The AUSTRALIAN MUSEUM MAGAZINE

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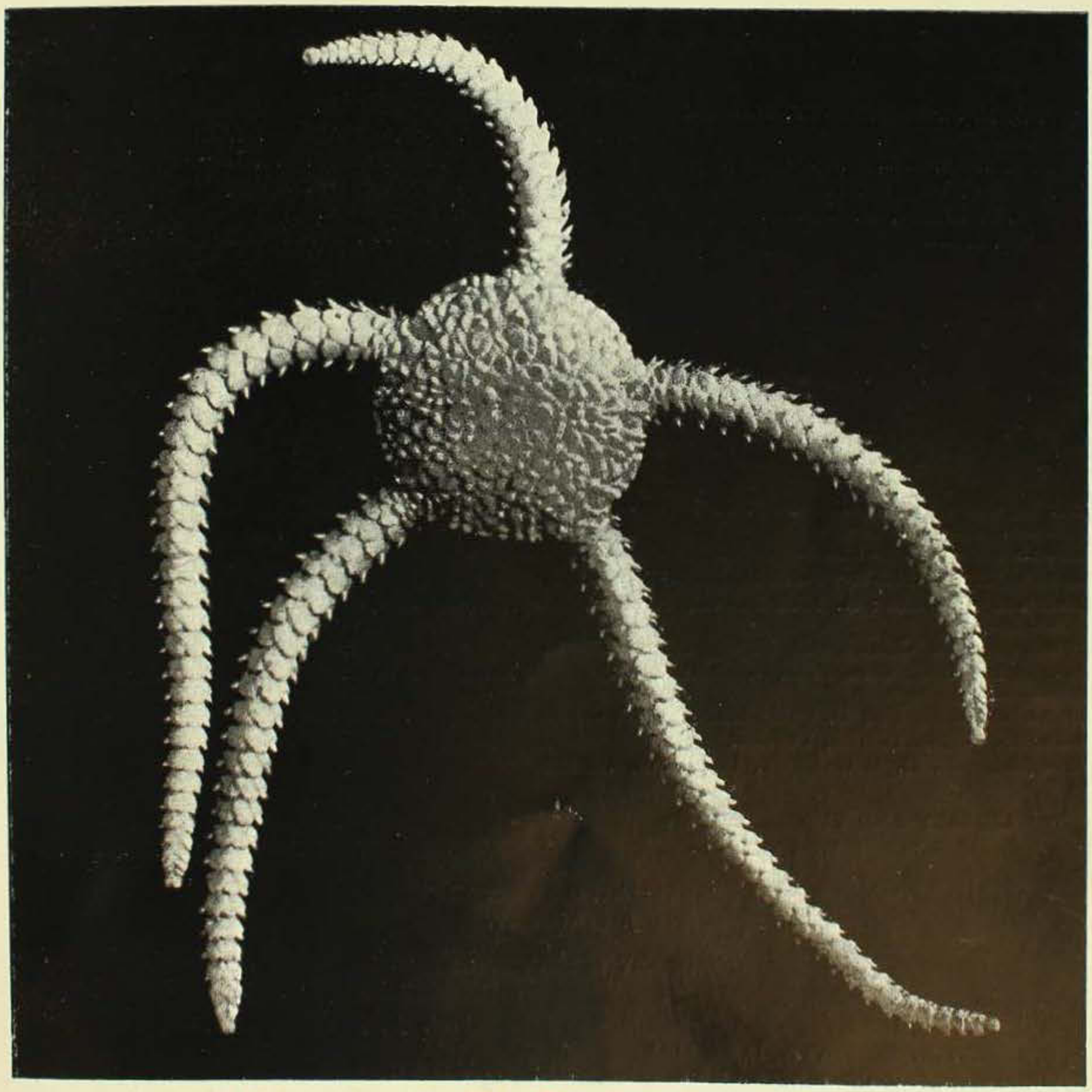

A Brittle Star from West Tasmania. (Four times life size).

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THE AUSTRALIAN MUSEUM

HYDE PARK, SYDNEY

THE AUSTRALIAN MUSEUM MAGAZINE

● OUR FRONT COVER: This beautifully sculptured small brittle star (as yet unidentified) lives beneath rocks which are bedded on sand and gravel. The specimen illustrated was captured at Cape Sorrell, west coast of Tasmania, and is pictured some four times its natural size. In life the "star" was biscuit yellow in colour with faint, darker cross-stripes on the arms.

VOLUME XI, NUMBER 11. SEPTEMBER 15, 1955.

•A beautiful example of a dilly-bag used by aboriginal men in Arnhem Land. It is a twined basket, ten inches high, decorated with a red, white and yellow painted pattern, and with panels and pendants of red parrakeet feathers. Feather string, implements and small sacred objects are carried in such baskets. The one illustrated was obtained at Oenpelli, on the East Alligator River. Turn to Page 368 for other examples of Arnhem Land baskets.

THE AUSTRALIAN MUSEUM MAGAZINE

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VOL. XI, No. 11. SEPTEMBER 15, 1955.

Museum Developments

By J. W. EVANS

THE purpose of this article is to inform readers of the MAGAZINE of present plans for the development of the Museum's exhibition galleries.

The plans involve no change in policy on the part of the Trustees as this remains the development of the Museum as a leading educational and research institution.

Progressive changes are not easy to bring about in a building which is far from modern in design and which is suffering from overcrowding and while the most desirable development would be the construction of a new wing, lack of such a wing cannot be permitted to impede developments.

Shortage of space is not a new feature in the Museum, nor is it a condition peculiar to the Australian Museum, but such a state of affairs is not accepted with complacency but is regarded rather as a challenge.

In the first volume of this MAGAZINE, published in 1923, the then Director, Dr. Charles Anderson, wrote as follows:

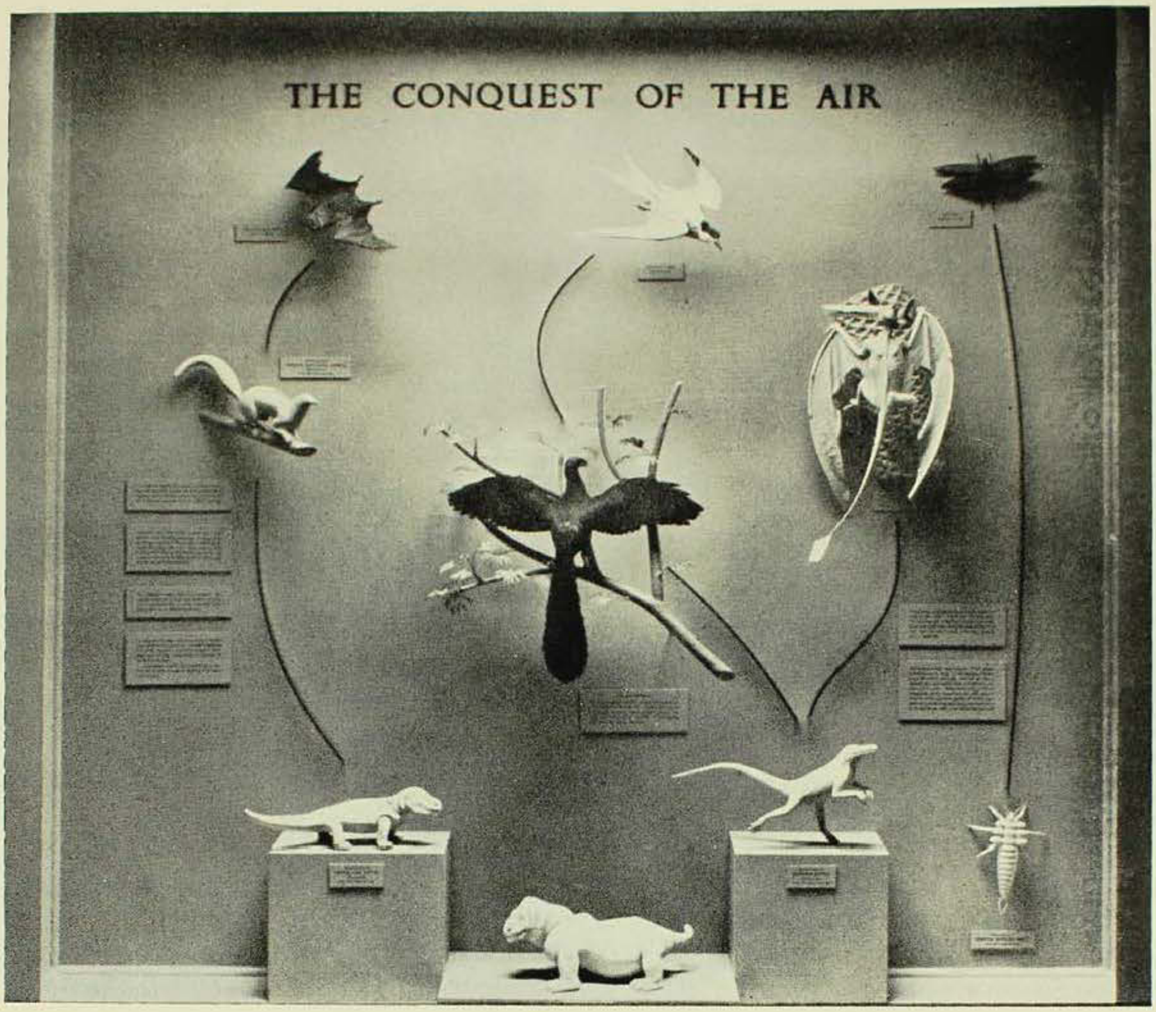
> As generally happens building has not kept pace with the expansion in the collections and now an extension of the existing buildings is urgently required. Extra space is needed for exhibition purposes, for storage of specimens, for the library, for work rooms. The reserve and reference collections are for the most part accommodated in darksome basements or in unsightly galvanized iron sheds.

It is now 32 years since those words were written and almost half a century since any major additions have been made to the Museum buildings. Consequently, as may be imagined, the accommodation position at the present time is very acute indeed.

Since there is still uncertainty as to when a new wing will be built, plans for gallery changes have had to be prepared on the basis of existing display space even though the result, unfortunately, will be that less material than at present, will be shown to the public.

These plans, which have been prepared as a co-operative effort by the whole of the scientific and preparatorial staff of the Museum, are long-term ones and flexible.

The first project is to be the completion of the Aboriginal Gallery. Visitors to the Museum will be aware that this is already a fine gallery but it is incomplete since no small objects are shown and some of these form an important part of the cultural background of the Aborigines. Additions, which will be placed in island cases, will include such objects as ornaments, clothing, message sticks, magical objects, stone implements, and fishing lines and hooks.



A striking "instructional exhibit" in the British Museum.

Reproduced by permission of the British Museum (Natural History).

It is intended that the next development will be the conversion of a ground floor gallery, where at present material illustrating the cultures of Melanesian peoples is shown, into a Children's Room and a Fossil Gallery.

Children are already well catered for at the Museum by the provision of facilities for special classes, the showing of natural history films and in other ways. Nevertheless, because of the importance of developing and encouraging the interest of children in natural history it is intended to follow the example of many other museums and to make a room available solely for the use of children. The room, which will serve the double purpose of a class room and a natural history club room, will be equipped with materials such as paints, modelling clay and reference books, and in it not only will children be able to examine and handle specimens, instead of looking at them through glass, but they will also be able to bring in for identification and information small living creatures such as insects and lizards.

The Children's Room will occupy only a small part of the gallery and the greater part will be devoted to the display of fossils and of casts of extinct animals.

Unfortunately the word "fossil" seems to conjure up in the minds of most people something which is inexpressibly dry. In fact fossils are amongst the most important and interesting objects in a natural history museum. They provide evidence of the animals and plants which formerly inhabited Australia, of the sort of climates that occurred here in past ages, and their study helps considerably in reaching an understanding of the inter-relationships of living groups of animals. A special feature of the new Fossil Gallery will be miniature dioramas containing models of extinct animals set against backgrounds illustrating the vegetation of the corresponding geological periods.

Other developments planned for the Museum are the provision of "Striking Instructional Exhibits" and the special display of "Treasures of the Museum".

The intention of the instructional exhibits will be to provide information in an attractive manner on some of the findings of biological science. For instance on such matters as the inter-relationship of the principal groups of animals; on how evolution comes about and on bird migration.

An example of a "Striking Instructional Exhibit" is shown on the opposite page. This is an illustration of one in the British Museum.

Every museum is full of treasures and the Australian Museum has certainly an abundance in every one of its several departments. Nevertheless, and because of this very abundance, many escape the notice of visitors. In order to draw attention to notable objects, a small section of one of the public galleries will be devoted to their special display. They will be changed frequently and shown to the best advantage. It is hoped that visitors will, as a result, develop the habit of paying frequent visits to the Museum to find out for themselves what is new.

The above are only a few of the projects planned. Quite apart from developments such as these it is intended to continue as before with the policy of bringing all the galleries up to to date and in keeping with modern museum techniques and practice.

A simple, uncrowded, informative exhibit.

Reproduced by permission of the British Museum (Natural History).

This will entail less material on display than at present, but a few well arranged and well documented specimens are preferable to a large number of which not one attracts any particular notice.

In the illustration "Sea Shore" the birds shown are few in number but they are arranged with pleasing balance, can be readily recognized and have the association of a common environment.

In spite of disabilities due to lack of space, the Australian Museum,—the largest and oldest museum in Australia—looks forward to the future with confidence. This is because, not only has it the asset of being situated on a magnificent site in the greatest city in Australia but also because it is concerned with matters of interest both to Australians and to the whole world, since Australian animals are of unique scientific importance.

Tasmanian Seashores

By ELIZABETH C. POPE

TO any naturalist who has more than a passing interest in the geographical distribution of animals or plants, Tasmania offers a fascinating field of study. Much attention has been directed to land animals there—the monotremes and marsupials, and such humble creatures as frogs, earthworms and shrimps of the freshwater lakes—because their distribution gives the best clues to the existence of land connections which joined one land mass to another in former geological times.

Certain animals and plants in southerly parts of Australia, and more especially in Tasmania, have their nearest relatives today in such widely separated areas as South America, southern Africa and New Zealand, and there is considerable evidence to support the theory that the distributions of these organisms took place in the distant past *via* a large, southern or antarctic land which at one period or another was connected to these countries. The antarctic route has even been suggested as the one by which marsupials reached Australian shores. A most fascinating recent account of these views is to be found in Maurice Burton's book "Living Fossils".

However, a certain amount of opposition to this hypothesis has been raised by a school of zoogeographers which supposes that our mammals followed a northern route in coming to Australia, and travelled down through the Indo-Malayan Archipelago and New Guinea. To the solution of this puzzle Tasmania possibly holds the key. Even though the field trip about to be described was concerned solely with mapping the distribution of plants and animals in Tasmania, it is not intended here to enter the lists and support either of these rival theories. This is because the organisms studied on this occasion all lived between tidemarks on the seashore. The sea, which forms an insuperable barrier for creatures like frogs and earthworms and marsupials, is more in the nature of a grand highway for the organisms in which we were interested and our data thus have little or no relevance to the arguments about antarctic migration routes. Our study to us was just as fascinating as any controversy abcut invasion routes of marsupials because Tasmania (theoretically our coldest coast) offers to the marine zoologist not only shores lying in higher latitudes than any other part of the continent but it also includes the area furthest removed from the influences of the teeming tropical fauna of Indo-Malayan seas and shores. Here then one should be able to find a marine fauna that is more truly indigenous and typically Australian than anywhere on the mainland. The object of the expedition was to collect facts and specimens and to map distributions of shore-dwelling organisms so that some idea of the fauna could be gained. Until comparatively recently only a very limited amount of material had been published about Tasmanian shores—especially about the wild west coast and the storm-lashed south—so it was hoped to be able to add as much information as was possible in the time available.

The narrow passage between the lights is the notorious Hell's Gate, vividly described in "For the Term of His Natural Life." Waters that enter or leave Macquarie Harbour all race through this small gap.

Photo.—Author.

The 1955 trip was third in the series begun by Miss Isobel Bennett and members of the staff of the National Museum of Victoria in 1954. It was undertaken by Miss Bennett, Miss F. Wilson and the author and it differed from previous ones in that it was land-based. Travelling was done chiefly by car and trailer. Over a thousand miles were covered in a little over two weeks on the island. Camps were pitched each night and packed up next day and six widely spaced localities were worked—two on the west coast, two on the east coast and two on the north. It was an arduous trip and there always seemed to be far too little time available for the preservation and labelling of specimens, the lengthy note-taking and traversing, and mapping of the shore communities that has to be done to make a trip of this kind worthwhile from the scientific point of view.

During the first two trips collections and observations were made at many points round the coast of Tasmania and the outlying islands. The scientists travelled in the Lighthouse Supply Ship, *Cape York* and visited some very lonely and normally "unget-at-able" places. During the present trip gaps left during the two previous ones were, as far as possible, filled in and collecting was done at intermediate localities. It was also desired to observe seasonal differences in the shore populations on all coasts and to check previous findings in the light of newer information. Visits and records have now been made in Tasmania in the depth of winter and the height of summer and in all some seventeen localities have been worked. When all the collections have been studied it should be possible to have a much clearer picture of Tasmanian shore life than before. Such work is laborious and takes sometimes a year or two before it is ready for publication, so that a short account of the main findings—a sort of preview—will probably be of interest to many marine workers.

There is an extremely strong resemblance between the intertidal communities to be seen in Victoria and Tasmania and this resemblance is stronger, for instance, than that which exists between corresponding intertidal communities in the central part of New South Wales and the extreme easterly area of Victoria. This, in spite of the fact that the coasts of Victoria and New South Wales are contiguous, whereas the coast of Tasmania is some hundreds of

The surf-lashed shore at Green Point, near Marrawah, on the west coast was dangerous at times and always cold. Giant kelp is seen near low water and dark patches of mussels near the feet of the workers.

Photo.—Author.

miles distant from the nearest Victorian coast and stormy Bass Strait lies between. In spite of the affinity between the two southern areas there are, nevertheless, certain small but subtle differences in the shore communities of the mainland and Tasmania and some of these will be remarked upon below.

A word of warning must be given here about the making of comparisons between the shore communities of one coast and that of some other area. Comparisons must always be made between areas exposed to approximately the same degree of wave action; the populations of the shores of sheltered bays and inlets differ so greatly from those lashed by surf that it would be useless to do anything else. Also, for any likenesses or differences to be valid, other environmental conditions must be as similar as possible.

A very clear example of the differences to be seen in two shore faunas, resulting from variations in environmental conditions, was seen at Macquarie Harbour on the west coast of Tasmania. Here, just inside the entrance to that ill-famed inlet of convict days (referred to as Hell's Gate by Marcus Clark), is a shore composed of broken boulders sloping gently to the water—at first glance it looks like a perfect collecting spot for a naturalist. With memories of the delights of collecting at Bottle and Glass Rocks (similarly placed just inside Sydney Harbour) it was a rude shock to find a fauna comprising only from seven to ten species and at the most only ten species of plants, with lichens and algae in about equal numbers. That this qualitatively poor fauna was due to some peculiarity of the environment became all the more obvious when collections were made on the surf-lashed, exposed west coast just across the headland. The rocks were the same type but there a rich and very varied fauna flourished (more than a hundred larger, obvious species of animals were seen) and the number of kinds of seaweeds and lichens probably outnumbered the animals. One would not expect, from previous experience, to find such a falling off in the number of species just because of a reduction in the amount of exposure to surf. Some other factor must be operating to make the "inside" habitat less favourable to marine animals. Actually there were three unusual conditions which could account for the poverty of the shore life in Macquarie Harbour. Firstly the presence of extra-large quantities of freshwater is obvious, even after very cursory inspection. Not only did the water near the mouth of Macquarie Harbour taste almost fresh but it was also the colour of weak tea, due to the presence of a peaty, brown extract from the Button Grass swamps which are a feature of the country drained by the Gordon River; this extract might be inimical to marine animals and plants. The third unusual factor is the peculiar and, at present, unpredictable tidal flow inside the harbour. Outside, the normal diurnal tidal rhythms seem to obtain.

While one normally expects some dilution of sea water in an estuary, the phenomenally high rainfall on this part of Tasmania's west coast, averaging 150 inches a year, means that the waters of Macquarie Harbour, even near its mouth, have a salinity comparable more with that of an up-river area of, for instance, the Hawkesbury River, and the extreme reduction in the number of species near Hell's Gate is understandable. It is interesting also to note that the animals found there are noted for their adaptability to changes in environment. In other words the shore near Hell's Gate is in no way comparable with what at first sight appeared to be a similar area in New South Wales—Bottle and Glass Rocks in Sydney Harbour. While this is an extreme case of difference between two similarly placed collecting areas, it nevertheless serves to emphasize the need for caution when talking about likenesses and differences between faunas on different coasts. Some confusion in the past has occurred because of failure to observe this fact.

For the purposes of this geographical survey of the animal communities only those of the very exposed coasts are being compared—places where the surf usually pounds in on the rocks, as seen in the illustration of the rocks at Green Point, Marrawah, on the west coast of the island.

We found the temperature of the sea around the Tasmanian coast in February to be about 15° C. and therefore only a fraction warmer than the winter temperatures of the sea off Sydney. This, combined with the cold winds, especially on the west coast, has a profound effect on the

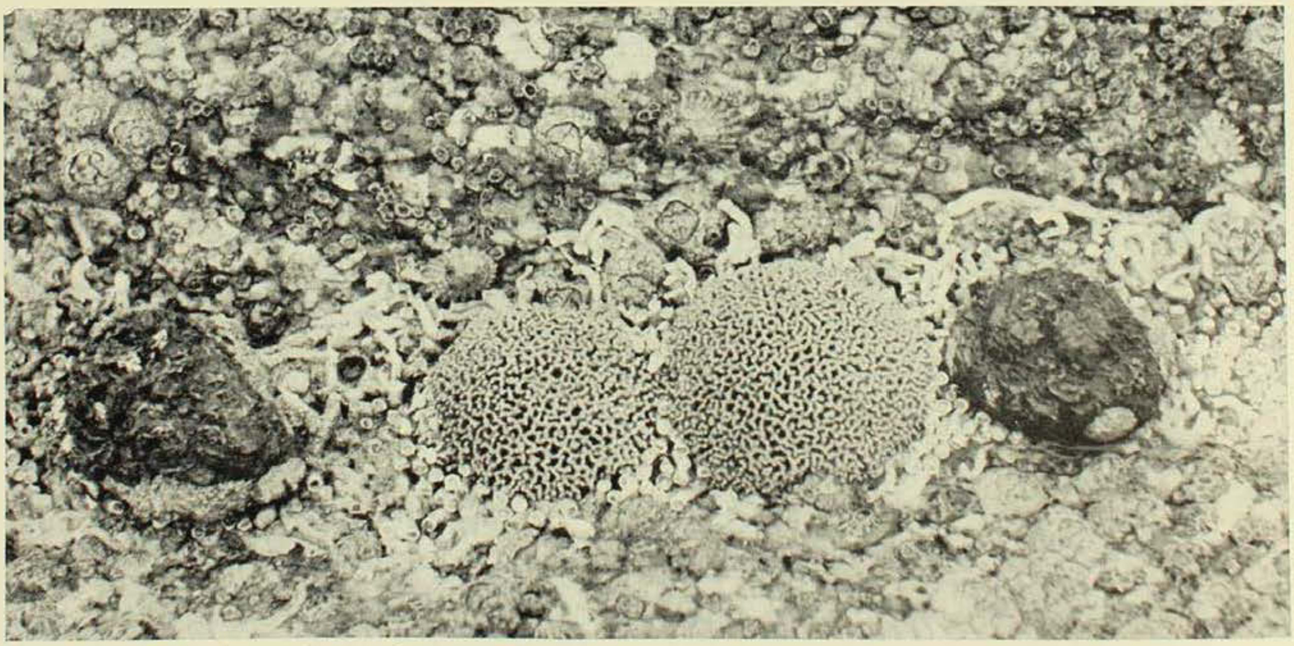
Granite shores on the east coast, at Bicheno, show a text-figure-like arrangement of shore zoning. Top of the large kelp is just exposed with a band of *Xiphophora* weed above it. A few Cunjevoi (ascidians) fringe the latter. The two workers are in the barnacle zone.

Photo.—Author.

Close view of the giant kelp or *Sarcophycus* band and the strap-like *Xiphophora gladiata* which lies above it. *Xiphophora* also occurs in New Zealand.

intertidal community. Typical of these colder seas are large brown seaweeds—much larger than their counterparts in New South Wales. On all exposed coasts we found the Bull Kelp, *Sarcophycus potatorum,* which is best seen at dead low water when the holdfasts, big as soup plates, are exposed and the great fronds move in the surges. Alan Cribb, the algologist, has picturesquely described such a kelp-rimmed rock platform as follows:

> During the low water on a calm day the gentle swell lifts the weight of the lamina and the rhythmical movement of a stand of erect stipes [stalks] near the platform margin vaguely suggests from a distance the motion of a group of black swans.



Lithophyllum hyperellum, a hard coralline seaweed forms the two clumps in the centre. Flanking them are two darker Cunjevoi (*Pyura*) and some straggling serpulid tubes of *Galeolaria caespitosa.* Remainder of the rock is studded with barnacles (*Catophragmus* and *Chamaesipho*) and limpets (*Patelloida alticostata*). Locality, Bicheno.

Photos.—Author.

Such a sight may be expected on all exposed Tasmanian shores and all along Victorian coasts. In southern New South Wales and eastern South Australia these huge seaweeds are replaced by much smaller species of brown algae.

Cunjevoi (the ascidian *Pyura stolonifera*) occurs low down on the shore in Tasmania, just as it does in New South Wales and some parts of Victoria, but it is generally sparser in the colder waters. Between the top of the soup-plate-like attachments of the kelp and the Cunjy, a band of the brown seaweed, *Xiphophora gladiata*, is often found in Tasmania. These three bands are shown in the photograph of the rocks at Bicheno, on Tasmania's east coast. The presence of the *Xiphophora* alga marks one of the differences between the coasts of Victoria and Tasmania but is a point of resemblance between the latter place and New Zealand.

At Bicheno the turtle-backed rocks, sloping at an angle of some 15 to 20 degrees to the water, display an almost text-book-like layout of the various shore organisms which are arranged in a series of friezes from low-water mark up to the back of the shore.

Above the three bands mentioned comes a wide area of rock where various barnacles, limpets and periwinkles reign supreme. Thousands may be present in quite a small area but they do not show up in photographs of general views of the rocks. Moreover various bands and sub-bands occur within this major barnacle area. However, a detailed account of these belongs properly to a more technical story than this and only some of the more noteworthy species can be mentioned here.

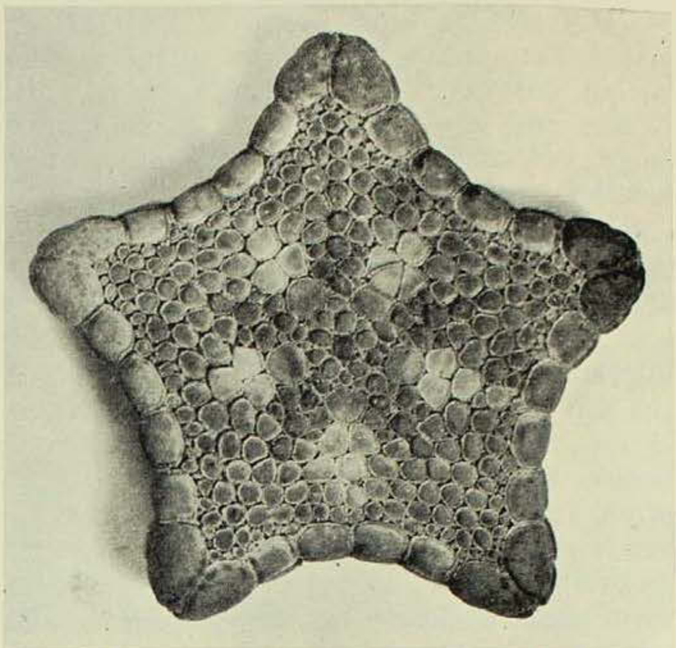
The most obvious point of difference in the higher region of the shore is the band of brick-red lichen which coats the rocks of the back-shore in many areas of Tasmania. A trace of this reddish lichen appears very high up on the rocks at Wilson's Promontory in Victoria, and may be seen from the sea more obviously than when one works on the rocks themselves; apart from this one occurrence on the mainland, the red lichens belong peculiarly to Tasmanian shores and have been recorded from all coasts. Near Bicheno and the Bay of Fires they are particularly well developed on the granite boulders.

Millions of scallop shells lie jammed among granite boulders near the Bicheno Fisheries Co-op. Factory. In spite of the numbers it was difficult to find a pair of perfectly matching valves.

Photo.—Author.

Broadly speaking, the differences in the intertidal organisms of the east, west and north coasts of Tasmania are very slight and will be evident only after detailed analyses of the faunas have been made. The differences between the shore communities of Tasmania and Victoria will, as one would expect, be of a higher order than those between the one area of Tasmanian coast and another, but they are still not very great in magnitude—not as great as those between southern New South Wales and eastern Victoria.

Some of the notable species collected in Tasmania were echinoderms, for very little was known even of the common forms from the west coast. At Cape Sorell a fine specimen of the starfish *Austrofromia polypora* was captured among seaweeds near low-water mark, its brilliant orangey-yellow colour contrasting vividly with the dull greeny-browns of the algae. Colour photographs were made of it for there is no record in literature of its colour in life. Another beautiful echinoderm collected here was the small but most distinctively sculptured brittle-star shown in the cover illustration. There were swarms of them under certain of the rocks which were bedded on sandy bottom and it was difficult to disentangle specimens from one another without breaking them apart—they certainly tried to live up to the name brittle-star. Their colour in life was a biscuit yellow with faint darker cross

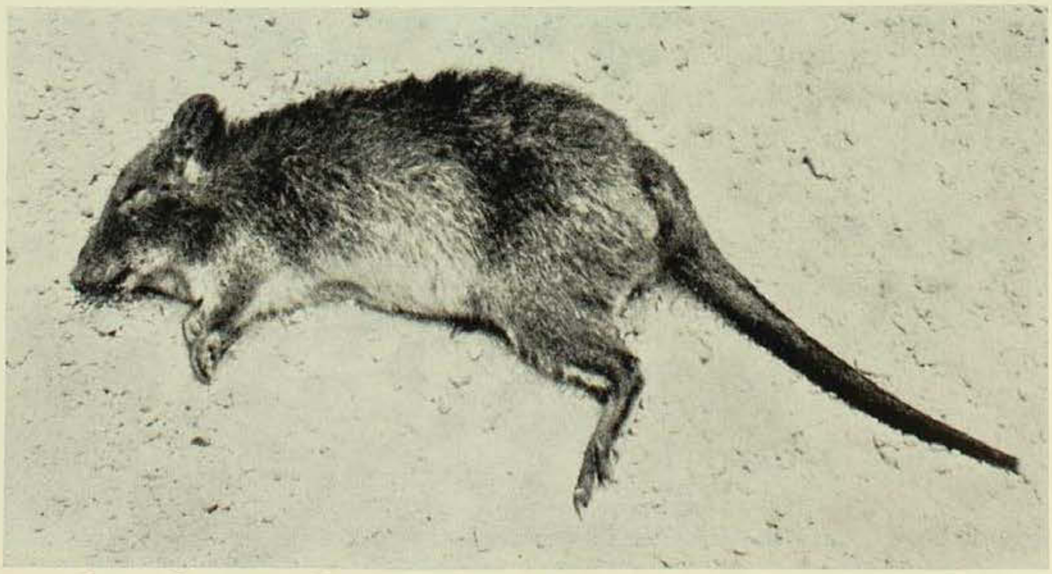


Seastar, *Tosia australis*, is characteristic of the cooler southern waters of Australia. It is plentiful along the shores of Bass Strait. Natural size.

stripes on the arms. Their correct scientific name has yet to be determined.

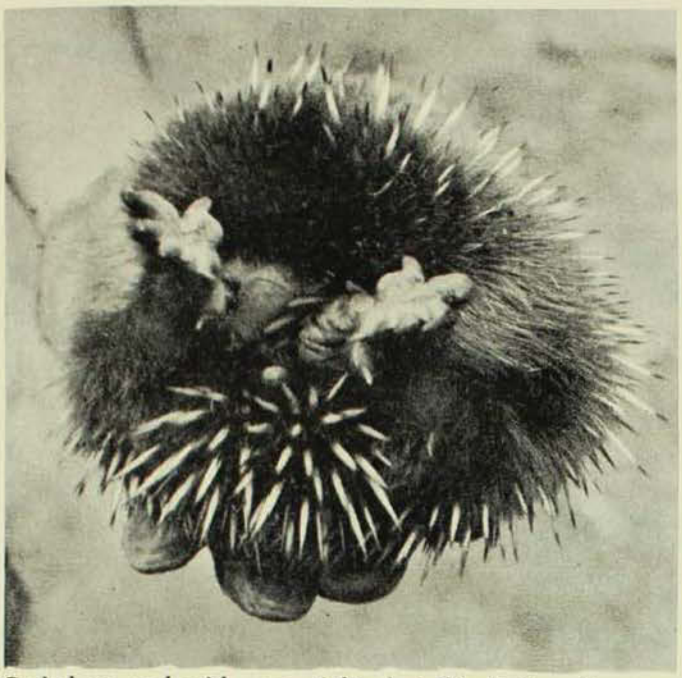
The beautiful little Biscuit Seastar, *Tosia australis*, is rather common in the south, especially on the outlying islands off the northern coast of Tasmania where it occurs together with two species of *Patiriella*, *P. exigua* and *P. calcar*, the latter reaching a very large size for the particular species.

Molluscs are very prominent members of the Tasmanian shore fauna and it comes as rather a shock to find that many of the



Dying Bettong or Rat-kangaroo. One of many marsupial victims of motorists on roads through the national parks of Tasmania.

Photo.—Author.



Curled up and with eyes tight shut this Spiny Anteater (*Tachyglossus setosus*) presents a formidable front of spines, claws and poison spurs to the camera. Note its comparative hairiness when compared with the mainland species.

Photo.—Author.

limpets and limpet-like shells, although they appear so similar at a casual glance to those of New South Wales, are different species or at least southern variants of well-known local species. Many of Tasmania's molluscs are also found along the Victorian coast but the common limpet, *Cellana solida* of the Tasmanian shores, is not found on the mainland although it crosses Bass Strait *via* the string of islands and approaches as near to it as the Glennie Group, which lies a few miles off Wilson's Promontory. It seemed so incredible that this limpet had not extended its range the final few miles across to the Promontory, that a special, subsequent and careful search was made for it, but it was not found.

At one point on the east coast, near Bicheno, thousands of scallop shells were jammed in between the granite boulders but the mystery was solved when their proximity to the factory of the Bicheno Fisheries was noticed. As no regard had been paid to keeping paired shells together, even in spite of the millions of shells there it was hard work trying to find matching pairs and they were of little use to conchologists. The sheer beauty of shape and colour of the shells as the waves washed over them was, however, hard to resist and we found ourselves spending half-an-hour searching for a set of perfect Queen Scallops.

Although the field trip was primarily marine in its object, it was impossible while in Tasmania not to take notice of the snakes, lizards, birds and various marsupials which kept intruding their presence during periods of travel or camping. Being February and somewhat warm, snakes were frequently seen either hurrying across the road in front of the car or lying squashed on the roadway. But snakes were not the only victims of the motorists; it was saddening to see so many small marsupials, such as wallabies and bandicoots, lying dead on the roads.

One of the pleasures of camping in Tasmania was the friendliness of many of the creatures in the national parks. The wallabies at Lake St. Clair came up behind us, stood up and pawed us to show that they wanted some of our salad greens. At Mount Field National Park a friendly possum was so insistent in his demands for beans that we had to be careful not to let the beanstringer cut him. On two occasions we encountered Spiny Ant-eaters and were able to verify that the Tasmanian Echidna is hairier than his mainland counterpart and that his digging abilities are equally good.

The weird cry of the Spur-winged Plover and the noises of the small birds waking up in the dawn will always bring back memories of this field trip. Looking back one forgets the chilly, damp, crack-of-dawn starts and the day when the lunch was left behind and not even a cake of chocolate was available. One remembers the sombre beauty of the dark ferny gullies and beech forests, or re-lives the excitement of the first view of the strange and colourful hills of Queenstown—jagged, with rotting tree stumps, and blazing in the brilliant sunshine as though not quite of this world. Such memories as these, coupled with the pleasure of exploring new and exciting shores, serve to make the 1955 field trip to Tasmania one of the most memorable the author has enjoyed.

Dimorphodon—one of the smaller types of flying-reptiles. These creatures did not beat their wings like birds but used the wind for soaring and gliding.
"Natural History" illustration.

The First Birds appear on Earth

By H. O. FLETCHER

ABOUT three hundred million years ago certain fishes left their aquatic environment and ventured on an entirely new kind of life ashore. This new life as air-breathing creatures was a momentous event in the history of evolutionary development as the way was opened for the spectacular progression of vertebrate life which led slowly but surely to the great variety of mammals we know to-day.

It was in late Devonian times that the amphibians first took the epoch making step of invading the land, a move which set in motion evolutionary trends directed towards adaptation of life on the land and in the air. Creatures took to the air in middle Mesozoic days when birds and flying-reptiles appeared for the first time in the pattern of vertebrate life.

The most important difficulty which the early amphibians had to overcome when they began a terrestrial life was the necessarily changed method of breathing. To a great extent this problem had been solved for them by their crossopterygian air-breathing ancestors. The Australian Lungfish, still living in the northern rivers of Queensland, is a descendant of the Early Devonian lungfishes and has changed little in appearance from *Ceratodus* of the Mesozoic, and the still more ancient Devonian lungfish *Dipterus*. It is only one of the many extraordinary creatures found on the Australian Continent which has led this country to be referred to frequently as the "Land of Living Fossils".

The emergence of amphibians from the seas in late Devonian times coincided with the growth of definite vegetation on land. Trees of considerable size formed great forests and in time these swarmed with an abundant variety of insect life. The conditions which existed in the coal forests of the Carboniferous and Permian times must have provided a favourable environment for the development of insect life. Fossil insect remains have proved the existence in those days of a remarkable number of species and many attained a size which has not been equalled since. There were great numbers of cockroaches and from the rocks of the Coal Measures of North America alone more than five hundred different types have been recorded. In Australia many species of insects have been described from the Upper Coal Measures of the Permian. These were not of great size; it was not until early Mesozoic times that insects attained comparatively large size in this country.

In an environment such as this evolution proceeded and from the amphibians developed the reptiles. In turn mammal-like reptiles gave rise to the first mammals in middle Mesozoic times. These were small, fast running creatures, controlled to some extent by the dominating reptilian group, but playing their part in developing the basic mammalian types which were to flourish at the close of the Mesozoic when the greater part of the reptilian stock became extinct.

The Mesozoic Era had a time duration of one hundred and thirty million years and it was then that the reptiles evolved into bizarre and giant forms which frequented the continents, the seas and the air. Seldom before or since has any group of animals evolved into such an abundance of strange and fantastic creatures. Some forms attained proportions far in excess of all other known land animals. Amphibious dinosaurs weighing as much as forty tons found it necessary to dwell in swamps and marshes so that their great weight, buoyed up by water, would be eased from their legs. Giant bipedal reptiles, forty-seven feet in length, with a maximum development of weight, teeth and claws, also roamed the continents — rapacious creatures standing erect on their hind-legs and

The fossil remains of *Archaeopteryx* with head and neck preserved. This specimen in the collection of the Berlin Museum shows very distinctly the feathers on the wings and tail and, to a lesser extent, on the hind legs.
"American Museum of Natural History Journal" illustration.

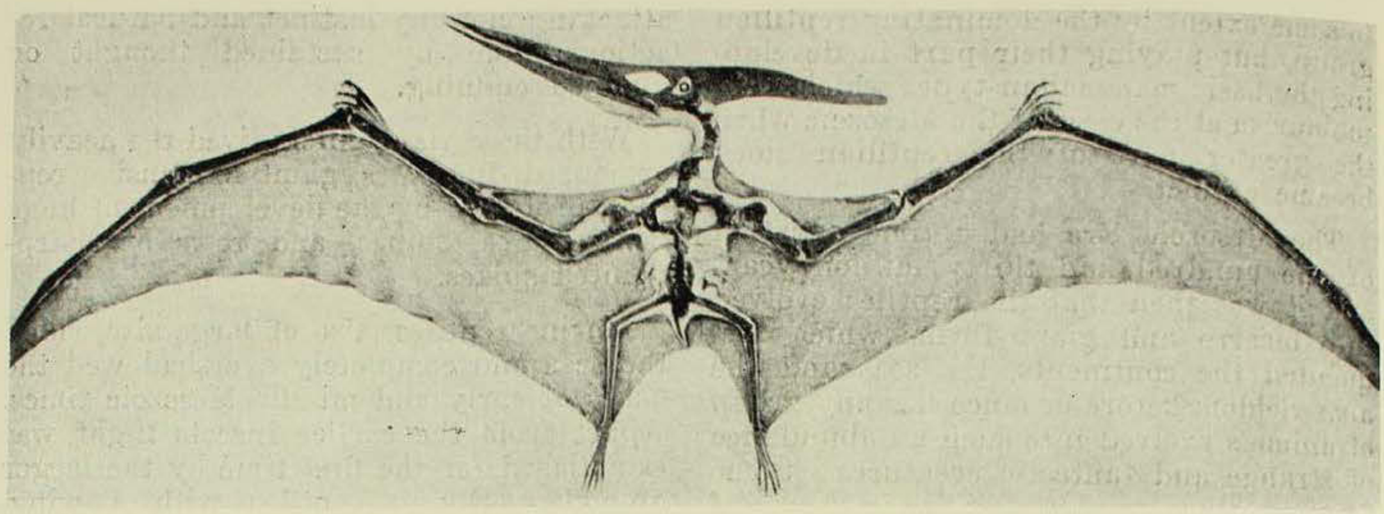
attacking more by instinct and natural reactions than by sustained thought or planned cunning.

With these giant killers lived the heavily armoured dinosaurs, giant inoffensive reptiles, protected by the development of huge bony plates, spines, and rows of sharp-pointed spikes.

Marine reptiles, also of large size, ruled the seas and completely overshadowed the fishes of early and middle Mesozoic times. Apart from the earlier insects flight was established for the first time by the larger animals. Flying reptiles with a wing-spread of twenty-two feet existed in middle Mesozoic days. With these great wings they were capable of sustained flight although possibly a great deal of their time was devoted to soaring, which would conserve their energy and strength for fast flight and diving to catch the fish which must have been their main diet. It is obvious from the skeleton of a flying reptile that it was not designed for the action of alighting on flat ground. That would have been most awkward and no doubt these reptiles rested in groups on sloping hillsides where projecting rock-masses provided a satisfactory landing place.

Into this amazing world there appeared for the first time birds with a covering of feathers. Descended from an early reptilian stock they took to the air, however, independently of them. They differed from flying reptiles in the development of strong hind-legs, which made it possible for them to walk or run on the ground in the same manner as living species. Flight was possible with feathers extending along the arm-bones; other feathers covered the body and a single row extended down either side of the long reptilian type of tail.

Our knowledge of these early birds, the first representatives of our present avian fauna has been derived from two skeletons and some fragmentary material found during the working of the lithographic stone of Bavaria. This slightly yellow limestone is exceedingly fine-grained and readily splits into thin layers. It was originally laid down or deposited in a shallow lagoon of what was in middle Mesozoic times a tropical sea. The flying reptiles and birds



The giant flying-reptile *Pteranodon*, with a wing-spread of 22 ft. and a body weighing possibly no more than 25 lb.

"Natural History" illustration.

which died and fell into the water were buried in the soft sediments continually being built up by erosion from neighbouring land surfaces. With them were entombed other examples of the fauna.

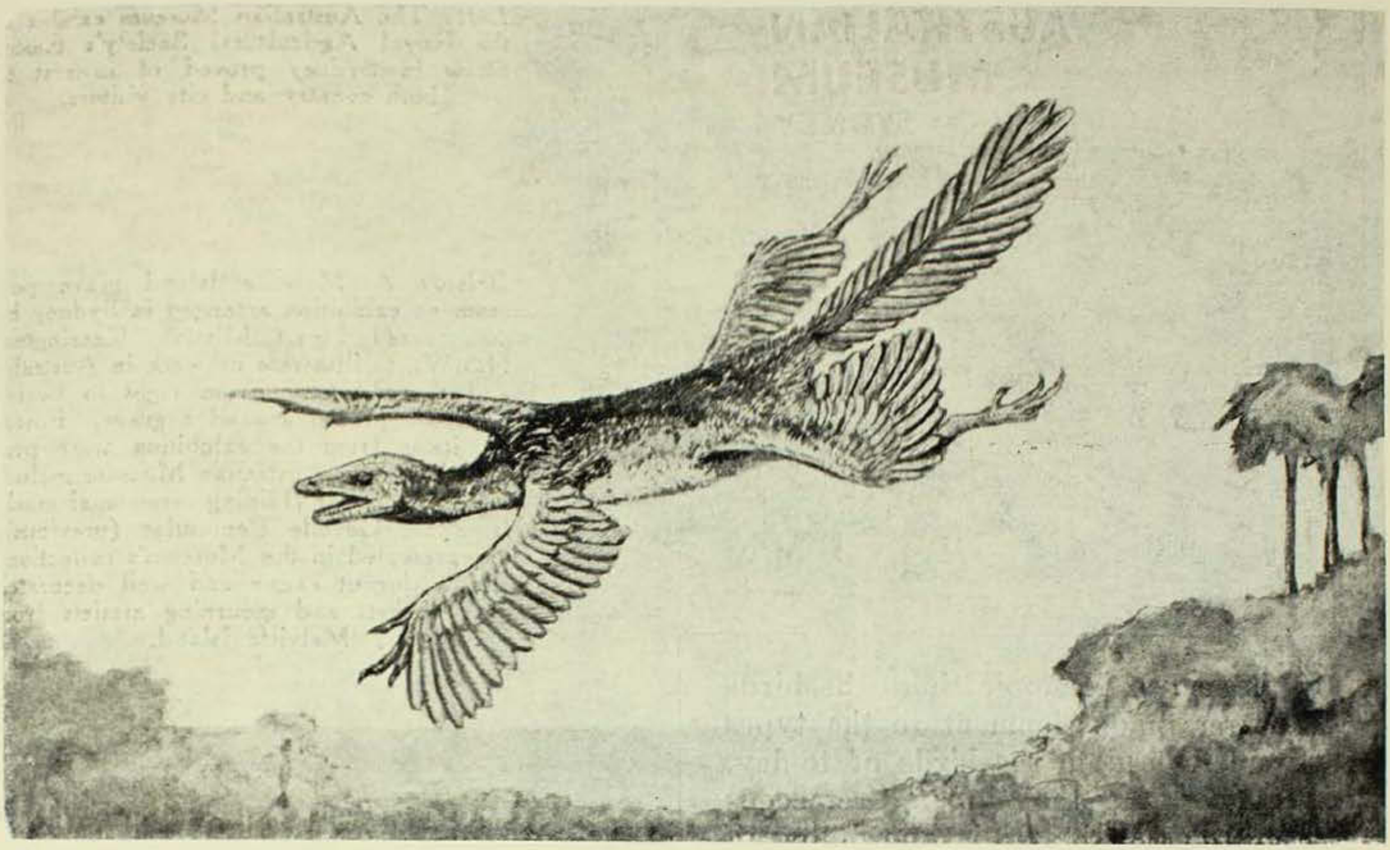
As the sediments attained their maximum thickness they slowly hardened to form a type of limestone now referred to as lithographic stone. Earth movements later raised the limestone to form part of the Bavarian landscape as it is now represented in low, flat-topped hills, isolated from each other by natural weathering which removed the intervening rock.

During the working of the lithographic stone at several localities north of the Danube, and particularly at the village of Solenhofen, Mesozoic life was found beautifully preserved as fossils in the planes of separation of the limestone. The rock is so fine-grained that even jellyfish impressions exhibit sufficient characters for them to be classified. Land plants swept by floods from a nearby continent into the sea were found embedded in the rock with dragonflies and other insects of the forests of those days. Myriads of marine shells and other types of organisms, including the skeletons of flying reptiles, lizards and, most important of all, bird skeletons with well preserved impressions of feathers still attached, have also been found.

It is from fossil localities such as Solenhofen, and from others in all parts of the world, that the palaeontologist is able to determine the life of each geological period and to reconstruct the gradual progression and advance of life through geological history.

The only fossil remains of the middle Mesozoic birds so far found are those from lithographic stone. One specimen is a skeleton without a head or neck, now in the collection of the British Museum. It was purchased in 1863 from Dr. Haberlein who received it in payment for medical services to the quarrymen. The price was £700. The other skeleton in the Berlin Museum, includes a head and neck and thus, fortunately, one specimen supplements the other so that the complete skeleton is well known. An isolated impression of a feather is in the collection of the Palaeontological Museum, Munich. Other features preserved with the two skeletons indicated from the outset that even though these creatures possessed many reptilian characters they were definitely birds, were warm-blooded and could fly.

The name *Archaeopteryx* was first given to these birds by Professor H. von Meyer when in 1861 he recorded the impression of an isolated feather as *Archaeopteryx lithographica*. For many years it was generally considered that two species were



A drawing showing the "four-winged stage" in the ancestry of birds. In this possible ancestor, based on characters in *Archaeopteryx* and in the young of modern birds, flight was restricted to gliding from trees to the ground. The pelvic wings would assist in volplaning.

"American Museum of Natural History Journal" illustration.

represented, *Archaeopteryx macrura* described by Owen in 1863, and *Archaeopteryx siemensi* later described by Dames. It is now thought, however, that they might possibly belong to the same species. While the skeleton and feathers of these extinct birds afford considerable knowledge regarding the middle Mesozoic birds the exact point at which they diverged from the reptiles and developed feathers is still obscure.

Several theories have been advanced to account for birds taking to the air as a natural means of progression. *Archaeopteryx* had already developed an expanded brain case indicating far greater intelligence than that of the reptiles, and a complex nervous system essential to an animal of flight.

It has been argued that birds gained their power of flight from ancestral forms which were runners and flapped their wings to assist their progression along the ground. In time, with slight changes and a strengthening of the wings, birds may have been able to leave the ground and maintain themselves in the air. Another theory is that the birds lived in the trees and flight was gradually developed by gliding from tree to tree or from trees to the ground.

The first birds were about the size of a crow and possessed a skull shaped not unlike that of a present-day bird. The front of the skull and the lower jaw were produced to form a narrow beak. A series of thirteen conical teeth in distinct sockets was developed on each side in the upper jaw; teeth in the lower jaw were of the same type.

The neck was long and flexible, the back was short and the tail, differing from that of all later birds, had a series of long vertebrae (about fifty in all) gradually tapering to the extremity. Each vertebra carried a pair of feathers. The hind limbs were strong and essentially avian, with three clawed toes pointing forward and one short toe directed backwards.

Left: The Australian Museum exhibit at the Royal Agricultural Society's Easter Show in Sydney proved of interest to both country and city visitors.

Below: A Melville Island grave post from an exhibition arranged in Sydney by the Sacred Heart Mission, Kensington, N.S.W., to illustrate its work in Australia and the Pacific. From eight to twelve posts are placed around a grave. Forty-six items from the exhibition were presented to The Australian Museum including a fine set of Baining ceremonial masks from the Gazelle Peninsular (previously unrepresented in the Museum's collection) and a dugout canoe and well decorated bark baskets and mourning armlets from Melville Island.

By the end of Mesozoic times the birds were nearer in development to the types that were to lead to the birds of to-day. *Hesperornis* from the Upper Cretaceous rocks of Kansas, U.S.A., is known by an almost complete skeleton. In this remarkable bird the jaws were provided with a series of sharp-pointed teeth which were sunk in a deep continuous groove. The anterior part of the upper jaw was, however, free of teeth and in all probability sheathed in a horny covering like that of existing birds. *Hesperornis* was specially equipped for swimming and diving and its legs were powerfully constructed with the feet adapted to assist the bird in motion through the water. There are also indications that the tail was capable of movement in a vertical plane and could be used as either a swimming paddle or a rudder. The bird stood about five or six feet high and its inability to fly was compensated for by the many adaptations of its structure to life in the water.

At the beginning of Tertiary times immediately following the Mesozoic Era the birds resembled very closely those existing to-day. There is a remarkable structural uniformity in the group even though there has been developed a great variety of forms as a result of evolutionary developments.

Conservation of Freshwater Fishes and Shoreline Fauna

By GILBERT P. WHITLEY

THAT there are as good fish in the sea as ever came out of it seems to have been accepted as an article of faith for centuries and until recent years few voices have been raised to question the idea.

The references to "conservation" in Dean's monumental *Bibliography of Fishes* number only ten, the earliest being C. Abbs' "Observations on the remarkable failure of haddocks on the coasts of Northumberland, Durham and Yorkshire."[1] The others are concerned with local declines of food-fishes, notably Salmonidae, in parts of England and the United States. Since Dean's work was published over thirty years ago there has been considerable anxiety about depletion of stocks and conservation of fish.

At the seventh Pacific Science Congress in New Zealand in 1949, Professor G. S. Myers pointed out that pressure for conservation has come from three groups: Those interested in the continued abundance of food or industrial resources; those interested in hunting and sport-fishing; and scientists and nature-lovers.

The last group, to which the writer belongs, is numerically the weakest. Some may have difficulty in understanding how a museum man can be keenly concerned with the perpetuation of life. This, however, is one of life's paradoxes—while the museum worker is anxious to complete his collection of dead bodies he is so entranced by the wonder of the creatures he studies that he wants all species to survive. Up to the present fishes have scarcely been considered by this "weak" minority, and Myers pointed out that even the National Parks Service of the United States, which has been very strict in preserving the native fauna [*i.e.*, mammals and birds] of the National Parks, allows heavy sport fishing, and even assists in introducing exotic species of fishes. He concluded: "Information on zoologically or esthetically important fishes which are threatened with extinction is not available and must be compiled before any programme of protection can be begun."

What is the position in Australia? Where littoral (or shoreline) fauna and freshwater fishes are involved I would assess it as follows:[2]

LITTORAL FAUNA.

Regarding the shore fishes and other animals and their habitats in coral reefs, rockpools, etc., there seems little cause for anxiety at present. The growth of ports and waterfront buildings and streets with their outfall of rubbish and alluvium; ordinary fishing activities; and alterations to habitat by cutting down mangroves, draining swamps and dredging bays are the main factors detrimental to some fish. But the northern and southern coastlines of Australia, each with its separate fauna, are so vast that there is no fear for the safety of most of our marine fishes. Here and there, may be little "pockets" of marine regions with special characteristics—particularly in north-western Australia where trevallies and other fish seem to be evolving into incipient new species in response to curious water-conditions. The descendants of the holothuria, medusae and invertebrates recorded by the earliest north-western explorers are still to be seen in the same areas (and possibly nowhere else); the devil rays noted from time to time—should not all these creatures be protected as a unique biological heritage rather than exploited (like whales) for temporary gain, or shattered and poisoned by instruments of destruction?

[1] Phil. Trans. Roy. Soc. Lond. lxxxii, 1792, pp. 367-373.

[2] This article was read before the Pan Indian Ocean Science Association, West. Australia, 1954.

The rockpool naturalist, fisherman or tourist should replace any stones or coral he overturns in search of souvenirs or bait; the spearfisherman should take only the immediate requirements of science or the table—these are elementary requirements which should be, and probably are, known to most people. Education is thus the chief weapon of conservation; an enlightened people will understand the need for sparing life and its haunts as much as possible. Australia may expect a growing army of underwater explorers and students now that breathing-apparatus for their purposes has been invented. To all of these the idealistic propositions of P. Diolé in his book *The Undersea Adventure*, 1953, can be recommended. The recognition of submarine reserves for their special beauty or fauna and flora might well be considered immediately by spearfishermen.

A cyclone or two can do more damage to a coral reef than a party of tourists[3] but the exploitation of coral for commercial purposes (lime, building material, etc.) should be controlled.

Freshwater Fishes.

There is no published up-to-date list of the freshwater fishes of Australia but I have a manuscript catalogue listing some 180 native species which is evidence that I do not subscribe to the academic dictum that there are only two kinds of true freshwater fishes in the Commonwealth—the Queensland lungfish, *Neoceratodus*, and the burramundi, *Scleropages*. It is true that all the others may have been derived from marine migrants since the Tertiary Era, but it is obvious that species which live and breed in inland waterways and never go to sea must be considered true freshwater fishes. When considering the origin of Australia's present fresh waters and the animals inhabiting them we cannot venture back with certainty more than a million years in time. But that million years' period has given us a series of aquaria of living "lost world" animals, not as dramatic as dinosaurs, but none the less unique and interesting. Surely these wonderful old laboratories of Nature should be kept intact as much as possible for future and better equipped generations to study and use? Man, the greatest enemy of our fauna, can be its greatest friend.

"The lowliest fungus may be of world-wide importance in healing. No single creature can fail to have some significance." So wrote John Béchervaise when stressing the importance of national wildlife reserves.[4] The total area of national parks in Australia is pitifully small and compares unfavourably with other countries—7,000 out of 2,974,581 square miles, or 0.23 per cent., according to Béchervaise's map. The native animals of Australia have in any case a cruel battle for existence and no introduced species should be allowed into the strict sanctuaries of their reserves. For apart from man's activities—fishing, altering habitats by building, clearing, draining, inducing erosion, etc.—introduced foreign species seem to me to be the main cause of the depletion of native freshwater faunas.[5]

As E. B. Ford[6] said in his "The Experimental Study of Evolution": "Nowhere in the world has the introduction of foreign species taken place on so great a scale as in Australia and New Zealand. Its disastrous effects are only too well known when they have given rise to economic problems; they are less obvious but none the less real in other instances, in which the survival of the wonderful indigenous fauna and flora is threatened by competition with alien forms, by the parasites which they have brought with them, or by the ecological changes which they produce."

Examples of the great deal of damage which has been done to the fluvifaunulae (consociations of river animals) will rise readily to mind. It has been impossible to form any picture of the original fauna of the zoogeographically and geologically important Glenelg River in Victoria because the native species have been so completely upset or exterminated through introductions from elsewhere. The Snowy

[3] Rainford, Aust. Mus. Mag. ii, 5, 1925, pp. 175-177 and map.

[4] Walkabout, June, 1950.

[5] Please re-read my articles on Introduced Fishes, Aust. Mus. Mag. x, 6 and 7, 1951.

[6] Rept. 28th Meeting A.N.Z.A.A.S. (Brisbane, 1951), 1953, p. 149.

River had alien fishes introduced into it before most of us were born. Even the remote North-west Cape district in Western Australia was subject to meddling in the early days. Saville-Kent, in the 1890's introduced carp, goldfish, freshwater eels, Murray cod and perch from the eastern States into Western Australia; the good Australian food-fishes failed to thrive whilst the pests persisted and have since been joined by others. Trout had been introduced near Albany in 1874 from Ballarat (Shipway, W. A. Nat. iii, 1953, p. 173) and *Gambusia* was widely diffused during World War II; lately the leopard fish (*Phallocerus*) has appeared in the Swan River system.

The continuing indiscriminate distribution of trout into waters, such as those of south-western Australia, inhabited by fishes, crustaceans, etc., which are found nowhere else in the world and probably could not live anywhere else is to be deplored. We know practically nothing about the life-histories and habits of our native fishes; the work of Bruce Shipway and of a handful of aquarists on Australian freshwater species is of prime zoological importance and should be greatly extended.

Fish-farming (acclimatisation and pisciculture) and conservation are not quite the same thing, indeed they are often opposed. Australian species which may be recommended for pond or dam culture are: mullet, Macquarie perch, Australian perch or bass, Murray cod, callop, silver perch, catfish and freshwater blackfish, with smaller native fishes as food for the larger ones, as scavengers or mosquito-destroyers. Very rightly any attempts at introducing fish into streams can be made only with the sanction of our State Fisheries Departments. Introduced foreign fishes (carp, tench, *gambusia*, redfin perch—not to reiterate trout) should never be allowed access to open flowing waters. It were better to encourage the propagation of Australian food-fishes than alien ones. An excellent pamphlet on fish-farming by Butcher and Thompson was issued in 1947 by the Fisheries and Game Department, Melbourne, Victoria. Truly it has been said[7]:

> Pisciculturists tempted at one time to replenish their waters by the introduction of exotic species, such as carp, trout or perch, which often found very favourable conditions for reproduction, have gradually come to regret such solutions. Temporary successes lead sometimes to final disaster, and once more we are brought back to the golden rule, namely that native species should be used in such attempts undertaken for economic ends.

In times of drought it may be necessary to rescue young fishes left in evaporating pools, a paying method of conservation discussed by H. K. Anderson.[8] The construction of fish-ladders to bypass spillways and weirs is another very necessary step in conservation.[9] Pollution, especially from factory wastes, is a danger to water life which always should be guarded against; carelessness with noxious effluents, DDT, and through floating oil catching fire, has caused unnecessary, serious mortalities in various parts of Australia.

Australian parasites, fungi and diseases are not normally a serious hazard to our freshwater fishes, which have established a balance with them so that, for example, the black spots on *Retropinna* or *Galaxias* due to parasitic worms known as trematode metacercariae do not incommode them. But below suitable temperatures, the domiciled fish are affected by "salmon disease" (*Saprolegnia*) and introduction of foreign fishes into their haunts increases the chances of other diseases and parasites occurring.

The rest of the natural enemies of our freshwater fishes are unimportant. Predatory fishes like the burramundi, even an occasional shark entering fresh water are no more dangerous than water rats and the rare seals ("bunyips") which might take a fish or two The cormorant or shag has been singled out from other birds for vituperation and destruction but a mass of

(*Continued on page* 364.)

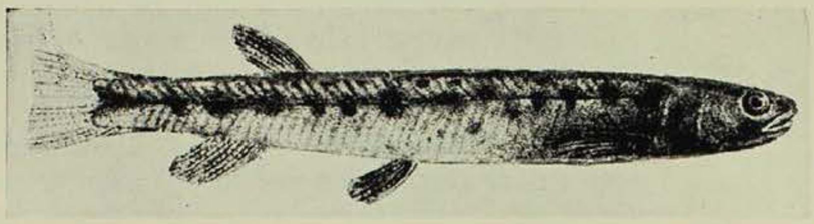
[7] Bulletin Internat. Union for the Protection of Nature, iii, Nov. 1954.

[8] Austr. Zoologist, i, 1918, p. 157, figs. 1-2.

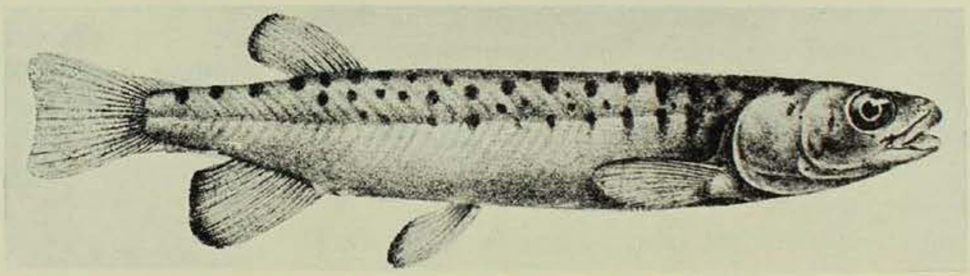
[9] A symposium on "Dams and the Problem of Migratory Fishes" appeared in Stanford Ichthyological Bulletin, i, 6, 1940, pp. 173-216, illustr.

NATIVE FISHES WORTH PROTECTING

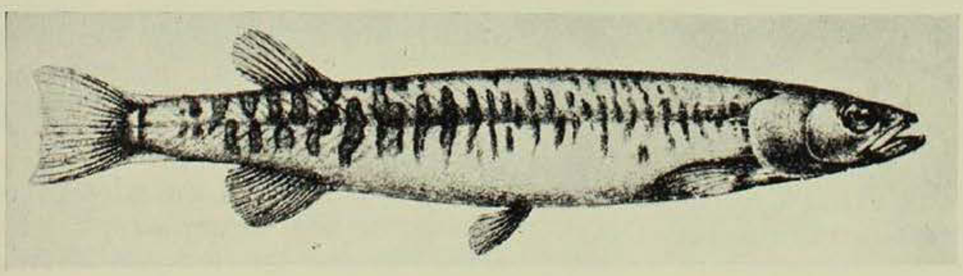
Brachygalaxias nigrostriatus from Western Australia.
After Shipway.



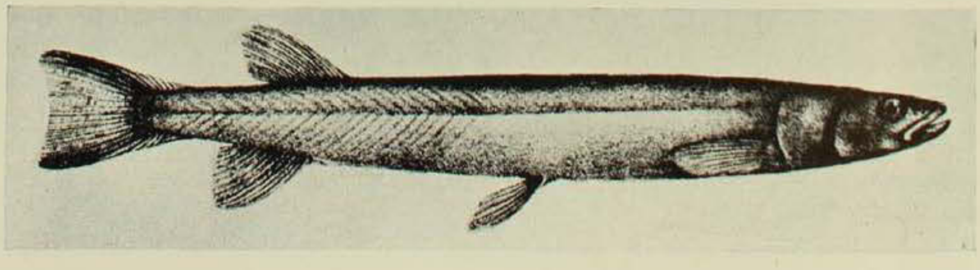
Galaxias findlayi from Mount Kosciusko.



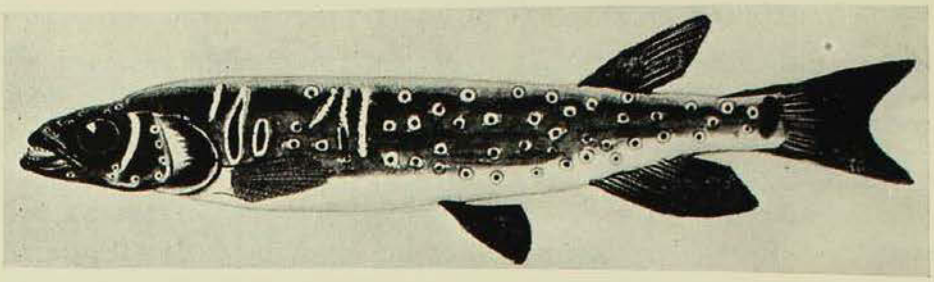
G. auratus from Great Lake, Tasmania.



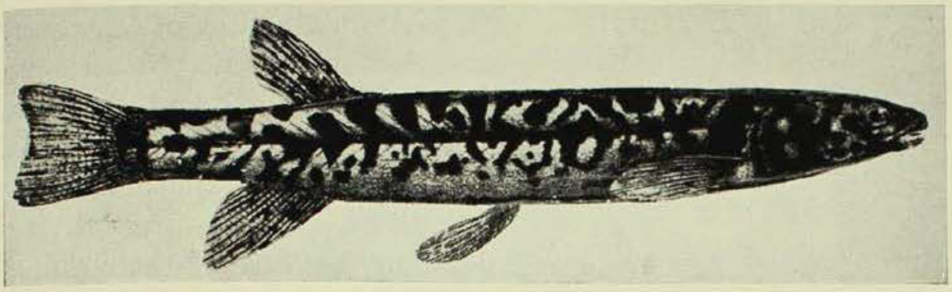
G. occidentalis from Western Australia.



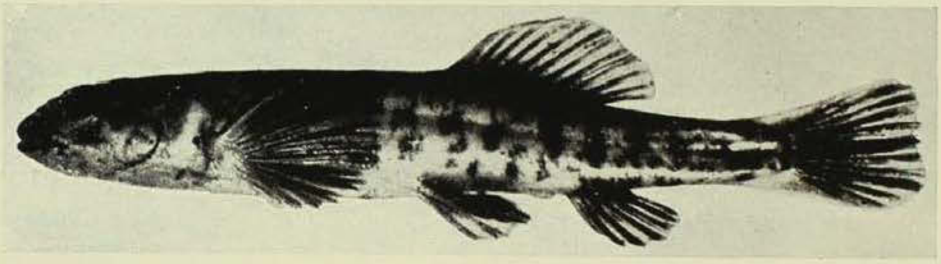
G. planiceps from New South Wales.
After Regan.



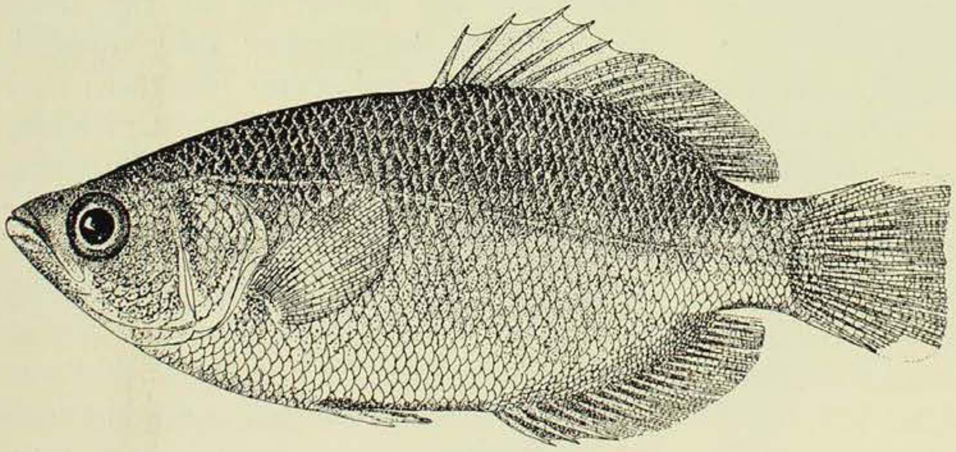
G. truttaceus from Tasmania.
After Cuvier and Valenciennes.



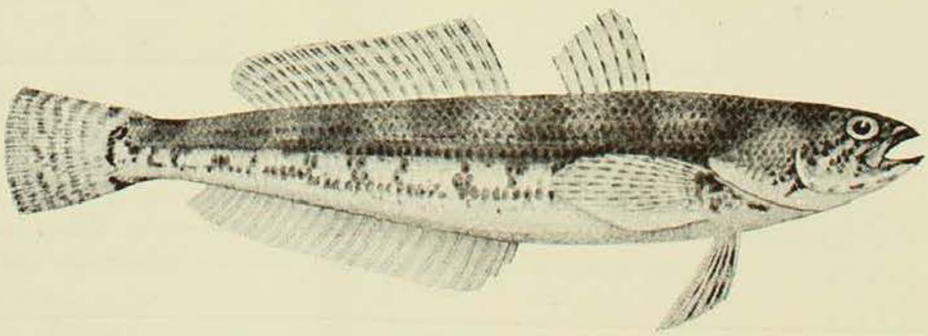
G. weedoni from Tasmania.
After Regan.



Paragalaxias dissimilis from Tasmania.
After Stokell.



A primitive type of Archer Fish (*Protoxotes lorentzi*) from New Guinea and Northern Territory.
After Weber.



The Congolli (*Pseudaphritis bursinus*), which is becoming rare in southern Australia and Tasmania.
After Waite.

(*Continued from page* 361.)

evidence indicates that whilst shags eat an occasional trout or commercial fish (especially netted or disabled ones) the greater part of the birds' food consists of fishes of no importance to man. Other birds (pelicans, kingfishers, ospreys, etc.) are hardly worth mentioning in this connection.

PROTECTION OF FRESHWATER FISHES.

Protection may be extended in several ways, for instance I suggest that the taking of certain fish might be totally prohibited, or only allowed above a certain size, or that the waters they inhabit might be proclaimed as sanctuaries. The latter course is impracticable in many cases because sudden floods at rare intervals—characteristic of the Australian climate—can break all barriers and are the means of disseminating fishes over great areas.

We may bypass such common types as freshwater herrings ("bony bream"), catfishes, eels, grunters and certain other perch-like fishes, gudgeons and gobies, as most of these seem able to look after themselves. The Queensland lungfish is already protected by law, as are, to a less extent, food-fish like the Murray cod, callop, perch and bass. Faunal reserves like the Kosciusko area at least afford protection to *Galaxias findlayi* for much of the year. Aboriginal reserves in the Northern Territory ensure for the time being the protection of native fauna from all but native hunting. There are several species of inland or outback *Craterocephalus* and other atherines and sunfishes which ought to be protected; probably these and more of our tropical fishes when they are better known will prove popular with aquarists both here and overseas. *Toxotes*, the archer fish, might well qualify for Myers' "esthetically important" group; it is well known for its habit of "shooting" insects with jets of water. The life-histories of lampreys need investigation so that no obstacles may prevent their migration and breeding. *Lovettia* and other anadromous whitebait have already suffered exploitation. Leaving aside all these for the present, it is recommended that because of their uniqueness the following genera of Australian freshwater fishes should be afforded the utmost protection:—

Galaxias spp. and allied genera of "native trout", family Galaxiidae; *Prototroctes*, the grayling; *Quirichthys*, the blackmast; *Bostockia*, *Edelia* and *Nannatherina*, Western Australian percoids; *Protoxotes*, the prototype of the archer fish; *Kurtus*, the nursery fish; *Gadopsis*, the slippery or freshwater blackfish; *Pseudaphritis*, the tupong or congolli; *Chlamydogobius*, a unique Central Australian goby; *Lindemanella*, a gudgeon; *Milyeringa*, the blind gudgeon; *Scleropages*, the burramundi; and certain saltpan or freshwater soles which are so rare that they are almost unknown. It is possible that some of the above-mentioned fishes are approaching extinction.

Collecting and Preserving Insects and their Allies

(*Continued from page* 339.)

By A. MUSGRAVE

SOME insects may be preserved without trouble in the field, others must be given special treatment when the collector returns to camp or home. A collector of insects in general will require more impedimenta than one confining his attention to a single group of insects, and the suggestions here given are for the general collector.

Equipment.

Collecting Gear.—Butterfly net, beating net or umbrella, small net or wire tea-strainer, killing bottle (cyanide or acetic ether), sucking tube, long forceps, strong bladed knife or tomahawk, small tubes (4 x 1 inch), spirit tubes (3 x 1 inch), tins, pocket-box, pill-boxes or cardboard boxes, labels (cartridge paper), butterfly envelopes, magnifying glass. (To be carried according to requirements.)

Haversack.—To carry gear in the field a light but strong haversack, preferably of two compartments, is a first essential.

Nets.—A butterfly net is necessary to capture flying insects such as moths, butterflies, dragon-flies, flies, wasps and active insects of all kinds.

Butterfly nets are of various types. The collapsible kinds sold by dealers in natural history material are as a rule oval rather than circular, and have the advantage of taking up little room when not in use. The type of net used by the staff of the Museum has a spring steel framework, the two ends at the top of the net being fastened by a wing nut, or a sliding groove, which effectually clamps the ends.

If the more elaborate types of nets are not procurable, a home-made one may be constructed. A ring of fencing wire (No. 8 gauge) about 15 inches in diameter, has the ends straightened and bound with fine wire to a ferrule of light metal, then soldered. If no ferrule is available the ends of the ring may be bound with wire to a wooden handle previously grooved at the sides to accommodate the wire ends. A handle need not be more than about 18 inches in length (too long a handle makes a net unwieldy) and can be made from a broomstick. A calico strip 3 or 4 inches deep, into which the wire frame has first been inserted, will serve to reinforce the bag which is attached to it. The bag should be of Bretonne net (which has a smaller mesh than mosquito net) at least twice the diameter of the net opening, that is, it should fold over from one side of the ring of the net to the other. It is even better if it is about six inches longer than twice the width.

Some collectors employ a beating net for certain types of insects. This is swished about amongst bushes to capture many kinds of leaf-eating insects and flower-frequenting spiders and insects. It may be made after the manner of a butterfly net, but with a heavier wire frame (No. 4 gauge), and a strong calico bag with straight sides and rounded in one piece at the bottom. The ferrule serves as a handle and need not be longer than 6 inches.

Many collectors prefer to use an umbrella instead of a beating net. This is held under a bush which is vigorously shaken over it. All sorts of insects and spiders are dislodged and, falling on to the black cloth, are easily seen and captured. An umbrella may be employed in capturing insects living under bark by placing it against the tree-trunk. When the loose bark is removed the insects fall down into the open umbrella.

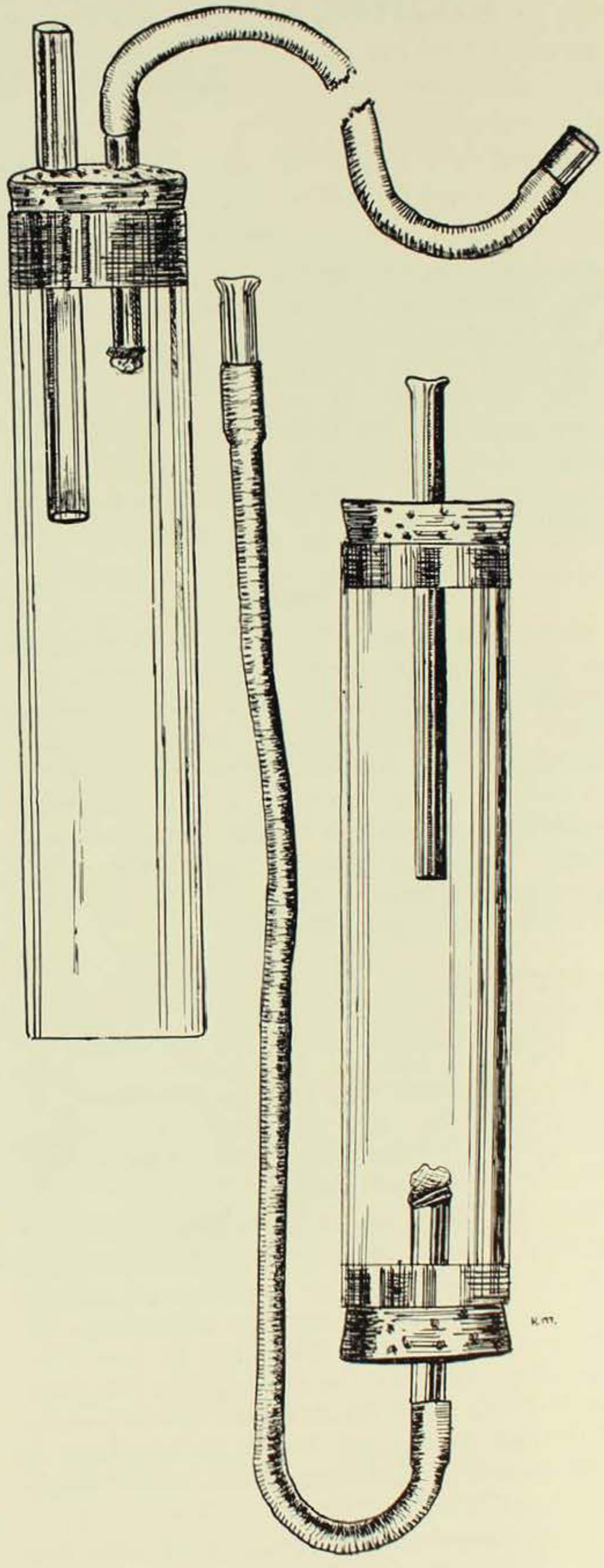
A water net for aquatic insects should be made of cheese cloth. It need be only half the depth of a butterfly net, *i.e.*, the depth should about equal the diameter of the net. A small wire tea-strainer and a sucking tube are useful aids when collecting aquatic insects among mud in pools and streams.

Sucking-tube.—For those who collect small insects a sucking-tube is indispensable. With its aid small insects may be picked up from inside a net and later shaken into a killing-bottle.

A simple form of sucking tube may be made from a glass tube 3 to 6 inches long and from 1 to $1\frac{1}{4}$ inches in diameter. A cork, preferably a rubber stopper, is placed in the open end of the tube, and through this short lengths of narrow glass tubing are inserted. One length of glass tubing is attached to a length of rubber tubing, into the other end of which a glass mouthpiece is inserted. The end of this tubing inside the larger tube needs to be covered with a piece of muslin, tied on with cotton. This is to prevent insects entering the mouth when the apparatus is used.

Killing Bottles.—While many hard-bodied insects may be killed and preserved in alcohol, there are others, such as moths, butterflies, flies and wasps, which are ruined, or at least not improved, by immersion in a liquid. Insects are usually killed in a killing bottle by means of the fumes of such substances as carbon tetrachloride, acetic ether, chloroform or cyanide of potassium (the last being a deadly poison and requiring care in handling). Many collectors find acetic ether (ethyl acetate) invaluable as a killing agent as it also possesses the quality of keeping specimens in a relaxed condition. On the other hand, it has the disadvantage of affecting certain colours.

Chloroform is useful for killing specimens quickly, particularly those too large for the killing bottle, but it hardens the muscles, making the setting of the specimens a difficult task unless done soon after death. However, a small bottle of chloroform and some 4 x 1 inch corked tubes, with a small pad of cotton wool or sponge rubber pressed well down on to the bottom



Sucking tubes.

of the tubes and covered with disks of paper, make a useful addition to the collecting kit. The cotton wool is damped with chloroform as required. Care must be taken to see that the inside of each tube does not become wet with chloroform, which may ruin the wings of many insects. This disadvantage is not confined to chloroform but to any liquid killing agent.

The cyanide killing bottle is the universal favourite of the insect collector, and insects killed with it remain in a relaxed condition. While it is the best killing agent, it is one which cannot be recommended for young people owing to its deadly nature. There are several ways of making a cyanide killing bottle of which the best-known is as follows: Small pieces of potassium cyanide are placed at the bottom of a wide-mouthed bottle provided with a tight-fitting cork or rubber stopper. Plaster of Paris in a semi-fluid state is poured over the cyanide to cover it to a depth of a ¼ inch. The bottle is left uncorked until the plaster is dry and hard. The inside of the bottle is cleaned of traces of plaster. As cyanide is hygroscopic, blotting paper cut to the diameter of the bottle should be pressed on to the top of the plaster to absorb surplus moisture. The paper will require replacement from time to time. Eventually the cyanide, too, will become a dirty-brown, but until its lethal properties are exhausted, no notice need be taken of this discolouration. *A label should be fixed to the killing bottle indicating its poisonous contents.* Some collectors paint the cork of the killing bottle red so that it is not easily misplaced.

Another way of preparing a cyanide killing bottle is as follows: The cyanide of potassium is placed in a glass tube and the open end plugged with cotton wool. The sealed end of the tube is then placed in a hole previously cut in the cork or rubber stopper of a wide-mouthed bottle. For collecting smaller insects a large size glass tube may be used and a smaller tube holding the cyanide embedded in the cork in the same way.

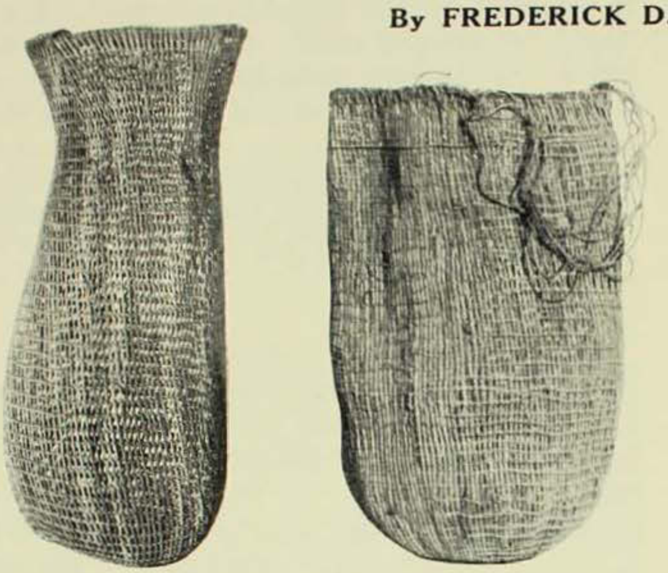
A killing bottle to absorb liquid killing agents such as chloroform or acetic ether may be prepared by selecting a jar with a wide mouth and pouring liquid plaster of Paris, the consistency of thick cream, into the jar until the bottom is covered for a depth of about ½ inch. When this sets the hardened plaster readily absorbs any of the already mentioned killing agents which may be poured on to it. About a dessert-spoonful to a tablespoonful of the liquid may be poured in, the amount depending upon the size of the jar and the insect itself.

Boxes.—Material collected in the field may be emptied from the killing bottle or chloroform tubes and placed in cardboard boxes, tins, glass-bottomed pill-boxes or match-boxes, with a little wadding or cotton wool (though this last-named can be a nuisance by getting entangled in the legs of the specimens). Here they remain until they are ready to be set or mounted for the collection. Some collectors use pocket-boxes (corked) in which they pin freshly killed specimens. Moths and butterflies may be placed in butterfly envelopes which have been prepared prior to setting out. Butterflies when caught in the net should have the wings folded back and a sharp pinch given to the thorax near the base of the legs. This affects the nervous system so that the insect may be placed in the killing bottle without fear of damage. The envelopes are prepared by taking pieces of paper of an oblong shape, say, 5½ x 3 inches, folding them diagonally across and folding over the two ends so that they lie flat. Information such as locality, date of capture, elevation and collector's name may be written on one of the flaps. The envelopes may be stored in tins, such as tobacco tins. A little flaked naphthaline or crushed moth ball should be placed with the envelopes. In the tropics humid weather soon rots the specimens and the envelopes should be put in wooden boxes with naphthaline and a little trichlorphenol.

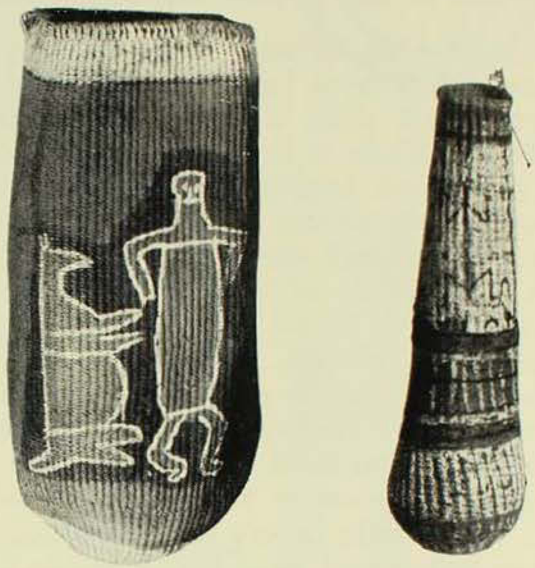
(*To be continued.*)

Arnhem Land Baskets

By FREDERICK D. McCARTHY



A large open-work basket of the necked type, 17 in. long, used by women, and an open-work flexible basket from Yirrkalla, 17 in. high.



A man's basket, closely twined and bearing an unusual design of an ancestral being with a kangaroo; painted in white and red on a brown basket. 10½ in. high. Oenpelli.

A slender basket, 6½ in. high, used by male Aborigines for holding sacred articles. It is decorated with emu tracks, a stick-like human figure, and other motifs; painted in red on a white ground. Merkinalal Creek.

AMERICAN Indians are famous for their beautifully made baskets, equal in craftsmanship, variety of shape and decoration to those of any other primitive people. In some parts of Australia the Aborigines were, and in other areas are still, basket-makers. Their products do not equal in skill those of the American Indians but they are well made in a limited series of shapes best suited to the life of a semi-nomadic people. In fact, one of the most striking things about the material culture of the Aborigines is the great variety of containers (for food, water and other articles) which are made of wood, bark, palm leaves, tree gnarls, human skulls and large shells.

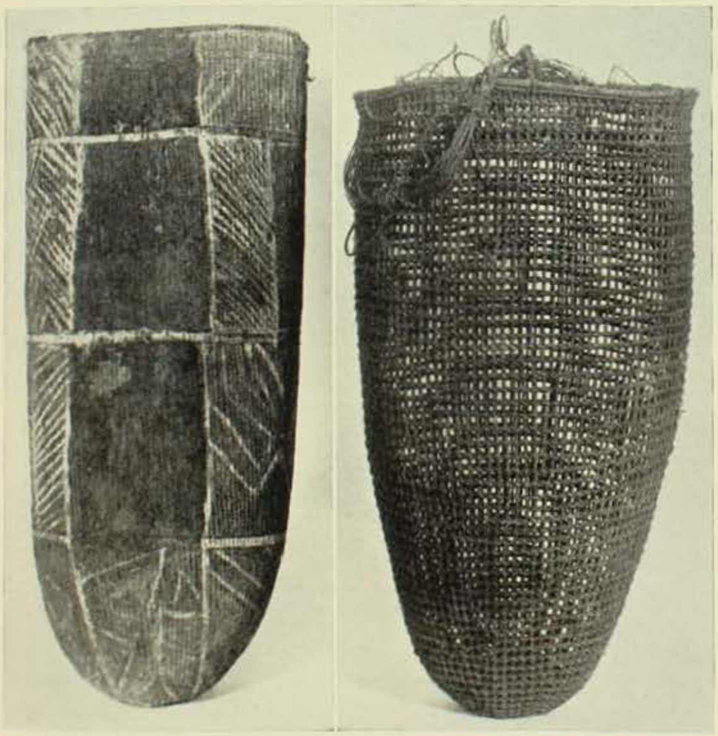
There were three major basket-making centres in Australia—Arnhem Land, Cape York and north-eastern Queensland, and south-eastern Australia. In the two former areas the twining technique is employed. The coiling technique was used in south-eastern Australia but there basket-making has survived as a craft only at the Point Macleay settlement on the lower Murray River.

In technique, style and decoration the baskets of Arnhem Land illustrate well the skill of their aboriginal makers. The natives of this area have a richly developed culture, particularly in ritual and mythology, art and music, and their dynamic approach to life in general has contributed largely to the relatively high artistic development of even their simplest possessions.

In the twining process the vertical ribs form the skeleton of a basket and to them the horizontal bindings are secured. Materials and stiffness vary in the different kinds of baskets made. Most of the baskets are cylindrical in shape, but others may look like an inverted cone or a beaker, narrower (or wider) at the top than in the middle. The other important series has a distinct neck near the top. Both groups include rigid and flexible baskets fashioned in a closed mesh or in an open work pattern.

Arnhem Land natives classify baskets according to the way in which they are made, and their use. Thus Sir W. Baldwin Spencer listed the following types named by the Kakadu tribe of the Darwin district:—1. Neckless: (*a*) *Kurokura*, open-work, made of pliant twigs or stiff grass or rushes bound with bark fibre string; (*b*) *Djilara*, close mesh, made of grass stalks bound with a single strand of string; (*c*) *Nuborgo*, closer mesh, made of twisted grass stalks or pandanus fibres bound with double strings. 2. Necked: (*a*) *Maleba*, and (*b*) *Numalka*, both made in the same way as the *Nuborgo* but with close and closed mesh respectively.

The half dozen kinds of neckless baskets form the commonest type for both men and women. The large rigid and cone-shaped women's baskets are from 9 to 32 inches long, with a mouth up to 18 inches across. The ribs are water lily stems, vines or roots split into hard strips ⅛ inch thick, and the bindings are of bark-fibre twine or pandanus leaf strips, the latter being up to ⅜ inch apart. Strips of the same material as the ribs are bound around the tops to strengthen the lips of the big baskets. Another large type of open-work basket, varying from flexible to stiff in nature, is made of bundles of two or three strips of pandanus which form both ribs and bindings, though in some cases split grass or rushes are used. Being simply a food basket of the least valued type this kind is never decorated. It is sometimes used to catch fish in various kinds of traps, and to hold plant foods which have to be soaked in water overnight to leach out toxic secretions.



Left: A bound twining, fine and close, was used in this 17½ in. high basket from Oenpelli. It is covered with gum or wax to make it watertight and to hold honey.

Right: A large open-work, rigid basket, 21 in. high, used by women for carrying plant and other foods. Alligator Rivers.

One of the most interesting groups of baskets from Arnhem Land, and that most abundantly represented in museum collections, includes a series of stiff and pliable baskets up to 21 inches long in which the ribs and bindings are both made of pandanus strips. There are several varieties among them. One is a medium-sized type between 8 and 14 inches long, favoured by the men, in which the pandanus strips are about ⅛ inch thick and the bindings may be either pressed closely together or set slightly apart. Some very small baskets are made in this way, from 4 to 8 inches long, and among these one with a slender body and swollen bottom, only a couple of inches wide, is a rare but attractive example. The finest kind is made of very thin strips of pandanus set so closely against each other that no light shows between. They are long cylindrical and flexible baskets, from 13 to 20 inches long and 5 to 7 inches across, beautifully made and often elaborately decorated. Some of them bear overstitching in parallel rows to separate the bands of decoration.

The necked baskets from western Arnhem Land include the rigid, stiff and flexible kinds with similar bindings and ribs to the neckless ones. The top, however, is a widened flap which forms a broad turned-back lip. In size they range from 8 to 22 inches long and up to 11 inches across, and they may be decorated with simple but bold designs.

The women collect pandanus leaf, water-lily stems, vines, roots and other raw materials while searching for food during the day. The older women tend to remain in camp looking after children and doing chores, and, if skilful in the craft, making baskets and mats. The baskets are fashioned from the bottom which is formed by a disk of closed bindings several inches wide, sometimes with a dummy-shaped projection in the middle. A single binding of bark-fibre twine may be used, but the commonest binding is a chain-twist of one or two continuous strands, each of which is plaited alternately in front of and behind each rib right around the basket. The women often sit in a group and gossip while they are at work, and the girls are given the tricky task of stripping the outer sheath from the pandanus leaf with their thumb nails to expose the inner tough and fibrous layer. A stock of strips of the latter is prepared. The handles of the baskets consist of several strands of two-ply twine which are continued as a binding in a series of half-hitches around the top to preserve the shape and durability of the baskets. Sometimes a few strips of pandanus are bound around the lip to make a neatly finished top.

The skilful women work rapidly and occasionally experiment with the effect to be gained by a variation of the technique. Thus a few baskets consist of broad bands of open and closed bindings which produce pleasantly contrasted horizontal areas. A similar but more striking effect is obtained by binding groups of a dozen or more ribs horizontally and then binding the sections between them vertically. Another variation is to close the bindings on one side and space them on the opposite side so that the top of the basket is oblique.

Large baskets are used by aboriginal women when collecting food in the forest, swamp or seashore, and a familiar sight in the late afternoon is that of the women returning to camp laden with a heavy basket of yams, cycad nuts, water-lilies, shellfish or other food.

A design is painted on a basket with a feather or twig brush. Milingimbi.

Photo.—Author.

The red ground colour for this basket was smeared on by hand. Milingimbi.

Photo.—Author.

In the medium-sized baskets both sexes keep their personal possessions—string, fire-sticks, string-figure loop, and other things by the women; ochres, spear points, human hair and ornaments, sacred and magic stones by the men. Baskets of this size are used by the men to carry honey and also may be used for water if smeared on the outside with beeswax.

Closed mesh baskets are decorated with many designs, some of which are applied direct, or a ground colour of red or brown may be smeared by hand all over a basket or on two-thirds of its surface, portion being left bare because it rubs against the body. The wide range of designs is painted with a brush. On the older baskets thin stick-men with bent limbs were painted in panels and bands. Other designs include alternate broad bands of three or four different colours such as red, yellow, white and black; panels of crossed and crescentic line patterns; a field of coloured splotches, or sets of diagonal lines; cross-hatching in two and three colours; dots and lozenges in contrasting colours. The motifs are often outlined with a stitching of possum-fur or human-hair twine, or with parrakeet feathers. Some of the designs are decorative in nature. Others, applied to special baskets, are sacred; if the men bring them into camp they may be seen by everyone without risk of punishment for infringing a taboo but only initiated men

Making a pandanus mat. A chain twist is used in which one strip is threaded from each side around each rib.

Photo.—Author.

may see them during a ritual on a ceremonial ground. Sacred designs are painted on baskets on a ceremonial ground to the accompaniment of songs and chants. In addition, from two to eight pendants of possum-fur twine, often colourfully embellished with red and yellow parrakeet feathers, are attached as pendants. Great value is attached to designs worked out in rows, panels and pendants of dark red parrakeet feathers, and the baskets bearing them, mostly of the medium-sized type, are valuable articles in the ceremonial exchange systems and barter featured in the economic and ritual life of Arnhem Land tribes.

Mr. R. M. Berndt, a research anthropologist from the University of Sydney, ascertained that the baskets, ritually, symbolize the womb of the Great Fertility Mothers, the Djunggewul Sisters. Thus the women decorate their own special baskets with totem designs which they say are not understood by the men. These special baskets are intended as replicas of those used by the Djunggewul Sisters to hold sacred totemic symbols (Rangga) of clans, until the men stole them during the Dreamtime and kept them secreted from the women. The women keep their most valued possessions in these special baskets.

The making of baskets is the most highly skilled craft of the women. They also make a circular mat called the Ngainmara, sometimes made by men as well. These mats are from three to five feet in diameter and are fringed, but some are only halves or quarter sectors in size. They are made of pandanus strips, a carrying loop being fixed in the middle. A man or woman will curl up under a full sized mat for protection against the sun, mosquitoes, sandflies and flies. They sit on them in the camps, and the women wear them for modesty when strangers are visiting a camp.

The craft of basket and mat making has been maintained in Arnhem Land, but European buckets, tins, and even cartons are rapidly replacing baskets, and blankets are taking the place of mats. On the mission stations European shapes have been adopted to the exclusion of the genuine aboriginal forms.

More about the Kraken

By JOYCE ALLAN

IN a previous article in this MAGAZINE[1], the story was told of the Kraken, the mythical monster of the ancients, but now accepted as a Norse legendary name applied to any giant cephalopod, be it squid, cuttlefish or octopus, that haunted the northern seas and appeared periodically as a terrifying monster to fishermen, naturalists and other sightseers. As a follow-up to that article, readers may be interested in some facts taken from a free translation by Miss F. Sachs, of the Museum staff, of an address in Amsterdam given by Professor Piccard, the famous deep-sea explorer, which appeared in *Der Anker* (3.5.1955).

Speaking of his experiences and what he observed from his bathyscaphe in the great ocean depths, Professor Piccard said that he believed that in depths deeper than 6,000 metres there existed a peculiar luxurious ground flora, and that in the deep-sea mountain chains were large sea-moss fields which covered a type of marshy ground hundreds, if not thousands, of metres deep. This marshy ground, according to Professor Piccard, was the elixir of life to many deep-sea creatures which he had observed from his bathyscaphe. He had in his possession Kraken and fishes which he had caught with electric steel-nets and lines and whose lives began after 3,500 metres.

In depths of about 3,000 metres he had watched whole Kraken colonies of fifty to one hundred giant animals that swam towards his diving apparatus. "I always had the feeling to flee. I could not stay long in the vicinity of these monsters. I am positive that these deep-sea polyps, which measure over seven to eight metres are the guardians of the sea bed and are dangerous to even a hyper-modern giant diving boat".

Professor Piccard has in his private deep-sea museum two prepared giant cuttlefishes whose bodies when caught were covered with a slimy mass that is found only at a depth of over 8,000 metres on the sea bottom, in the so-called sea-moss fields. He believes that in these depths exist still more powerful cuttlefishes of which present day science has no conception. Of deep-sea animals' intelligence, Professor Piccard said: "I have the impression that the deep-sea creatures become more intelligent with greater depth. I have no doubt there are thinking deep-sea creatures". He believes from his experiences in the depths that in the greatest deeps entire Kraken herds form colonies and have dreadful battles. Following his bathyscaphe in formation he has seen cuttlefishes with powerful arms relieve each other in the leadership of the Kraken herd.

In his future diving attempts Professor Piccard hopes to establish proof of his assertions that in the deep-sea mountains there are sure to be waterless grottos and caves that have become sealed by volcanic action, thus hiding secrets of which we know nothing.

In speaking of the giant creatures, Professor Piccard probably refers to giant squids rather than to cuttlefishes (cuddlefishes) as these are more littoral in their habits than squids. Although the word "Kraken" is universally understood to be a legendary name for sea monsters as visualized by the ancients, helped by the exaggerated and fanciful tales of their attacks and behaviour as told by naturalists and litterateurs of the times, its use still persists as a popular appellation for the giant cephalopods of mystery. The name has no place in modern systematic zoological nomenclature.

[1]J. Allan, *The Kraken—Legendary Terror of the Seas.* AUST. MUS. MAG. xi (9), March, 1955, 275-278.

Notes and News

Dr. L. Holthuis.

Photo.—E. Pope.

Crustacea.

Dr. Lipke Holthuis, a curator of invertebrates at the Rijksmuseum van Natuurlijke Historie, Leiden, and a noted authority on his subject, recently visited the Invertebrate Department of the Australian Museum to examine collections of Australian crustacea. Other well-known workers on these animals who met him at the Museum were Mr. H. M. Hale, Director of the South Australian Museum, Dr. A. Racek, New South Wales Fisheries Department, and Mr. W. Dall, C.S.I.R.O., Fisheries Division, Cronulla.

Mr. Dall has studied in Australian waters the prawns of the family Penaeidae. A number of these crustaceans has an important bearing on an industry which promises to expand into a wider oceanic fishery than hitherto. Dr. Racek has been carrying out a similar type of research in Sydney. This common interest gave special value to their meeting at the Museum.

Mr. F. Ellis, Assistant Director of the Queen Victoria Museum and Art Gallery, Tasmania, spent several days at the Australian Museum studying museum techniques.

A special exhibit of Land Crabs has recently been completed and installed in the Museum galleries. This features the nocturnal scavengers which live on numbers of tropical coral isles in the Indo-Pacific region. A prominent place in the display is given to the Coconut Crab, a climber of palms and eater of coconut meat. This giant of the hermit crab tribe has dispensed with a shell to house its tail parts and appears to have become entirely adapted to a life on dry land.

Mammals.

A study of the Museum's collection of Australian mammals has been made by Dr. Elizabeth Horner (who is carrying out research under a Fulbright Fellowship grant) and her research associate, Miss Mary Taylor. M. Jacques Tripier, of Paris, representing the International Union for the Protection of Nature, was another overseas visitor interested in Australian mammalian fauna.

Shells.

A recent visitor to the Shell Department has been Mrs. Stanley Boswell, of Johannesburg, South Africa. Mrs. Boswell is a keen conchologist and collector of coins and stones, and a member of the Conchological Society of South Africa. During her present "round the world trip" she hopes to acquire many specimens to add to her private museum. Mrs. Boswell has a shell collection of some 4,000 different species. She was very interested in the Australian Museum shell collections, particularly in shells of the family Volutidae, of which Australia is the headquarters. It is of interest that many East African shells are related to Australian forms, in particular to those of tropical Australia.

Palaeontology.

In 1925, Dr. Errol White, of the Geology Department of the British Museum (Natural History), described and named a collection of Australian Arthrodires (Bull. Brit. Mus. i, 9.). These are the armoured or joint-necked fishes of the Devonian geological period. For a time they were the dominant vertebrates but their success was short-lived and at the close of the Devonian the arthrodires became extinct and completely disappeared from the geological record.

In the paper mentioned above, Dr. White dealt with specimens collected from rocks in the Burrinjuck Dam area of New South Wales. The material proved to be of particular interest and importance and, although fragmentary, was excellently preserved. In order to expose delicate inner structures of the fish remains, Mr. H. A. Toombs, of the British Museum, successfully applied the acetic acid process with good results. At least a year was devoted to this work,

Earlier this year Mr. Toombs made a hurried visit to the type locality of the Australian Arthrodires in the Burrinjuck area to seek additional material. The arthrodire remains are found in the limestone deposits of the Taemas Series of Middle Devonian age. It was in this limestone that a complete skull of a Dipnoan fish known as *Ganorhynchus sussmilchi* was found. It is one of the Lung-fishes and attained a length of at least five feet.

Mr. Toombs was successful in collecting a good series of arthrodire remains during his short stay in the Murrumbidgee district. He is hopeful that, when the material is subjected to the acetic acid process the results may be even more interesting.

Insects.

Dr. E. O. Wilson, Harvard University, U.S.A., made the Australian Museum his centre of operations when earlier this year he visited Western Australia and New Guinea to further his researches on ants. While at the Museum Dr. Wilson inspected collections and met workers in myrmecology.

Mr. D. K. McAlpine, B.Sc., has joined the Australian Museum staff as Assistant Curator of Insects. He is continuing research begun at the University of Sydney on some little-known and uncommon flies called *Batrachomyia*. This word is derived from the Greek words for frog and fly, indicating that the larva or maggot stages of the flies are parasites of frogs. As they are the only flies with such habits so far known from Australia the common name of "Australian Frog-flies" would seem appropriate.

Though the flies are widely distributed, having been recorded in either the adult or larval stage from every Australian State, they are rarely seen and apparently do not occur outside Australia. Ten species of *Batrachomyia* are known, but only three of these are known to be parasites of frogs. The individual species are, from the information at present available, only recognizable as adult flies, so that the identity of parasitic larvae can be determined only by rearing in captivity a sample of a larval population to the adult stage. This is a tedious process frequently entailing the keeping of parasitized frogs in captivity for many months. It is highly probable that when the life histories of all species are known, most, or all of the flies will be found to be frog parasites.

The Frog-flies are small yellowish to brown flies about the size of a house-fly, varying in appearance with the species. Some have three or four conspicuous black stripes on top of the thorax. They are rarely seen in bush country and closely resemble many other types of flies in appearance. They are not therefore easily recognized by amateur naturalists.

The larvae are sedentary and permanently parasitic under the skin of various species of frogs. They breathe by means of a very small hole in the host's skin. The soft yellow larvae, which reach about half an inch in length, emerge by enlarging this hole just before pupating. This emergence normally takes place in the light. The pupa is enclosed in the hardened, blackened (melanized) last larval skin and therefore has almost the exact shape of the larva.

Frog-flies are most frequently found in the larval state by collecting large numbers of frogs and searching for the oval swellings on the skin which indicate the presence of the parasites.

"Pix" photo.

Anthropology.

Dr. Andreas Lommel, Konservator at the Museum fur Völkerkunde, Munich, worked at the Australian Museum for a fortnight, studying the anthropological collections. He and his wife are particularly interested in primitive art, and Mrs. Lommel painted some beautiful reproductions, for exhibition at Munich, of a number of designs from Australian and Pacific Islands specimens. Dr. and Mrs. Lommel later went to the Kimberleys to further studies on cave paintings and ceremonies begun by Dr. Lommel when a member of the Frobenius Expedition in 1938 and 1939.

Since the article "Grooves in the Rocks" appeared in the last issue of this MAGAZINE useful details have been received of nine other localities in New South Wales where rock grooves have been made by Aborigines. Mr. H. Barton (Newcastle) provided information about sites at Awaba, Bowenfels, Morna Point, and three in the Mudgee district —Broker's Creek, Cooyal and Barrigan. Mr. W. Nicholls (Rylstone) wrote about sites at Terra Bella (on Little River, between Dubbo and Wellington), Breelong Creek (between Gilgandra and Bearbong), and one in the Rylstone district.

Four of the Museum's specimens of didgeridoo, a wooden trumpet used by the Aborigines of Arnhem Land and Cape York, are shown at the left. The instrument, made of bamboo or hollow eucalypt branches, produces a droning note which rises and falls in different tempos. It is played by aboriginal men during corroborees and ceremonies. In the picture are Mr. John Antill, composer of the ballet *Corroboree*, Miss Anna Russell, the musical satirist, and Mr. F. D. McCarthy, Curator of Anthropology at The Australian Museum. Miss Russell experimented with a series of didgeridoos from 3 to 15 ft. long with the idea of introducing an Australian item into her repertoire.