt, edges or sides. In some cases they have served as anvil stones and bear indentations on one or both sides as a result; it has been claimed that these holes are finger-grips, but a study of a large series of specimens, especially hafted axes, renders this assertion untenable. The materials of which axes are made comprise a wide range of rocks, mostly igneous and metamorphic, such as basalt, diorite, diabase, quartzite, serpentine, and others, although hardened sedimentary rocks are occasionally used. Many outcrops of rocks form "quarries" for the aborigines.

The handle fitted to the axes by the aborigines is of a very poor type in comparison with those of the Pacific islanders. In Australia a piece of strong vine, or a strong pliant plant stem, is bent round the blade, and covered with gum-cement. The two ends of this withe, as it is called, are then bound with twine made from bark-fibre. Generally speaking, this type of handle is quite strong enough for the purpose, but on some hafted axes the strength of the withe is so inadequate in comparison with the size of the blade that a ceremonial function for them may be concluded. Strangely enough, a similar withe is used on a polished double-bladed axe of ritual significance in Bougainville, Solomon Islands.

Although the adze is pre-eminent among the Pacific islanders, it is rare in Australia, where the axe holds sway. Adze-type blades occur among the pebble and chipped ground-edge implements throughout eastern Australia. The true adze shape is found in the hammer-dressed group, especially in the Darling-Paroo district of far western New South Wales, where quite large examples have been collected.



An Aranda native of Central Australia sharpening an axe blade. In those parts of the continent where suitable outcrops of stone do not occur, small axe-grinding stones are carried about or left at camping places.

Sir W. Baldwin Spencer.

Another series of ground-edge implements includes the skinning-knives, which vary from small flakes to pebbles with a lateral blade. Ground-edge chisels may be mounted on short handles with twine and gum-cement, while others, made from long flat pieces of stone, are used without a handle. Most of these tools are miniature, and are found throughout the distribution of the ground-edge axes on the continent.

This brief description of axes in Australia gives some idea of the wide range

of types and their local variations, and the study of their development forms an interesting aspect of the history of the progress of culture.

Although the Australian Museum has a large collection of stone axes and adzes from Australia and the Pacific Islands, some localities and types are unrepresented. Specimens from these regions would be welcome as they may assist in completing the collection.

Mr. Ted Dranga, a prominent conchologist from Florida, made an extensive examination of the Museum's shell collection, having flown from Bali. At Bali he had made considerable collections from which he was kind enough to make valuable additions to our material. He also presented some beautiful exhibition specimens from the West Indies.

Mrs. Archbold, accompanied by Mr.

Tucke Abbott, visited this Museum recently. They were on their way to the Pacific, where they will join the Archbold Expedition which is making extensive zoological collections at Fiji, and the Gilbert and Ellice Groups. This expedition is sponsored by Mrs. Archbold, and is collecting on behalf of the Museum of Comparative Zoology, Harvard, where Mr. Abbott is Assistant Conchologist.

# Animal Parasites—The Tapeworms\*

By FRANK A. McNEILL

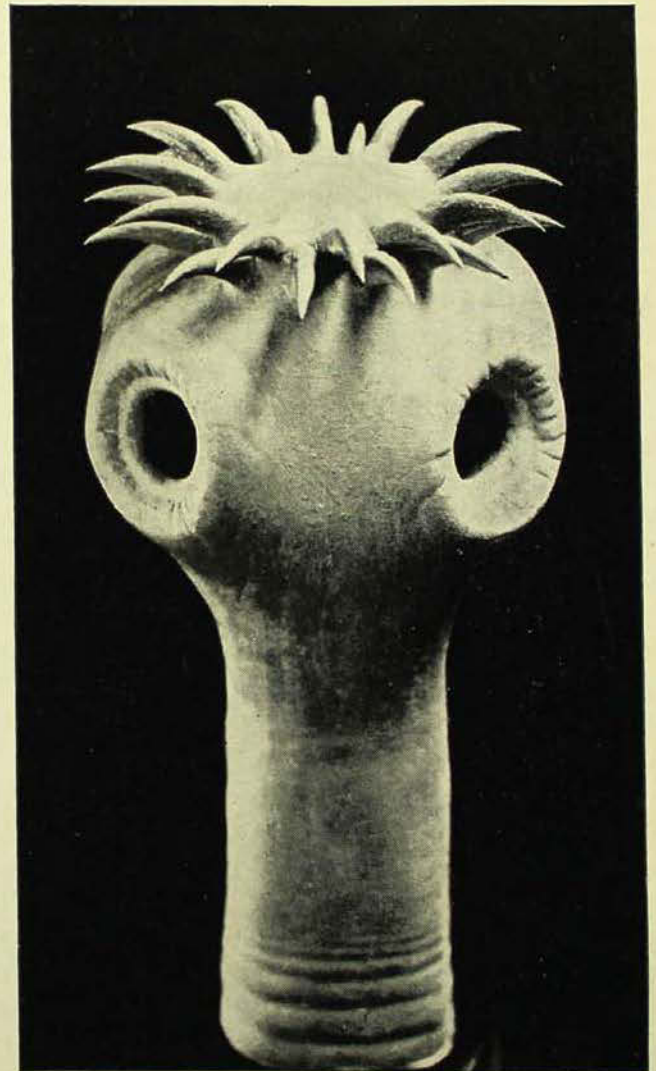
THE statement that parasites are numerically greater than free individuals will offend the credulity of most people. Too many are apt to look upon the parasitic habit as an aberrant way of life—something quite immoral or at least less respectable than the mode of existence of free-living animals. But since we have the proof of science in these matters, should we not consider a parasitic existence a normal way of life? The parasite, too, is not always the dread killer that many believe. Its very existence depends upon doing the least amount of harm to the animal it infects. In some cases it is actually beneficial. Hence who can say that the parasite is a less considerate creature than the carnivorous animal, which strikes down and kills its victim outright?

It is true that, of the millions of animal parasites, there are a vast number which are invisible unless we are able to see them magnified under a microscope. Even those of visible proportions are mostly hidden from our everyday sight, and for this reason alone are unfamiliar. The question of the size of parasites brings us to the subject of this article. Tapeworms as a group can be accepted as the largest animal parasites, especially those infesting mankind. These degenerate creatures live in the intestine or food tract of what we will call their hosts. In a way they are visitors, although unwelcome ones, deriving their nutriment from the food passing through the bodies of their victims—food that has been secured and brought to the tapeworms without their making any effort on their own behalf. In any case, they could not help themselves in that way, for their manner of life has made them completely helpless for anything other than living without eyes in a place of black darkness.

In fact, they are even devoid of a mouth to feed with, but the explanation of this can be postponed for the moment. Let us first of all study the shape and parts of the tapeworm body.

## STRUCTURE AND LIFE CYCLE.

At one extremity of the tapeworm there is a well-defined knob-like head. Although in life this is the smallest part of the animal, it has a very important work to perform—that of clinging to the sides of the intestine to prevent dislodgment by food passing on its way. A crown of sharp



Model of the head of the Pork Tapeworm, greatly enlarged. The illustration shows the commencement of body segmentation in the neck region.

\*Based on an address in the Educational Broadcast programme to schools.

spines is used as grapple hooks. Below are the several openings around the head which might be mistaken for mouths. Actually these are very strong suckers, and take so firm a hold that the tapeworm could not be pulled from its position without breaking apart. Behind the head the body gradually becomes wider and wider, until it has the appearance of a thick tape. The accompanying illustration shows this feature very well. Single tapeworms living in man in other parts of the world have been known to be three-quarters of an inch wide and sixty feet long. Different kinds are different lengths. Quite commonly individuals are twenty and thirty feet long, even in small animals like dogs.

The tape-like body is divided all along its length into sections. These are bigger and more clearly seen towards the hinder end of the worm. Just behind the neck region of the head the sections barely show as close wrinkles in the skin. And the extraordinary fact about a tapeworm is that it adds to its length by growing more body sections in the neck region. There may be hundreds of these body sections in a single tapeworm.

Reverting now to the question of how tapeworms feed, we can say that their lack of a mouth is bound up with the dependence on a host's help throughout life. Degeneracy has accounted for the absence of any sign of this familiar organ. Neither is there a trace of any digestive system in the whole length of the body. Living as they do in the intestine of another animal, digested food is ready at hand for them. They simply "soak up" their nourishment in truly the laziest way of living.

Those sections of the body we have spoken about are each complete little units of their own. The biggest sections towards the hinder end are called the ripe segments, and their important function is breeding. Two sexes are combined in each of the ripe segments, and each is able in a wonderful way to develop great numbers of fertile eggs. Thus as each segment in turn becomes fully mature at the end of the tapeworm,

it drops off and passes out with the waste matter from the tapeworm host's body. The beginning of many thousands of very minute baby tapeworms may be gathered together in one of these ripe segments. Unless the eggs reach some place where they will be taken in with food by another and different animal host, all will perish. Nature ensures, though, with such prodigious broods, that a few at least will go on to the next stage of the life-history or cycle, otherwise there would not be any more tapeworms in the world.

As different kinds of animals are generally the hosts of different kinds of tapeworms, it naturally follows there must be some sort of connection between the first host and the second host in the life-history. Sometimes there is even a third host figuring in the cycle of a life-history. Thus again we find Nature has so arranged things that the tapeworms in dogs come from the rabbits, or maybe the wallabies and kangaroos they hunt and eat; and sometimes even from sheep, as we will learn later on. Birds of prey get their tapeworms from the mice, rats and snakes or lizards they capture for their food. Man is able to get tapeworms from eating raw or only partly cooked fish, beef and pork. Even some fishes have tapeworms. The manner of transfer is called passive, and hinges on what happens to the tapeworm eggs once they reach the open air. To make our story clear from this point onwards, we will have to deal with one special kind of tapeworm. As an example we can take the most common tapeworm met with in man. This is the so-called Beef Tapeworm.

#### BEEF TAPEWORM.

The second or intermediate host of the Beef Tapeworm is the cow, bull or bullock—animals which provide mankind with beef. In places where sanitation is either poor or lacking, some of the eggs of the Beef Tapeworm are carried to the grasses or other vegetation eaten by their large animal hosts. Once an egg is swallowed in this way the tough covering is digested off and there emerges a mite of a thing called an embryo. It is armed with six



tiny hooks, and bores its way through the wall of the intestine straight into a blood vessel. The blood carries the minute baby to a muscle, where it settles and grows into a sac or bladder which is about half an inch long. Inside the bladder is grown the little head of the future tapeworm.

The Beef Tapeworm bladders may be carried by the cow or bull for the rest of its life without any inconvenience. And if an infected beast dies a natural death, nothing further happens to the bladders. If, however, there is a killing to supply beef for human consumption, and man eats the raw or undercooked meat containing the bladders, their skins are digested off and the little tapeworm heads inside push out and cling on with their suckers. Back again now to its final host, the life-history of the Beef Tapeworm is completed. Nourished by the plentiful supply of food so close at hand, it soon grows the usual long body and produces eggs in the same way as the parent tapeworm did before it.

It is the duty of meat inspectors at the killing yards of big centres of population to seek in the carcasses for the bladders of Beef Tapeworms. Most frequently they are found in the jaw muscles and in the muscles of the heart, and even though large, they can at times be overlooked. Intensive meat inspection in Australia and in the United States of America has greatly reduced the occurrence of this once common parasite. In the latter country, though, the barbecue vogue is still a source of infection. Today in the Sydney, Australia, abattoirs "measly" beef is a great rarity; the last case on record occurred years ago. Measly mutton is much more prevalent, but this is concerned with the life-history of one of the larger tapeworms of the dog. The most recent extensive Australian occurrence of measly beef was about seven years ago. It was traced to a herd of cattle kept on a sewage farm in Victoria. The record is published in *The Medical Journal of Australia*.

The population of parts of Africa where sanitation is poor, is badly infested by

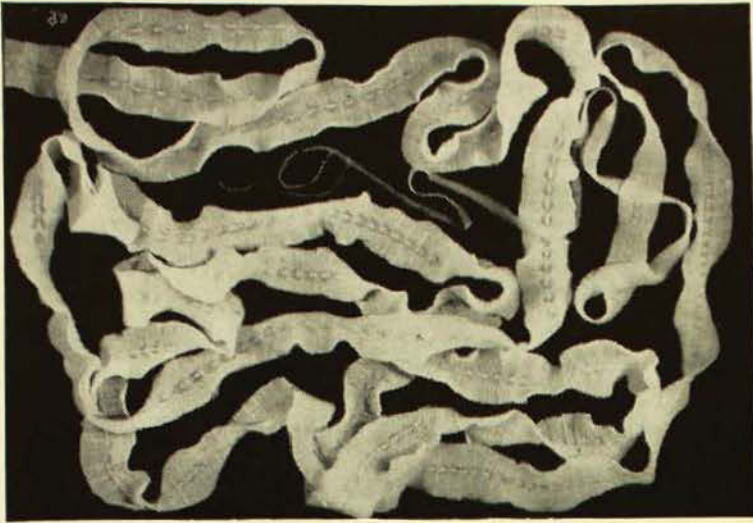
Beef Tapeworms. And in Tibet, where beef is eaten after primitively broiling large pieces over an open fire, a large proportion of the population is infected. The practical immunity of the Hindus of India is understood when we consider the sacred place the cow has in their religion and the consequent restrictions against the eating of beef. It would be very embarrassing for a Hindu to be caught with a Beef Tapeworm.

#### PORK TAPEWORM.

In the same way the not uncommon Pork Tapeworm found in man rarely troubles Jews and Mohammedans, who similarly avoid eating the meat of the pig. The Pork Tapeworm resembles the Beef Tapeworm closely. It has a similar life-history except, of course, that the bladders develop in the pig, which in this case is the second or intermediate host. Although the possession of a tapeworm may cause a person some degree of mental and bodily discomfort, and sometimes even severe sickness through what is believed to be the release of poisons in the system, death rarely eventuates. There is, however, one especially dangerous thing about the Pork Tapeworm. Occasionally the embryos are freed from the eggs inside a human host without going on normally to the intermediate host—the pig. The bladder stage then develops, and if finally lodged in the muscles, no great harm results. At times, however, the bladders lodge and grow in the eyeball, with dangerous results. Some cases, too, of insanity and epilepsy have been proved to be due to the lodgment of a bladder stage in the brain.

#### BROAD FISH TAPEWORM.

The most injurious tapeworm that lives in man is, of course, the variety attaining the great length (sixty feet) referred to earlier. This is called the Broad Fish Tapeworm and is one in which the life-history features two intermediate hosts. For the uninterrupted progress of the cycle the eggs must reach water and the hatched larvae be eaten by tiny crustaceans called copepods. The copepods



Example of the Broad Fish Tapeworm taken from a dog. The head end of the worm seen in the centre of the picture is reduced almost to a thread. (Half natural size.)

After H. McL. Gordon.  
(Block by courtesy of "Medical Journal of Australia".)

in turn are eaten by fishes. Man becomes infected by the tapeworm when he eats raw or imperfectly cooked fish. Even dogs, cats, pigs and presumably any other fish-eating mammal can be the hosts of this particular tapeworm. In the human host the parasite gives rise to severe anaemia.

According to an American authority (Buchsbaum, in *Animals without Backbones*, 1938), the Broad Fish Tapeworm occurs in many places all over the world and has been known for centuries in the Baltic region of Europe, where in some localities nearly all of the people are infected. The same authority states that: "In relatively recent years Baltic immigrants to our Great Lakes region have brought these tapeworms with them and have established them by infecting the fish in the lakes of Minnesota, northern Michigan and Canada. Since these lakes supply millions of pounds of fresh fish to other parts of the country, and since visitors to the region carry tapeworms home to their own localities, this parasite is spreading in the United States. . . . Those who eat fishes from these regions should never taste the raw fish during the preparation, and should be careful to cook the fishes very thoroughly; smoked fish may not be safe."

In Australia the Broad Fish Tapeworm is occasionally detected in immigrants, and has recently been found in several dogs. Generally speaking, though, tapeworms in man in this country are comparatively rare.

#### SMALL DOG TAPEWORM AND HYDATIDS.

There is, however, one dangerous intermediate stage of a tapeworm infecting humans here which, up to comparatively recent years, was far more prevalent than it should have been. This is the hydatids phase of the Small Dog Tapeworm, which is such a tiny creature that one would never suspect it was capable of so much harm. The length is little more than one quarter of an inch, and the body is made up of only three or four sections. Minute ripe eggs of this particular parasite can reach the intestine of man on uncooked vegetables which are eaten without being thoroughly washed. Children playing with infected dogs, mainly in country districts, are liable to pass the eggs to their mouths with their fingers. The result is the development of a hydatid cyst (the equivalent of the bladder in other tapeworms) which may become a terrible complaint. When man inadvertently becomes the intermediate host of the Small Dog Tapeworm there is an end to the life-history. This is not carried on for the simple reason that the dog does not eat man. It is a case of one of Nature's laws going somewhat astray. Hence we find that in these circumstances a hydatid cyst lies undisturbed for years. The resulting ailment becomes aggravated through the capacity of the initial or mother cyst to add continuously to its bulk by budding off daughter cysts. Medical men say that mostly a hydatid cyst is as old as the patient, and when contracted in childhood often remains symptomless for up to twenty years. Without timely removal, the increasing volume of a hydatid cyst in a vital organ will cause death. Even while growing in any part of the human body there is always the deleterious effect of the poisons which are secreted.

A normal intermediate host for the Small Dog Tapeworm is the sheep, or maybe the rabbit, which is at times hunted and eaten by dogs in the country districts. Through lack of knowledge of these things in the past, nearly all country families who killed their own sheep for the homestead larder, threw the uncooked entrails of the carcasses to the dogs. This ignorant assistance to Nature left nothing to chance, and is one of the reasons why hydatid cysts in humans are more common in Australia

and New Zealand than in most other countries. The disease might be almost wiped out if all dogs' meat were cooked, or even immersed in boiling water for a few minutes. The main protection to the city centres of population is provided by the Government-controlled inspection of meat.

When the presence of a tapeworm is detected, a prescribed drug taken by mouth will kill the head and cause the parasite to detach itself from the intestinal wall.

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## School Films

FROM time to time reference has been made in these pages to the work in visual education, particularly films, that this Museum is engaged upon.\*

As we have mentioned previously, these films are produced as a result of generous aid from the Carnegie Corporation of New York, and they are circulated by the New South Wales Department of Education to schools and colleges.

Typical of these films is "Creatures of the Rocky Sea-Shore", a film of approximately 1,100 feet. Many other films have been prepared, and others are in the process of preparation.

To the young naturalist, the sea-shore is a never-failing source of interest. Among the boulders of its rocky reefs there is concentrated a wealth of marine creatures. These are mostly hidden from sight, as they have to seek protection for themselves from the destructive waves which ceaselessly break over their homes. This is why so much attraction attaches to a search when the tide falls and exposes an area of reef that may be explored. Every peep into a rock cleft or crevice produces a feeling of expectancy. Both

here and among the weeds and under the numerous boulders different and fascinating finds may be made. We can learn how the shore creatures feed. How they move about with the aid of organs strangely unlike the feet and legs of more highly developed animals. Then there is the great variety of shape, fashioned by Nature to fit creatures to their special modes of life.

This film has been prepared with the object of drawing attention to all these things. Where the very full titles lack some detail it will be found that some action in the production prompts the attention of a student. This is the true function of visual education.

All the most conspicuous or more readily found denizens of the rocky sea-shore are included. The subjects are those which inhabit any part of the ocean shore-line of New South Wales.

More common objects, such as the Sea Urchins and the Coat-of-Mail Shells, have been developed and expanded into lessons which are considered adequate for the youthful mind to absorb. Other creatures selected for the screening of some special feature have had that feature emphasized in the production, and with either title or action due comparisons have been made.

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\* "The Museum and the Cinema", AUSTRALIAN MUSEUM MAGAZINE, Vol. vii, No. 4, March-May, 1940, p. 111.

# The Mountain Minnow

## Some Additional Notes

By FRANK WALFORD

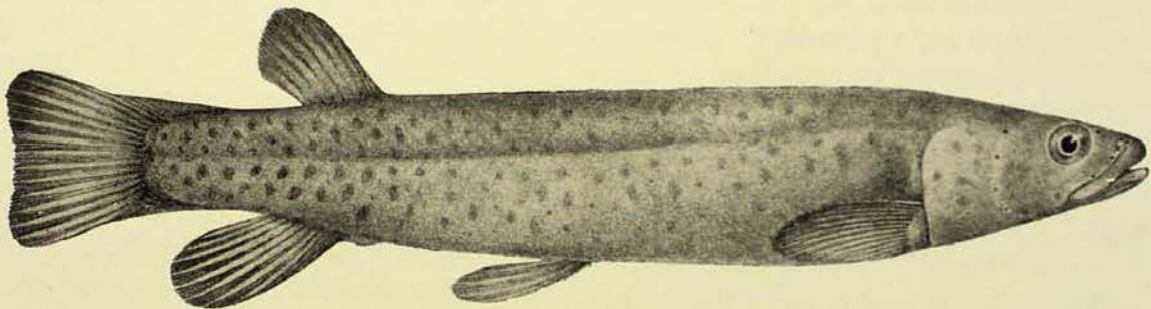
EARLY in 1927 I began to observe the habits of the Mountain Minnow (*Galaxias coxii* Macleay).<sup>\*</sup> Naturally, at that early stage in my investigations, the available facts were meagre and to a certain extent presumptive. However, continuous if necessarily sporadic (the native habitat of this fish is six miles from my home) study has confirmed practically all that was stated and deduced in my first article. It is only in a few minor details that I have felt compelled to revise my conclusions.

To clarify the following notes and establish a starting point, it might be well to set out the text of my original remarks categorically.

inches. It lives, breeds, and dies in fresh water.

The foregoing facts apply strictly to its native habitat. I find that it modifies its habits radically when transferred to higher levels. In this relation it is important to bear in mind that Megalong Creek is less than 2,000 feet above sea-level, whereas Katoomba is 3,300 feet—approximately 1,300 feet higher, with consequent reductions in temperature at night and during winter.

To facilitate study of this interesting little fish, I constructed a concrete pond in my garden at Katoomba. In this restricted habitat they have thrived excellently, and *bred regularly* for thirteen



The Mountain Minnow.

The Mountain Minnow lives and breeds in Megalong Creek, which rises in Nellie's Glen, on the central ridge of the Blue Mountains, near Katoomba, and flows south-west to join Cox River. There is no evidence of natural aestivation or hibernation. The fish is active through the full twenty-four hours. It does not burrow into the ground after the manner of its Tasmanian cousin, *Saxilaga*, or the New Zealand mudfish, *Neochanna*, nor retreat to lower levels during winter, as does the Mt. Kosciusko species, *G. findlayi*. Its maximum growth is five

years. The latter fact, coupled with irrefutable evidence that they breed annually in Megalong Creek, definitely refutes the suggestion that they find it necessary to struggle to the sea to reproduce, as does *Austrocobitis attenuatus*, which inhabits the freshwater reaches of Parramatta River. *Galaxias coxii* is definitely a freshwater denizen, completing its life cycle in its native stream.

In my pond I found a significant change in habit. At first, the fish were active in all seasons of the year. But gradually they became lethargic in the colder months, slinking under rocks and behind weeds, and displaying distinct symptoms

<sup>\*</sup>The initial results were published in THE AUSTRALIAN MUSEUM MAGAZINE, Vol. iii, No. 8, October-December, 1928, p. 274.

of torpor. Later, they frankly hibernated, by burrowing into the silt which has accumulated at the bottom of the pond. This change of habit, I assume, is due to the lower temperatures on the heights, where several degrees of frost are common in winter, often for periods covering days.

As the pond is "still" water, and they are essentially lovers of turbulent mountain burns, I introduced a number of fairly mature specimens into a permanent creek adjacent to my home. In this stream they have increased enormously in the space of a few years, and now number many hundreds. Owing to the persistency with which children harass them, they are excessively timid, and dart for cover immediately a human being appears. This, of course, interferes with observation to a marked extent. However, their presence has enabled me to confirm previous findings, which may be enumerated as follow:

A.—In Megalong Creek there are two main hatches of fry each year: one in September, one in November. Reproduction is not entirely restricted to these months; but the major hatches occur then. Fry, which obviously have been recently hatched, are always to be found from September to January, inclusive, but, apart from the two major breeding months, in small numbers.

B.—A warm spring witnesses a similar consistency in breeding habits on the high levels, both in my pond and in the artificially peopled creek. But should the spring be unduly cold, the September hatch is missed. Each year, to date, the November hatch has taken place, whereas the September hatch is frequently absent.

C.—The acquired habit of hibernation occurs during the four coldest months of the year, as a general rule; but its incidence varies in sympathy with the mildness or severity of the winter. It contracts or expands at either end, according to weather conditions, and may embrace any four-month period, or less, from May to October, inclusive. A particularly mild winter may witness the period reduced to three, or even two months. It is most

variable, evidently being directly dependent on the thermometer, and no universal rule can be stated. However, the salient fact is the annual occurrence of the winter torpor.

Just after I had established the foregoing facts to my satisfaction, I struck a patch of luck! I discovered *G. corii* on Katoomba's water conservation area, in Whipcord Creek. With an intimate knowledge of Katoomba and its environs, I think I may say confidently that Whipcord Creek is the only stream on the higher levels in which this fish is indigenous. It makes me wonder whether it has not come there adventitiously. Probably the point will never be cleared up; in any case, it is purely of academic interest. The important fact is the presence in its waters of *G. corii*.

By the courtesy of Katoomba Municipal Council, in response to a request by the Secretary of the Australian Museum, I was granted permission to enter the catchment area at will, in order to prosecute my studies of the fish. Their conduct in Whipcord Creek accords exactly with that witnessed in the artificially peopled creek and in my pond. They hibernate by burrowing into the soft silt in the creek bed. Patches of sand are avoided and preference shown for muddy areas. The reason of this, I imagine, is obvious. Not only is the mud softer and smoother in texture, but it does not consolidate in water, as sand does. The density of precipitated silt is little greater than that of water.

Thus we discover a fish, which normally does not hibernate, acquiring the habit when transferred to a colder climate, and spending the winter months buried in mud. It is a remarkable instance of the adaptability of an organism to a changed environment. Nor is it the sole instance of this hardy fish's adjustment to its surroundings. During the current summer there has been a water famine at Katoomba. Our normal rainfall of fifty-eight inches has shrunk to negligible proportions. This has meant permitting the contents of my pond to fall to a few inches in depth. During early November a leak

developed and the water vanished, leaving a mass of "soupy" mud in the bottom, covered with wilted marine growths. How many hours this condition had prevailed, I cannot say; but the mud was hot and steaming. Hastily I carried water in buckets from an adjacent creek, and immediately the fish emerged from the silt, none the worse for their experience. The sole casualty was one which had become entangled in the weeds, and was unable to burrow for shelter.

I have repeatedly noticed two peculiar phenomena. Immediately rain begins to fall the fish seek the seclusion of rocks and weeds. Also, lightning appears to send the fry into a panic. Both habits may be due to inherited ancestral memory, to which we have applied the blessed word "instinct". Rain inevitably means turbidity on the Blue Mountains, and this fish evinces a marked distaste for water that is not crystal clear.

In the last regard, a notable difference between their behaviour at high and low levels is worth recording. In Megalong Creek, fright causes them to dart swiftly up or down stream. In their three habitats on the high levels, they seek security by burying themselves in the silt. Possibly their winter retreat has taught them that safety lies that way. The habit is the more peculiar, in view of their innate hatred of turbid water.

With *G. coxii* breeding in my pond, I have had excellent opportunities for observing the development of the fry. When first seen, they are transparent organisms about  $\frac{3}{16}$  inch in length. The sole specks of pigmentation are the eyes, which are jet black. They grow quickly, and at six weeks are about an inch long, with a black notochord running from head to tail, and eyes proportionately larger than at any other stage of their existence. The stomach (probably due to ingested food) is a dark pouch, with a thin black line on the ventral side, connecting it with the cloaca. When swimming, the whole body works from the head back, much as a ciliated cell does, assisted by normal fin movements. They have the capacity of moving and darting with

astonishing celerity—a needful accomplishment, as the larger fish harry them remorselessly. In the last connection I have noticed a peculiar fact. It is only *strange fry* which are worried. Once the older fish have become accustomed to their presence they ignore them. This seems to obtain with all alien organisms introduced into their streams and pools. For instance, if Whirligig Beetles (*Macrogyrus oblongus*) are placed where none formerly existed, the fish make their lives miserable for some hours. Then they accept them with complete indifference.

At eight weeks—to revert to the growth of the fry—the body has thickened remarkably, but the tail remains slender. This gives them a faint resemblance to a starved tadpole. Their length now is about  $1\frac{1}{4}$  inches. At this stage their swimming powers, while still remarkable, seem less potent than at any period of their lives.

When three months old the fry present a peculiar, pseudoarticulated appearance, being divided into four fairly defined "segments" which may be conveniently described as head, thorax, stomach and tail. A month later the points of constriction vanish, and the fish assumes the true adult form. At this stage its pectoral fins appear to be rather disproportionately developed.

I am unable to say at what age the fish begins to breed; but there are factors which cause me to suspect that it is comparatively early.

*G. coxii* is long-lived. I have had specimens in my pond since 1927. With some knowledge of their growth stages, I should say that they were four years old when introduced. Consequently, they are now seventeen years of age, and still active and vigorous, despite the vicissitudes inseparable from life in such an artificial environment.

Once, by way of experiment, I introduced into my pond a few common gudgeon (*Gobiomorphus coxii*) from the freshwater reaches of Parramatta River. They were in process of digestion before nightfall!

My little daughter has a small pond of her own, wherein she keeps tadpoles, water nymphs and kindred "wogs", as she styles them. I found it almost literally wriggling with mosquito larvae, and transferred two of my fish to it. Next day not a larva remained. Twenty-four hours later I found that the tadpoles had vanished also, a catastrophe which placed me in my daughter's bad books.

Recently we heard much of an imported fish which destroys mosquito larvae. Why bring these exotics into the country, when in *G. coxii* we possess one of the most voracious eaters of mosquito larvae known? It is hardy, adaptable, long-lived, a prolific breeder, and unusually active and ferocious. Woe betide any "wiggler" which dared to invade its demesne.

For the information of aspiring aquarists, this fish will not live in a bowl. Twenty-four hours will witness the death of fry, and a considerably shorter period that of larger specimens. Possibly faulty aeration is the trouble. It will not eat fat; but any kind of raw, lean meat, well minced, is taken greedily. At first, I was in the habit of "chopping" earth worms as food for them. I soon discovered that they experience no difficulty in disposing of whole worms. It also is interesting to

watch the tugs-of-war which ensue when worms are tossed into the pond. As many as six or eight fish will seize one and wrestle desperately for possession. Unless a pool is over-crowded, once per week is sufficient artificial feeding. The novice will soon learn to gauge the quantity required. As with domestic fowls, the ideal is not to have any scraps lying about after the meal. If a concrete pond be used, let it "mature" for six or eight weeks before introducing the fish. A fairly safe indication is the development of slimes; wait until the walls of the pond are brown with vegetable growth. The acids from new cement are fatal.

In conclusion, there is one extraordinary aspect, about which I can only theorize. Ordinarily, the stagnant water of a pond grows "thick" and cloudy. This phenomenon does not occur in pools where *G. coxii* is kept in adequate numbers. Can the explanation be that it eats microscopic vegetable growths as well as the (presumably) animal life which it so assiduously ingorges from the walls of the pond? For periods ranging from a few minutes to fifteen or twenty, this fish will work along a wall at snail's pace, almost literally *licking* it! Its mouth opens and closes steadily as it is scooped along the wall. This practice is only indulged at surface level.

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Mr. M. W. F. Tweedie, B.Sc., Curator of the Raffles Museum, Singapore, F.M.S., is in Australia on furlough. Though a zoologist specializing in Crustacea, he is nevertheless intensely interested in pre-history, and whilst in the Commonwealth both these subjects will receive his atten-

tion. He spent some time here examining our collections.

Mr. J. R. B. Stewart, an archaeologist from Cyprus, visited the Australian Museum recently. He is particularly interested in art designs, and is engaged in a comparison of those of the Middle East and the Pacific.

# Put to the Swordfish

By G. P. WHITLEY

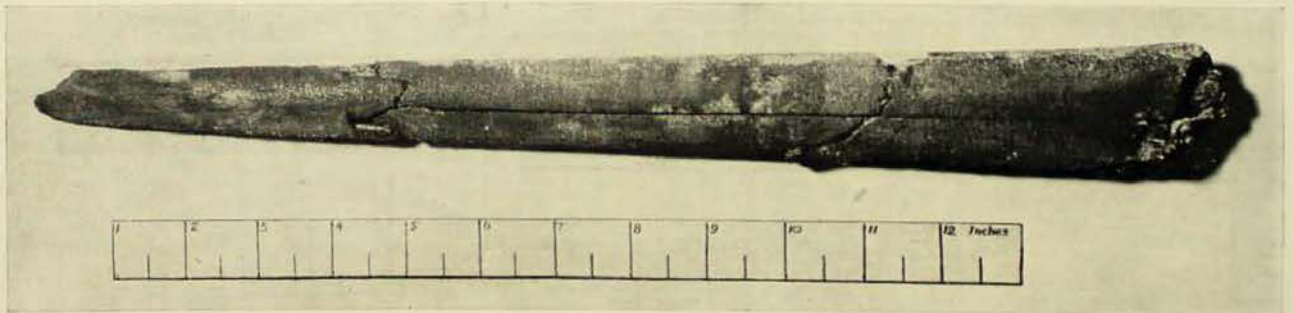
It is a swordfish that hath wrought us this,  
Nigh ruining our venture. Yea! a fish  
Six cubits long that hath for nose a beak  
Bony, shaped like a sword, sharp like a sword  
And hard as tempered steel; strong fins and tail  
That in its times of anger and attack  
Drive it like arrow through the waves. It hates  
The Whale; mistook us for its enemy;  
And dealt us deadly thrust. The blade had gone  
Through half a cubit of fir plank and oak—  
Loosening a beam end—where the sea poured in.  
The fish had broken off; his sword stood out  
A span clear in the hold.

—EDWIN ARNOLD, *The Voyage of Ithoba!*

**T**HE Australian Museum recently received, through Mr. S. G. Green of Burns, Philp & Co. Ltd., Sydney, the sword of a marlin swordfish taken from the hull of a ship at Apaiang, Tarawa, Gilbert Islands. This sword (or rather the fractured portions of it) is now on public exhibition in the Fish Gallery. It was accompanied by the following information from Mr. J. R. Handley of Tarawa, dated May 12, 1939.

Our native diver went down to examine and found about eight inches of splintered sword projecting out from the third strake up from the keel. That was cut away and cleft closed up. Now we have finally broken up the "Mauno". We were able to see with what terrific force the fish had struck the vessel. I am forwarding you by parcel post the part-length of sword. It had penetrated the sheathing, a two and a half inch plank, clean through at an angle of an eight inch timber and into an adjoining timber about five inches. It got broke into three pieces getting it out, but we joined them together though not too strongly. . . . We must have appeared as a whale, and to pierce 14 inches of solid timber it must have come with terrific force. I knew of a similar accident about 50 years ago, a Canadian vessel came into Valparaiso leaking. She too had been pierced by a sword fish.

Knowing that my friend Dr. E. W. Gudger, of the American Museum of Natural History, was interested in cases such as the above, I sent him the particulars for a monograph he was writing on swordfish pugnacity. But the information arrived too late for inclusion in his



The broken sword of a marlin, taken from the hull of a ship in the Gilbert Islands, and now on view in the Australian Museum.

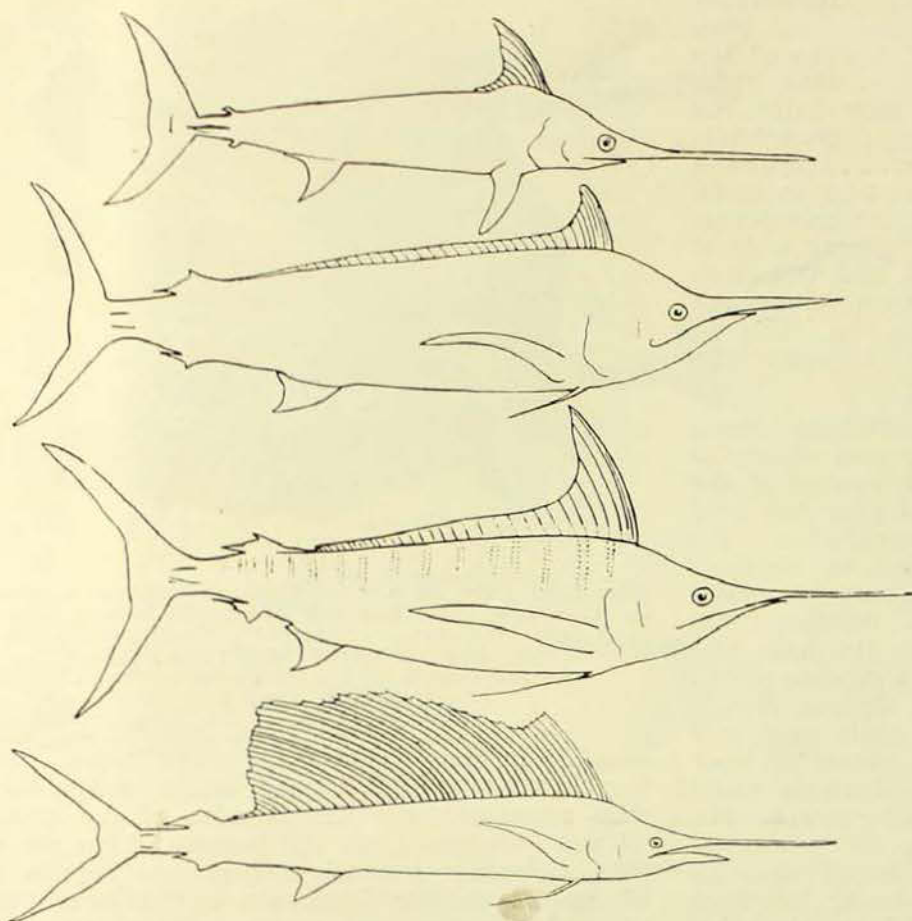
G. C. Clutton photo.

Here is a fish story, but a most extraordinary and authentic one. It may interest you, so I send it along. Late 1927, "Mauno" was at anchor S.W. Point Apaiang, outside. During the evening we felt a sharp vibration of the vessel. At first I thought we had touched a horsehead, but no. Then we concluded it had been a marine earth tremor, and so it passed off at that. But the following day we were making water. A close search was made and found one of the after limbers was welling up.

account, which has just been published\* by the Royal Asiatic Society of Bengal, Calcutta, so now, at his suggestion, I record it here, together with some references to swordfish attacks on vessels in

\* Gudger, E. W.: "The Alleged Pugnacity of the Swordfish and the Spearfishes as shown by their Attacks on Vessels", *Mem. R. Asiat. Soc. Bengal*, xii, 2, 1940, pp. 215-315, pls. iii-ix, and 22 text-figures.



**Swordfishes true and false.****Spearfish (*Xiphias*).****Black Marlin (*Istiompax*).****Striped Marlin (*Marlina*).****Sailfish (*Istiophorus*).**

Australian waters. Dr. Gudger's paper is a classic of its kind, for it details every case known over 2,000 years, from the Greek historian Polybius to modern newspapers.

Attacks by swordfishes on boats are delivered with such force that a penetration of 20 inches is recorded, of which at least  $14\frac{1}{2}$  were through solid oak; sometimes these attacks occur at night, but generally it is when a swordfish is being angled.

Perhaps the most spectacular incident occurred when Errol Flynn ("Robin Hood"), the Australian movie actor, was fishing in Mexican waters recently, and a 9-foot marlin was shot by a sportsman on board using a bow and arrow. Two men then went out in a dinghy to retrieve the fish by a line attached to the arrow. The marlin charged the boat and drove its head and half its body through one side and its spear projected about a foot beyond the other side of the dinghy. This

smashing blow was made possible by the fact that the planking of the boat was made of soft redwood only half an inch thick, and by the considerable weight (estimated at 240 lbs.) and the high velocity (probably about 20 miles per hour) of the charging fish.

Some of our older readers may remember a famous court case which arose over the alleged piercing of a ship by a swordfish (*Xiphias gladius*). Dr. Gudger discusses it as follows:

In the *London Daily News* for December 11, 1868, is an account of the trial in the Admiralty Court of a suit for damages resulting from the presumed attack in the western Indian Ocean of a swordfish on a ship. I have not seen the original but it was copied and published in full by R. A. Proctor (the probable author) in 1871, and its confidently referred to by Gray (1871), by Day (1880) and by Goode (1883). Here is what Proctor wrote:

'Last Wednesday the court of common pleas . . . was engaged for several hours in trying to determine under what circumstances a Swordfish might be able to escape scot-free after thrusting his snout into the side of a ship. The

gallant ship "Dreadnought", thoroughly repaired, and classed A1 at Lloyd's, had been insured for £3,000 against all the risks of the seas. She sailed on March 10th, 1864, from Colombo, for London. Three days later the crew, while fishing, hooked a Sword-fish. Xiphias, however, broke the line . . . the attack was made, and at four o'clock the next morning the captain was awakened with the unwelcome intelligence that the ship had sprung a leak. She was taken back to Colombo, and thence to Cochin, where she was hove down. Near the keel was found a round hole, an inch in diameter, running completely through the copper sheathing and planking.

'As attacks by Sword-fish are included among sea risks, the insurance company was willing to pay the damages claimed by the owners of the ship if only it could be proved that the hole had really been made by a Sword-fish. No instance had ever been recorded in which a Sword-fish had been able to withdraw his sword after attacking a ship. A defence was founded on the possibility that the hole had been made in some other way. Professor Owen and Mr. Frank Buckland gave their evidence, but neither of them could state quite positively whether a Sword-fish which had passed its beak through three inches of stout planking could withdraw without the loss of its sword. Mr. Buckland said that fish have no power of "backing", and expressed his belief that he could hold a Sword-fish by the beak; but then he admitted that the fish had considerable lateral power, and might so "wriggle its sword out of a hole". And so the insurance company will have to pay nearly six hundred pounds because an ill-tempered fish objected to be hooked, and took its revenge by running full tilt against copper sheathing and oak planking.'

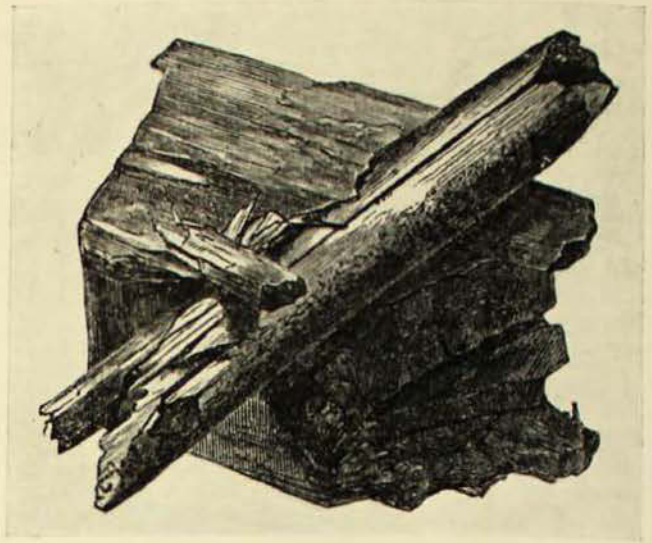
#### AUSTRALIAN OCCURRENCES.

The earliest account from Australia comes from *The Illustrated Sydney News* of 2 September, 1854, wherein the following article, illustrated by a wood-cut, appears:

#### Natural History Ichthyological

(Portion of the Sword or Horn of the Sword Fish taken from the bottom of the S. and M.S.P. Company's Steamship Governor-General.)

Amongst the numerous additions during the present month to the Australian Museum is a remarkable specimen (forwarded as a donation by the Sydney and Melbourne Steam Packet Company), being a portion of the solid planking of the bottom of their Steamship Governor-General, pierced through by the sword of that formidable monster of the deep, the Australian Sword Fish (*Tetrapturus Australis*), of which we gave a drawing and description in a former



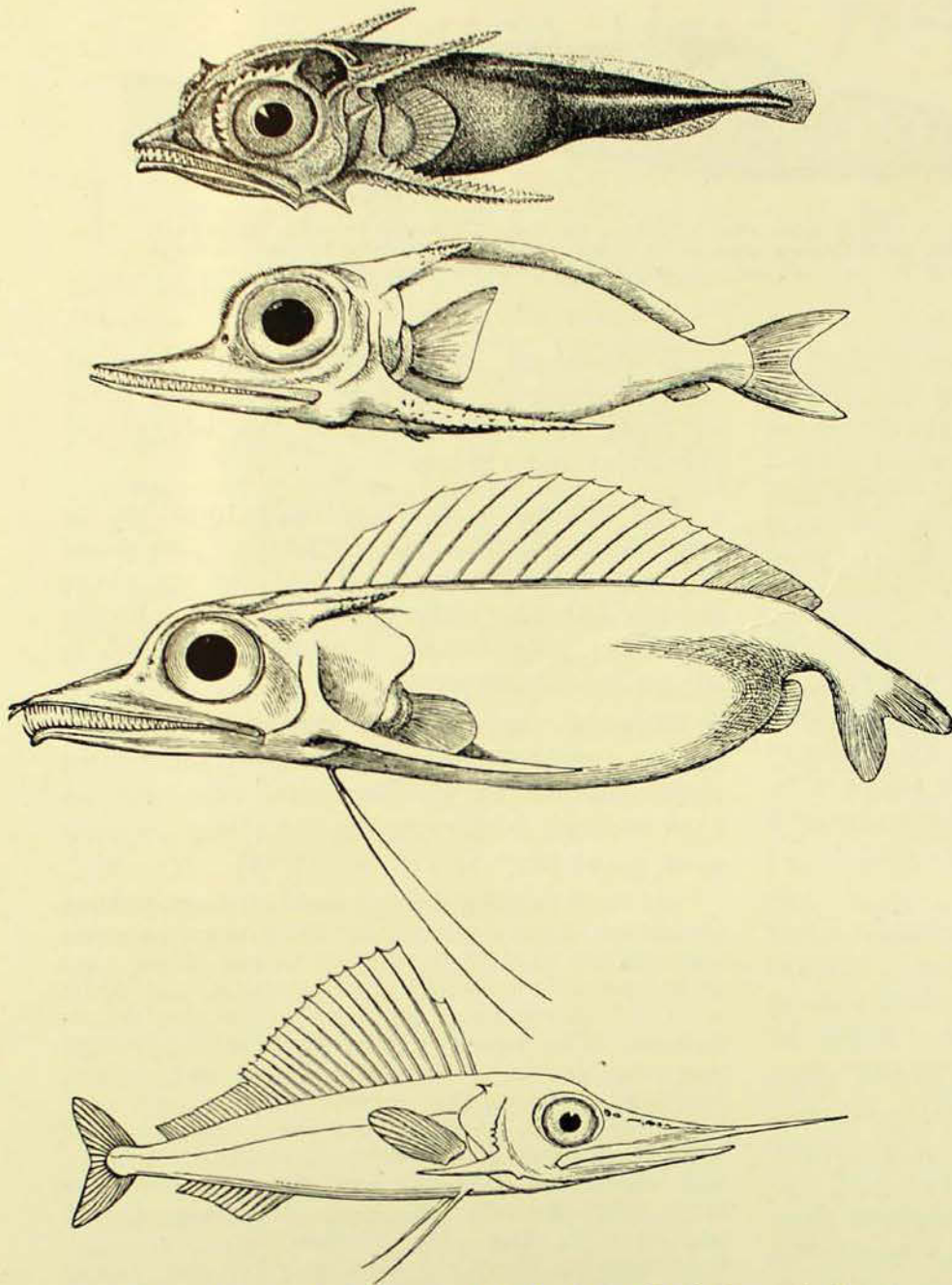
The first case of a swordfish attacking a vessel in Australia: the portion of sword in the timber of S.S. "Governor-General", Tasmania, 1854. From the "Illustrated Sydney News", September 2, 1854, by courtesy of the Mitchell Library, Sydney.

number of the *Illustrated Sydney News*. Subjoined is an extract from a letter to Mr. Korff who superintended the repairs of the vessel. 'It was obtained from the bottom of the steamship Governor-General during her repairs at George Town, Van Diemen's, on 3th June, 1854, at noon, being low water. Examining the copper on the bottom noticed a small hole with a deep graze in the copper leading aft from it in the starboard run, about 20 feet from aft, and about 4 feet up from the keel (like the mark from the fluke of an anchor); on removing a small quantity of marine vegetation, discovered a hard bony substance in the plank (American white oak, 3½ inch thick), ordered a small piece to be cut out, which proved to contain part of the horn of a Sword Fish. It was exactly on one of the ship's timbers, which the horn or sword had also entered at an angle of 32°, in consequence of which the whole length was not obtained.'

Unfortunately, the above specimen is no longer preserved in The Australian Museum, to which it was presented in August, 1854, but this is doubtless the Bass Strait record mentioned in D. G. Stead's *Giants and Pigmies of the Deep*.

Next in chronological order comes the Reverend J. E. Tenison-Woods' remarks (*Fish and Fisheries of New South Wales*, 1882, p. 56):

Mr. Oliver states that on two occasions boats lying on the outer grounds were impaled by sword-fishes and the crews only saved their lives with the utmost difficulty.



Larval and juvenile stages of Sailfishes (*Istiophorus*) from the Atlantic. From top to bottom their lengths are  $\frac{1}{8}$  in.,  $\frac{1}{4}$  in.,  $\frac{1}{2}$  in., and 2  $\frac{1}{2}$  ins. Note spines on head, long ventral fin-rays, and high dorsal fin.  
(Top figure after Chr. Lütken, others after A. Gunther.)

Then C. A. W. Monckton, in his entertaining *Experiences of a New Guinea Magistrate*, witnessed from N.E. of Australia "the sword fast in the solid keel of a big sailing canoe; and natives", he said, "have told me instances of the sword being driven through a canoe's planking. . . ."

Several cases of attack are to hand from the famous swordfishing grounds of the North Island of New Zealand, but

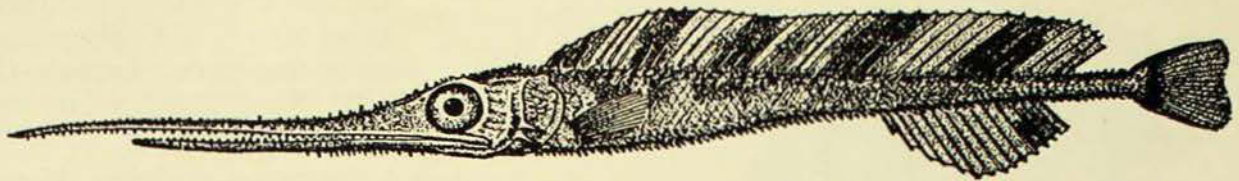
here is a Western Australian case of which Gudger and I were unaware. I quote from *The West Australian* newspaper of 22 July, 1937.

Carnarvon, July 16. — Mr. G. H. S. Baston, of Quobba station, reported on Sunday last that about 10 days previously a swordfish about 12 feet long was caught off Cape Cuvier Bay, Quobba, by Mr. Eric Goodman, skipper, of the Geraldton fishing boat, Intombi. . . . The fish was eventually landed after a battle lasting half an hour, in which it was finally dispatched by three rifle bullets, but not before it had charged the boat, leaving about six inches of its sword embedded in the Intombi's planking, causing a slight leak. A block and tackle was used to haul it aboard. As they had no way of keeping the fish on board the Intombi, the fishermen were obliged to throw its carcass back into the sea, retaining only the short section of the sword embedded in the boat as evidence of their catch. It is probably the first instance of a swordfish (which must not be confused with the sawfish) being captured along this part of the coast.

Finally, we read in *The Sydney Morning Herald* of January 12, 1938, that "four men had a narrow escape when an 18-ft. motor launch, in which they were fishing about 3 miles from Woody Head, Clarence River, was attacked by a large marlin or swordfish which pierced a hole about 4 in. long in the boat, causing the water to flow in rapidly. The launch was kept afloat by stuffing a bag into the hole."

#### GIVEN ENOUGH ROPE.

On August 20, 1937, at Laurieton, northern New South Wales, a marlin was stated to have "committed suicide" in the same manner as another of its kind at Port Macquarie, a few months earlier. "The crew of the 'Sea Hawk' were pulling lobster pots", says *Angling and Gun*



Baby swordfishes are not very much like the adults. In this 1½ inches-long Broadbill Swordfish from the Atlantic, both jaws are long and toothed, the body has rough tubercles, the dorsal fin is extensive, and there are no ventral fins.

After Chr. Lütken.

*Sport* for August, 1937, "when a marlin, seeing the movement of one of the ropes, charged, with the result that the rope became half-hitched on his sword and—his premature demise followed. The fish measured 10 ft. 6 ins. in length . . . and was consigned to the Municipal Fish Market of Sydney."

Swordfishes have often been disabled as a result of entangling themselves in anchor ropes and, whilst many of them fight vigorously when hooked, others have been hauled in by anglers with surprising ease, even when rods have been broken and, in one case, when the reel had to be wound by thumb.

While fishing in New Zealand, Zane Grey reported that he had seen a marlin charge and ram another and then follow the fleeing fish. In the same waters he caught a fine marlin whose "beauty was marred by the absence of a bill. . . ."

Swordfishes apparently do not attack whales, as Péron recorded many years ago from Western Australia, and others have suggested since from wide and far. Yet a "Bottle-nosed Whale" (*Delphinus boryi*) was figured in J. G. Hay's *Something About Fishes* from Western Australia, with the caption: "Captured at Geraldton, 20th June, 1909, by Mr. W. Davis, after being mortally wounded in the region of the heart, probably by Swordfish. Length, 18 feet; girth, 12 feet; snout, 15 inches." However, there are several records of *Xiphias* plunging its sword into the sea bottom, apparently when crazed by fear or attack, even the gills becoming filled with mud.

Dr. Gudger has gone to great trouble to try and determine the force of the swordfish's assault when it penetrates a ship.

This problem in dynamics was resolved into staggering figures: a striking force of from 500 to over 1,500 lbs. being conservative estimates.

The skeleton is strikingly modified to take the shocks and strains, the skull being compactly sutured and the vertebrae having interlocking vanes ensuring bodily rigidity; sometimes, however, the fish is killed by the impact.

Why do swordfishes "attack" ships? No better explanation has been propounded than that of F. D. Bennett, who was an experienced observer on whaling voyages over a century ago:

. . . the albacore around the ship afforded us an extraordinary spectacle: they were collected close to the keel of the vessel in one dense mass of extraordinary depth and breadth, and swam with an appearance of trepidation and watchfulness. The cause of this unusual commotion was visible in a swordfish, lurking astern, awaiting a favourable opportunity to rush upon his prey when they should be unconscious of danger or away from the protection of the ship. The assembled albacore continued, in the mean time, to pass under the keel of the vessel from one side to the other, often turning simultaneously on their sides to look for the enemy; their abdomens glittering in the sun as a wide expanse of dazzling silver. It was evident that the sword-fish desired but a clear field for his exertions; and in the course of the day we observed him make several dashes amongst the shoal, with a velocity which produced a loud rushing sound in the sea; his body, which when tranquil was of a dull brown colour, assuming, at these times, an azure hue. It is, probably, as a precaution against the attacks of this monster, that albacore, and some other tropical shoal-fish, attach themselves to ships and large whales: the close vicinity of a large body, being sufficient to deter the sword-fish from making his usual impetuous thrusts amidst the shoal; the which, when rashly attempted, have given rise to the appearance of the broken rostra of these fish impacted in the planks of ships . . . as is not unfrequently noticed.

## Jivaro Head Trophies\*

By ELSIE BRAMELL, M.A.

TO the Jivaro Indians, who dwell on the slopes of the Andes in Ecuador, South America, the most important thing in life is warfare. This holds true not only of the past but of the present as well, and doubtless is largely responsible for the continued production of shrunken head trophies even though the practice is now forbidden. Renown as a fighter, indicative of which is the number of heads taken, has been the chief incentive for the collecting of human heads, but for the past 75 years or more the practice has been converted into a profitable taxidermic hobby by unscrupulous individuals, not always Jivaros, who have found a ready market for their handiwork in the outside world; the craftsmanship, in this case, is frequently superior to that of the genuine product.

Mr. W. G. Preston has recently presented to the Museum a good example of this grisly craft. Unlike one specimen already in our possession presented by Mr. J. Ashbury, which has been distorted to the semblance of a monkey, it bears an extraordinarily lifelike expression of repose. An examination of it at once rouses our curiosity as to how the reduction in size, let alone the perfect state of preservation, could have been brought about. The process is actually quite simple, and we have it from an eye-witness, Up de Graff, who in 1899 accompanied a Jivaro war party and watched the proceedings on its triumphant return. Preceded and accompanied by ritual precautions, the operation was commenced by severing the head and part of the neck from the body. The flesh was slit up the back of the head, and the bones carefully removed, leaving the flesh and hair only. The slit was then sewn up, the lips skewered together, the eyelids drawn down, the eyebrows held in place with small pegs, and the nose and ears plugged with cotton. The aim was to preserve the normal propor-

tions of the head when it was filled out with hot sand. Next, each head was placed in a pot filled with fresh cold water and brought slowly to boiling point. Just at this point, so that the flesh might not be softened, the head was withdrawn and was found to have shrunk to one-third of its original size. Hot sand was then poured into the head to toughen and shrink it even further, the sand being renewed as it cooled; the outer surface was ironed over with hot flat stones. The treatment was carried on over a period of 48 hours to draw the oil and fat from the face, which by this time was considered "cured".

According to other accounts, a strong astringent vegetable juice was added to the water, and the application of heat was followed by smoking over a slow fire. On the old heads the facial skin surface was singed, but on the newer ones the down remains a noticeable feature. Much of the natural likeness was carefully preserved apart from the mouth which might be stretched when sewn up. Frequently long cords were drawn through the lips and run through the top of the head to suspend it.

When the full number of heads taken in the raid had been prepared, a warlike celebration was held. The dangling heads were the centre of interest; around them were performed a dance and a dramatization of the killing of the victims. Care was taken that a relative was not killed, for his spirit would seek swift vengeance. In the old days ample scope was afforded warriors who desired to add to their military reputation, for the Jivaro lived in small independent groups that were constantly at war with one another. Head hunting was once a widespread custom in the northern Andes, and the Jivaros are the last tribe in this area to retain the practice, though in their case it has taken a specialized form—the reduction of the head to about the size of a large orange.

\* See FRONTISPIECE.

# Vampire Bats

## In Fact and Legend

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

**B**ECAUSE of an age-old sense of mystery created by their nocturnal habits, bats are probably the least understood and even the most feared of all our native furred animals. Yet, as shown in the preceding article on bats,\* Mother Nature once again has succeeded in balancing the economic "loss with gain". Of fifty-odd species, four at most are destructive fruit-eating "flying-foxes", while at least forty little insectivorous bats are distributed over the mainland and Tasmania, engaged in the nocturnal battle against man's insect enemies, in alliance with the insectivorous birds.

The entire bat group presents a perfectly astounding variety of about 2,000 known species, from little insect-eaters about the size of a humming-bird to giant "fox-bats" of the southern tropics with a wing-spread of forty inches or so. Of all this world array, the only harmful species are some of the fruit-bats, and the blood-lapping "vampire" bats of the American tropics and West Indies, limited to three known species. Otherwise, the great majority are serviceable to mankind in their destruction of vast quantities of insect life.

Fear of these flying denizens of night grew with man's imaginative powers, and such fears have undoubtedly been influenced by fabulous legends of vampires and werewolves, which became associated with bats following the early accounts of South American exploration. According to Raymond L. Ditmars, Curator of Mammals and Reptiles at the New York Zoological Park, and other writers, the term "vampire" originated long before civilized man's knowledge of the "blood-sucking" bats, discovery of

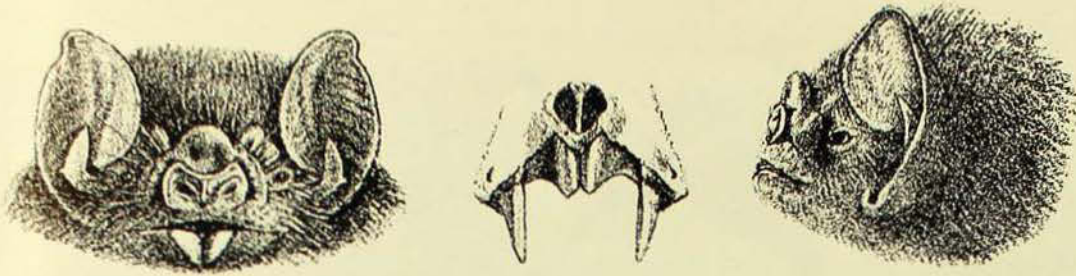
which inspired elaboration of the vampire tradition regarding flying mammals.

The word is apparently of Slavonic origin, first applied in eastern Europe to supposedly blood-drinking supernatural beings which represented the souls of departed people. Of all the shapes then said to be assumed by vampires, it is notable that bats were not mentioned in the earlier accounts. The more usual forms included the dog, cat, and even horses, birds of various kinds, snakes, and that hybrid horror the werewolf, and even inanimate things such as straw and white flame.

Superstition about blood-sucking creatures was widespread, though of unknown origin. Ancient legends about them are notable amongst those of the New World peoples (Mayans), before the Spanish invasion brought contact with Old World superstitions early in the sixteenth century. In the tropical New World fables of vampirism, however, there was a basis of fact in the actual occurrence of blood-feeding bats, as indicated by early native reverence for such a bat-god.

Upon the return of the first explorers from the American tropics, a vampire "epidemic" reached its peak about 1730 (*Encyclopaedia Britannica*, 1910), especially in Slavonic countries. Many semi-scientific and philosophical works recounted alleged instances of unfortunate people becoming afflicted with vampirism, due no doubt to the influence of horrifying tales upon unbalanced minds. Previously, apart from supernatural beliefs, bats had not been linked with vampirism, but a bat's form gradually became part of the tradition. Fiction began to provide these visionary vampires with bat-like wings and movements, culminating in that terrifying

\* Troughton—"Furred Aeronauts of Night", AUSTRALIAN MUSEUM MAGAZINE, vol. vii, no. 6, September-November, 1940, p. 206.



The faces of real vampire bats are not nearly as fantastic as those of many useful insect-eating species. Only the grooved lower-lip, and remarkably wide razor-edged front (incisor) teeth indicate adaptations for the blood-lapping habit.  
After British Museum (N.H.) Catalogue of Chiroptera.

transition from man to vampire-bat given in Bram Stoker's novel *Dracula*, an invention of the horrible which could not fail to increase the general unreasoning fear of the mostly helpful little flying mammals.

Actually, the early naturalists arrived in Central and South America with fore-knowledge of some kind of bat which fed upon the blood of other furred animals. This led to inferences that some of the largest and ugliest of bats were the real vampires, while attempts at actual observations were outweighed by the explorers' acceptance of fantastic tales, and the misleading deductions made from preserved specimens. Hence, old records contain weird accounts of vampire-bats hovering over sleeping victims, fanning them with their wings to induce profound sleep, or narcotizing the place of attack by salivary action.

Some idea of the general confusion is gained from the fact that the generic name *Vampyrus* was applied in 1822 to one of the largest of the spear-nosed family of bats, which are mainly fruit-eaters, although the actual species had neither the dentition nor digestive system associated with the blood-feeding habit. Subsequently, *Vampyrus* was described as a big harmless bat in nature books, but some justification for the name came to light with the discovery of its cannibalistic habits, though its "vamping" is concerned with the devouring of smaller bats, other small mammals, and birds.

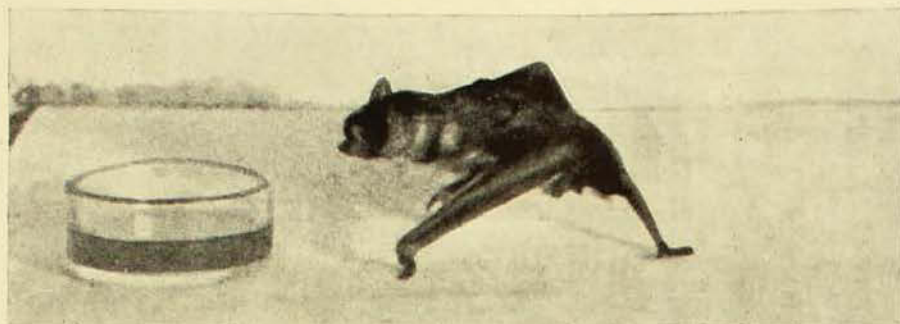
#### THE REAL VAMPIRE.

In actual appearance, the true vampire-bats do not differ markedly from an

average large insectivorous bat, having a body measurement of from three to four inches and a wing-spread of about thirteen inches. The face has only a medium amount of folding or ornamentation and is not unduly repulsive if dissociated from the owner's habits, of which the only outward sign is a deep grooving of the lower lip. Apart from the special form of the stomach, the large front or incisor teeth show the most definite adaptation for the blood-feeding habit in being greatly widened to form curved razor-edged blades. The teeth are said to enable the bat painlessly to slice away the skin to cause capillary bleeding, but examination of bites shows a crater-like wound conforming with the blood-lapping rather than blood-sucking method of feeding.

It is interesting to note that the great naturalist Charles Darwin provided the first authentic observations of a feeding vampire-bat, but it was not until 1932 that Dr. L. H. Dunn, while investigating the infection of the bats with the parasites of serious animal diseases, was able to prove that a lapping action was actually employed. Subsequently, observation of his captives by Ditmars at the New York Zoo, which I personally inspected during a visit in 1939, with a revulsion pardonable even in a mammalogist, confirmed a statement published in 1869 that vampire-bats can walk with a quadrupedal action instead of the shuffling movement common to bats.

Describing the stalking movements of the weird creatures, such as when manoeuvring to attack the legs of poultry, Ditmars states that the wings are so



A captive "vampire", under observation at the New York Zoo, approaches its meal of specially treated blood. The "tip-toeing" quadrupedal action of the flying mammal is associated with its stealthy attack upon living victims.

Flashlight photo—after Ditmars and Greenhall.

"compactly held that they look like slender forelimbs of a 4-footed animal". He stated that the pad at the base of the long hooked thumb, which is a relic of the palm of other mammals, functions as a "sole" pad at the end of the forearm, providing a most interesting observation as applied to the movements of other kinds of bats. It was noted that the vampire's movements were more agile than those of many quadrupeds, the bat resembling a spider when moving slowly on "tip-toe", but scuttling rapidly forward, sideways, and even backward on the ground, or on the back of a moving victim.

The ability to land lightly upon "all fours", spring into flight, or hop toad-like from one spot to another, combined with the tip-toeing movements and painless surgery of the practised vampire's bite, undoubtedly all contribute to the capability of attacking wakeful animals and sleeping humans without disturbance. With his usual sense of the dramatic, William Beebe in the *Edge of the Jungle*, recounting his own experiences of such stealthy surgical activities, refers to the strangely specialized little flying mammal as this "vespertilial anaesthetist".

There is, of course, no suggestion of local anaesthesia, although loss of hair around the wounds of animals indicates some form of interference with the tissues, while laboratory tests have proved the presence of anti-coagulating properties in the vampire-bats' saliva which must facilitate their secretive feeding habits.

Strangely enough, in spite of superstitions and the obvious danger to health resulting from the feeding habits, the

famous naturalist Bates is quoted as saying that "The vampire, however, is the most harmless of all bats, and its inoffensive character is well known to residents on the banks of the Amazon." Actually, the serious nature of attacks on domesticated animals was shown by the abandonment of settlement at times, and recent scientific proof that the bats were carriers of a trypanosome blood-parasite proving fatal to horses, though cattle were resistant. The discovery of remedial measures is of great importance since the bats attack the stock indiscriminately.

Such attacks have greatly hampered scientific expeditions, weakening the horses and causing soreness which prevents the use of saddles or packs. The rubbing-in of garlic along the back and withers is a form of treatment providing some relief for the animals, though probably too severe for the average scientist. My mammalogist friend Colin Sanborn, of the Field Museum, Chicago, collecting in Matto Grosso, Brazil, had his horses greatly weakened by vampire bats. The only suggestion of the native guide was to rub in jaguar fat, and a cheese cloth covering was no protection since eight bats were found on one horse by eleven o'clock. It was then discovered by Sanborn that the brilliant light of a gasoline lantern, hanging above the tethered horses till dawn, kept the bats away during the month in camp, although they constantly flew about the edge of the lighted area.

Recent researches have also shown that human dread of the vampire-bats has a great deal more than superstition as its foundation. Several serious outbreaks of





Australian False Vampire, once called the "Great Blood-sucking Bat" because of its relatively much more terrifying appearance. However, it lacks the specially adapted upper front teeth, and is actually a cannibal bat, feeding upon its smaller fellows, other small mammals, and probably on birds, frogs, and even insects, as well as the larger insects.

Photo.—A. Musgrave.

"acute spreading myelitis" in the West Indies have been traced to the infection of the virus of rabies carried by the bats. In Trinidad up to 1936, 2,000 animals and 53 human beings had died of the disease from which there had been no recovery. It was concluded that the dogs of Trinidad were either immune to the particular strain of rabies virus, or that the bats did not attack dogs since none were affected, suggesting a possibility that the bats have been infected for centuries. Interesting first hand information of the epidemics was received from the Trinidadian athlete, John Ashmead, during the 150th Anniversary Empire Games in 1938, who described the drastic measures enforced for the protection of humans and stock against spread of the disease by bats.

#### THE AUSTRALIAN FALSE VAMPIRE.

Fortunately, there are no true vampire-bats inhabiting the Australian region, although, as its popular name suggests, one large species was falsely accused of similar activities. Unlike those "false" vampires of cinema tradition, however, the grotesque facial appearance of the Australian bat was mainly to blame for its sinister reputation. It has also been called the "Great Blood-sucking Bat" because an Indian member of the family was supposed to be sucking the blood of a smaller bat which it was actually carrying away to devour. The absence of upper incisor teeth was also once supposed to be an adaptation for such habits, whereas the presence of enlarged razor-edged incisors is an essential part of the true vampire's equipment.

The Australian False Vampire Bat is not only the largest of all the local leaf-nosed species, but also of all the insectivorous group, as shown by the forearm attaining a length of four and a quarter inches. It is also distinguished by having the ears united in the middle line for more than half their length, as well as by the remarkably bleached appearance owing to the ashy-greyness of the back, whiteness below, and whitish membranes.

The False Vampires are really cannibalistic or bat-eating bats, as shown by the remains of smaller bats in all their cave-haunts, and also by the stomach contents of the cave-mummies which consist entirely of masses of bats' fur. They are also said to feed upon other small mammals, and insects, while foreign members of the family are said to capture small birds and even fishes.

The Australian species, however, seems to be almost exclusively bat-eating, and apparently occupied caves throughout South Australia for long ages, according to the mummified remains, and deposits of guano which have at times been exploited commercially in the Carrieton and Flinders Range areas.

The comparatively recent disappearance of False Vampires from parts of South

Australia indicates the declining fertility of the country to support an adequate supply of insect food. This supply is needed to sustain the cave-communities of small insectivorous bats upon which the cannibal bats lived.

The False Vampire has a wide range over the more tropical northern half of Australia. It has been recorded from

Mount Margaret on the Wilson River, south-western Queensland, the Pilbarra district in north Western Australia, and Alice Springs in the "Centre". My colleague, Mr. A. Musgrave, to whom I am indebted for the excellent illustration accompanying this article, observed cave colonies in the Rockhampton district, Queensland.

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## Window Displays

**M**ANY people consider that a childhood visit to the Museum should suffice, thinking that exhibits rarely, if ever, change. To correct this error, attempts are being made to bring the activities of the Museum to the notice of the public. One method of achieving this object is by special displays at various points in the city. The Government Printer and the Director of the Government Tourist Bureau have placed windows at the disposal of the Institution. The window at the Government Printing Office has been made available on three occasions representing a period of four months, while the Government Tourist Bureau has twice given us the use of one of their windows in Martin Place, thus enabling exhibits to be shown in the heart of the city for a period of

twelve weeks. In addition, a window at St. James' Underground Station has been made available for two months so that the travelling public may learn something of the Australian Museum.

Two backgrounds have been prepared to make the windows more attractive—one depicts the Kangaroo Group at the Museum and the other a view of the Mount Isa Mines, North-east Queensland. The displays have included selections of our bird, mammal, coral, ethnological, and mineral collections. With these, suitable labels have been placed explaining what is to be seen in the galleries of the Museum.

These exhibits have proved a success, for many enquiries have originated from them.

# Australian Insects. XI

## Orthoptera, 6. — The Crickets

By KEITH C. McKEOWN

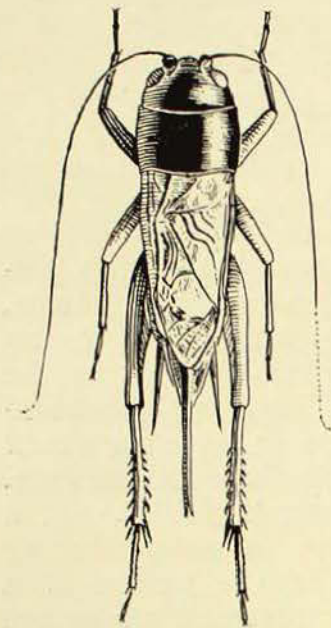
EVERYONE, whether in the least interested in insects or not, is in some way familiar with crickets, perhaps by reading Charles Dickens's charming story, "The Cricket on the Hearth", or from the popular belief in crickets as bringers of luck; the latter, it might be thought by some, a matter of no little importance in a superstitious age! The lives of the crickets are filled with an interest and fascination not less than the fanciful attributes with which poets and story-tellers have endowed them.

The crickets are members of the order Orthoptera, and are commonly placed in a single family, the Gryllidae, but some workers divide them into two groups, the Gryllidae or true Crickets, and the Gryllotalpidae or Mole Crickets. Some fifty species of the first family, and six of the second are known from Australia. So much for dry bones, for there are other and more interesting considerations which invite our attention.

Interest in crickets is usually first aroused by their song, that shrill chirping which brings back to our minds memories of mild summer evenings, gardens, creek-banks, and the wide bush. This song, whether it be the shrill "Cri, cri, cri-cri-i-i-i" of the common Field Cricket, or the curious mellow, rolling note of the Mole-Cricket, a note more frog- than insect-like, is produced by the same means, the rubbing together of the wing-covers or tegmina. The wing-covers, when at rest, are folded down flat over the body, but bent down sharply over the sides; the right usually overlies the left. Each of the tegmina bears a file-like process and a hardened and prominent vein which acts as a scraper against which the file of the opposite wing rasps. Each "cover" has a considerable area of thin, tightly-stretched membrane which

acts as an amplifier for the sounds produced. In the act of producing its music, the cricket raises its wing-covers to an angle of about forty-five degrees to the plane of the body, and moves them backwards and forwards so as to bring about friction between the file and the scraper. The cricket is an instrumentalist, not a singer. As in most sound-producing insects, the music is in the nature of a love song. As a complement there are paired hearing organs situated in each foreleg. The "song" of the cricket is stimulating, not only to the females, but also to rival males; this has been proved by placing a chirping cricket before a microphone, and amplifying the sounds in another room in the presence of other males; these burst at once into frenzied shrilling. The same occurrence may be observed in the field where, when one male commences to chirp, others in the vicinity will be stirred to emulate his efforts, joining, one by one, into the chorus. It is not known whether the female exercises any preference in her choice of a mate on account of his prowess as a serenader.

The most familiar of all our crickets is the Field Cricket (*Gryllus servillei*), a thick-set insect measuring about an inch in length, clothed in glossy black; the head is large, broad, and surmounted by a pair of long thread-like antennae. The female may readily be distinguished from the male by her possession of a slender ovipositor projecting from the extremity of the abdomen, an accessory of course lacking in her mate. Both sexes have powerful hind legs constructed for jumping. These legs, in the crickets, are very easily detached and, no doubt, this easy amputation is invaluable to an insect when seized by a bird, lizard, or other enemy, and many must owe their lives to leaving a leg in the jaws of an attacker



The common black cricket of bush and garden (*Gryllus servillei*), which makes its music on warm summer evenings. (N. B. Adams, del.)

in this manner. It is better to be handicapped by the loss of a limb than be converted into the food of another creature!

The Field Cricket is a dweller in bush and garden, and sometimes may create a stir in domestic circles by entering houses, possibly attracted by the bright lights at night. Indoors the presence of these insects frequently brings inquiries as to whether they will damage carpets and furnishings; no damage of any such nature is to be feared. In the open their food consists of a mixed diet of vegetable and animal matter, and it is well known that if several crickets are imprisoned in a box without food, the weaker insects will soon be killed and devoured by their stronger kin, only a few scattered limbs being left to bear witness to the tragedy. The song of this cricket has already been mentioned; it is a series of short crisp notes uttered in quick succession and terminating in a sustained shrill note, tremulous but clear. During the day the crickets remain hidden in burrows in the soil, or under stones, emerging at dusk to engage in active life.

By means of her stout and elongate ovipositor, the female cricket places her eggs in the soil, I believe singly. These eggs hatch out into minute wingless, but otherwise perfectly formed, insects, which grow by a series of moults. This process

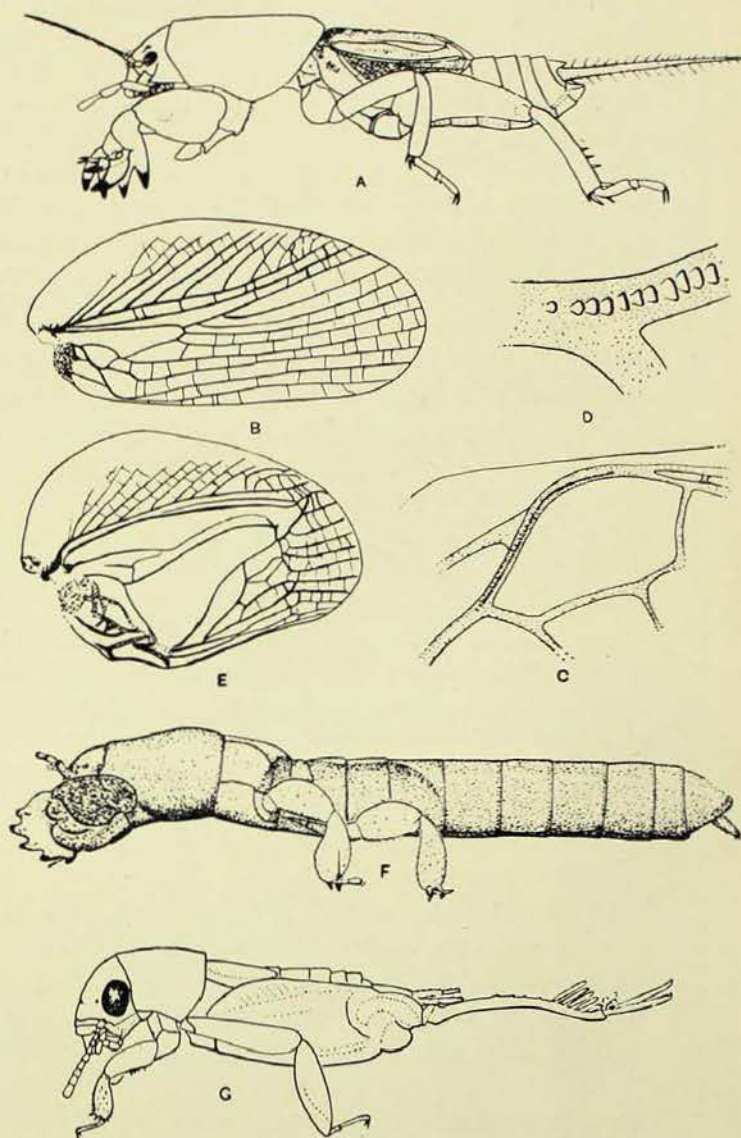
of casting the skin has been described in connection with other families of the Orthoptera, so need not be discussed here. With the last moult the insect is mature; it has acquired wings, and with them, especially in the case of the male, a very efficient musical instrument with which to serenade any prospective mate. Maturity is usually attained in the summer, and it is then that the warm evenings resound with the shrilling of the rival musicians. During the serenade, the female is usually somewhere close by, either at the entrance to her burrow, or hidden among the herbage, and seems torn by a desire to approach the singer and by an equally strong inclination to turn and fly from the scene. At length uncertainty is overcome, and pairing takes place. Fights sometimes take place between males seeking to win the favours of the same mate, but little damage usually ensues, the defeated candidate usually running away when he finds himself outmatched.

The Ghost-Crickets (*Oecanthus*), fragile-looking, semi-transparent insects with roundly tipped wings folded upon the back, are to be found among the foliage of shrubs. They do not rely upon the charm of their music alone to win the heart of a mate. It is true that they are musicians with a thin, ethereal song, a slow "Gri-ii-gri-i-i", produced with many pauses, as if the performer were somewhat uncertain of his talent. What the insect lacks in sound production is compensated for by ventriloquial powers, and the musician is usually difficult to discover, the sound seeming to come from every direction other than that of its true source. But the Ghost-Cricket does not put all his eggs in one basket; he has other means of winning the female. Perhaps the song is merely to advertise his presence and guide a mate to where he rests in the bushes. On the thorax, just at the base of his wings, there is a curious, somewhat cup-like depression containing a thin honey-like fluid. This sweet appears to have a remarkable attraction for the female, who approaches in response to the male's alluring call, and greedily consumes the fluid from the

thoracic cavity. The meal is in the nature of a wedding breakfast. The eggs of the Ghost-Cricket are deposited in rows in slits cut for the purpose by the ovipositor in twigs of vines and bushes, those with a soft, pithy core being usually selected.

The Mole-Crickets differ greatly in many respects from the true Crickets, and for this reason are placed by some authorities in a separate family, the Gryllotalpidae. They are comparatively large creatures, generally of a brownish colour. The thorax is in the form of a smooth rounded shield sloping to the head; the antennae are short, stout, and composed of many short, ring-like joints; the forelegs are expanded for digging, and the abdomen terminates in a pair of feeler-like cerci. There is no visible external ovipositor in the female. The wing-covers are short, and are usually provided with a file and scraper in both sexes. Mr. N. B. Tindale, of the South Australian Museum, has written: "I have observed, on two occasions, females of *G. oya* kept in captivity in a glass-covered vivarium, vibrating their elytra and emitting dull pulsating sounds clearly audible six feet away, and answering the calls of a male confined in another chamber. In stridulating, the elytra, in both sexes, are simultaneously moved laterally in opposite directions. Starting from the position of rest, they are opened until their posterior margins barely overlap, and are then returned rapidly to their former position."

The ears are situated in the forelegs, but are covered with a flap of integument, and are consequently hard to see. The call of the common Mole-Cricket (*Gryllotalpa australis*) is a liquid and musical trill; that of another species, *G. nitidula*, has a metallic, bell-like quality in its notes. The calling is usually performed within the security of the burrow, or from the shelter of a stone. The insects seem particularly sensitive to soil vibrations, and an incautious step will usually silence the musician—but not for long; within a minute or so the song will be resumed. It is frequently possible to trace the source of the song—and the



Strange Crickets: A, Mole cricket (*Gryllotalpa nitidula*); B, Tegmina of female; C, chirping area of tegmina; D, Scraper (greatly enlarged); E, Tegmina of male; F, *Cylindracheta psammophila*; G, a little Sand Cricket (*Tridactylus mutus*).

(After N. B. Tindale.)

singer—by walking softly towards the sound, pausing whenever the trilling ceases, and quietly moving forward again when it is resumed.

Mole-Crickets spend the daylight hours in deep burrows, usually situated in damp situations, the banks of creeks and water-holes being specially favoured. The insects are omnivorous, feeding upon insects and plants; they are sometimes destructive to seedlings in gardens, cutting through the roots in the course of their tunnelling operations. The eggs are deposited, to the number of some two

hundred, in a heap in a chamber at the end of the burrow. The mother, unlike the majority of insects, possesses considerable maternal attachment to her brood; she guards her eggs with the greatest devotion, and when the baby crickets hatch out, watches over them with equal solicitude until they are large and strong enough to care for themselves.

The foreleg of a mole-cricket is well worth careful examination, for there are few examples of such perfect adaptation of an insect limb to its allotted and specialized task. It is a digging instrument. The lower portion of the limb is flattened and expanded to form a broad shovel; its lower edge is serrated into a number (varying in different species) of broad, tooth-like projections, of which one is movable, and is believed to act in opposition to one of the others as a pair of shears for cutting roots. The rounded, shield-like thorax also aids the insect in forcing its way through the soil. The muscular strength of the forelimbs is relatively enormous, a fact that may be discovered for oneself by holding one of these crickets firmly (but not so firmly as to crush it) with the fingers; the forelegs will then be felt pushing strongly outwards, and such is the strength exerted that the fingers are gradually forced apart, enabling the insect to escape. How effective is their use of these tools is evidenced by the ease with which the insects drive their tunnels through hard ground.

Perhaps the commonest of the mole-crickets is *Gryllotalpa australis*, a dark brownish-black insect with the thorax densely covered with a short velvety pile. The male is about an inch long; the female somewhat larger. It ranges over Victoria, South Australia, New South Wales, and Queensland. It is quite common in the vicinity of Sydney, where

it is the usual species found in gardens. *G. nitidula* is also found about Sydney, but is somewhat rare; in this species the thorax is glossy and without pile. A third species, *G. africana*, of a dingy yellow colour, occurs quite commonly on the Nepean River, and has a wide range over Australia.

In the dry inland districts, tiny black crickets (*Tridactylus*) live in shallow burrows in the damp sand or clay of the banks of the tanks or dams excavated by the grazier for the conservation of water. The insects are easily routed from their hiding places by splashing water over the bank; when disturbed, the little creatures take to the water, where they appear to be equally at home as on land, swimming about rapidly over the surface, propelled by kicks of the long hind legs, or even plunging below the surface. Nothing is known regarding their life-history or mode of life, which should provide some country resident with an interesting problem on which to devote some of his spare time.

Several truly remarkable relatives of the mole-crickets have been placed in a separate sub-family, the *Cylindrachetinae*; these members of the genus *Cylindracheta* resemble excessively slender mole-crickets in which the thorax is narrow and elongated. They are wingless, but Nature has overcome the apparent difficulty of sound-production by placing organs for this purpose on the jaws and their accessory appendages! It is sometimes stated that these insects tunnel in the stems of plants, an operation not conducive to the well-being of the vegetation attacked, but the two species of which we know anything of the habits are burrowers in sand. Little is known regarding their lives. The Australian species are found in South Australia, the Northern Territory, and Western Australia.