

The
AUSTRALIAN
MUSEUM
MAGAZINE

Vol. VII, No. 3. DECEMBER, 1939-FEBRUARY, 1940. Price—ONE SHILLING.



Plain Turkey.

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

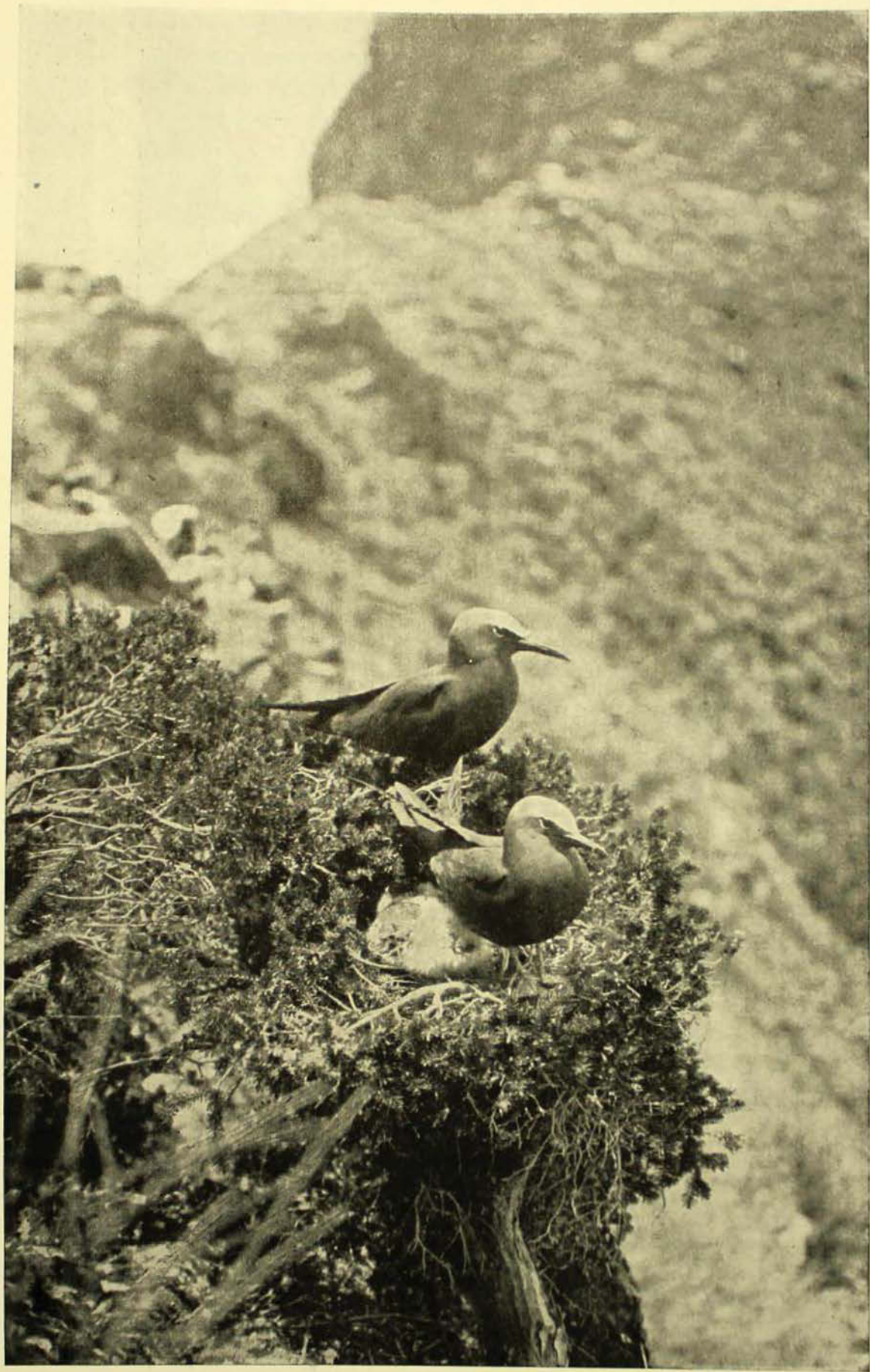
● OUR FRONT COVER. The Plain Turkey or Bustard (*Austrotis australis* Griffith and Pidgeon) is by Lillian Medland. It is one of a series of post cards issued by The Australian Museum.

This magnificent bird is related to the Great Bustard, which formerly roamed the plains of England, but which was finally exterminated at the beginning of last century. Captain Cook met with the Plain Turkey on the coast of North Queensland, and remarked upon its likeness to the European bird, as well as upon the excellence of its flesh. In fact, this made so good an impression that he called the place Bustard Bay, in honour of the bird which gave his company the best feast they had had since leaving England.

The Bustard loves the plains of the interior, and comes down to the coast only under pressure of drought. Since Australians appreciate its flesh as well as Captain Cook did, and since its nestlings fall an easy prey to foxes, its numbers are diminishing at a rapid rate.

It is chiefly insectivorous in habit, and makes no nest, laying one or two eggs, olive brown, blotched with darker brown, on the bare ground in open country.

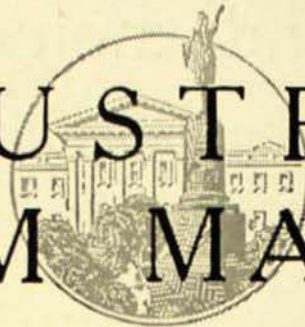
The Bustards are most nearly related to the Plovers, but have lost the migrating powers which most of these birds possess.



**Noddy Terns at their
nest on a cliff. (See
page 76.)**
Photo.—

M. S. R. Sharland.

THE AUSTRALIAN MUSEUM MAGAZINE



Published by the Australian Museum - - - - - College Street, Sydney
Editor: C. ANDERSON, M.A., D.Sc., C.M.Z.S. Annual Subscription, Post Free, 4/4

VOL. VII, No. 3.

DECEMBER, 1939-FEBRUARY, 1940.

Scientific Libraries

TO the scientific worker access to literature on his particular subject of research is every whit as important as the equipment of his laboratory. Unfortunately, in a country such as Australia, no one library can hope to cover the whole field in an adequate manner. Yet by pooling resources and eliminating wasteful expenditure on the acquisition of duplicates, it is possible for libraries, collectively, to have a very wide range. It is true that certain publications must have a place in every scientific library, for they are in such constant demand that they may be likened to the hammer and saw in a carpenter's workshop. But there are others, the presence of which in one or two centres is sufficient.

For libraries that are being built up much time and money are necessary before it is felt that any great progress has been made, and in such cases co-operation is a very great boon. Some years ago the Council for Scientific and Industrial Research (commonly referred to as the C.S.I.R.) issued what has come to be known as "Pitt's Catalogue", the short title being derived from the name of the editor; the full title is *Catalogue of the Scientific and Technical Literature in the Libraries of Australia*. This

appeared in 1930, and a printed supplement was issued in 1934, followed in 1937 by a mimeographed one. To scientific and technical workers these desk tools have been invaluable, enabling them to ascertain immediately where desired publications may be found, so much so that the hope may be expressed that at no distant date one may see a complete and new second edition, for never was its need greater than at the moment.

A recent advance in photography is the micro-film camera. The uses to which these miniature high-precision instruments may be put seem limitless. To the research worker who is remotely situated they have proved a veritable blessing, for they have made it possible, by means of film-strips, to bring to his aid literature otherwise unobtainable. These strips have the advantage of being cheap and costing but a few pence in postage. Moreover, the specialist has the benefit of having his references on his own file.

Services such as this it has been our pleasure to render—for a museum's function is the advancement of knowledge—and this has been rendered possible by the co-operation of the Fisher Library, University of Sydney, the staff of which has specialized in this useful branch of photography.

Terns and their Habits

Feathered Fishers of Sea and Shore

By MICHAEL SHARLAND*

TERNS and gulls are among the commonest seabirds to be found in coastal waters. Both are generally pearly-grey and white, and from a distance look alike, though in structure one differs strikingly from the other, the terns being finer "cut" for flying, but less gracefully proportioned than the gulls. This may be seen on almost any harbour wharf, navigation pile, floating light, or on rocks along the shore where both repair in little flocks, to rest in the intervals of feeding or to seek refuge on a stormy day.

The contours of terns are stream-lined. Their make-up consists of a fairly long, narrow beak, a flattened head, long, depressed, oval body, sharp pointed wings and a tail that often carries long, attractive streamers—a structure that enables them to fly with the minimum of effort and for lengthy periods at a time. Not inaptly are they termed "sea-swallows", because their long, sword-like wings and forked tails, together with their graceful, restless motion, render them somewhat similar in appearance when in flight to the common swallow which skims the streets of our towns and cities.

Only in their general colour, however, do they resemble the gulls—and when I mention gulls I am referring, of course, to the common Silver Gull, in the company of which they are most frequently seen. At most times it is simple enough to distinguish them from the gulls because they have black crowns to their heads, which give them the appearance of wearing little black skull caps. The amount of black on the head varies according to the bird's age and the particular season, but, in general, it can be accepted that in most of the terns this

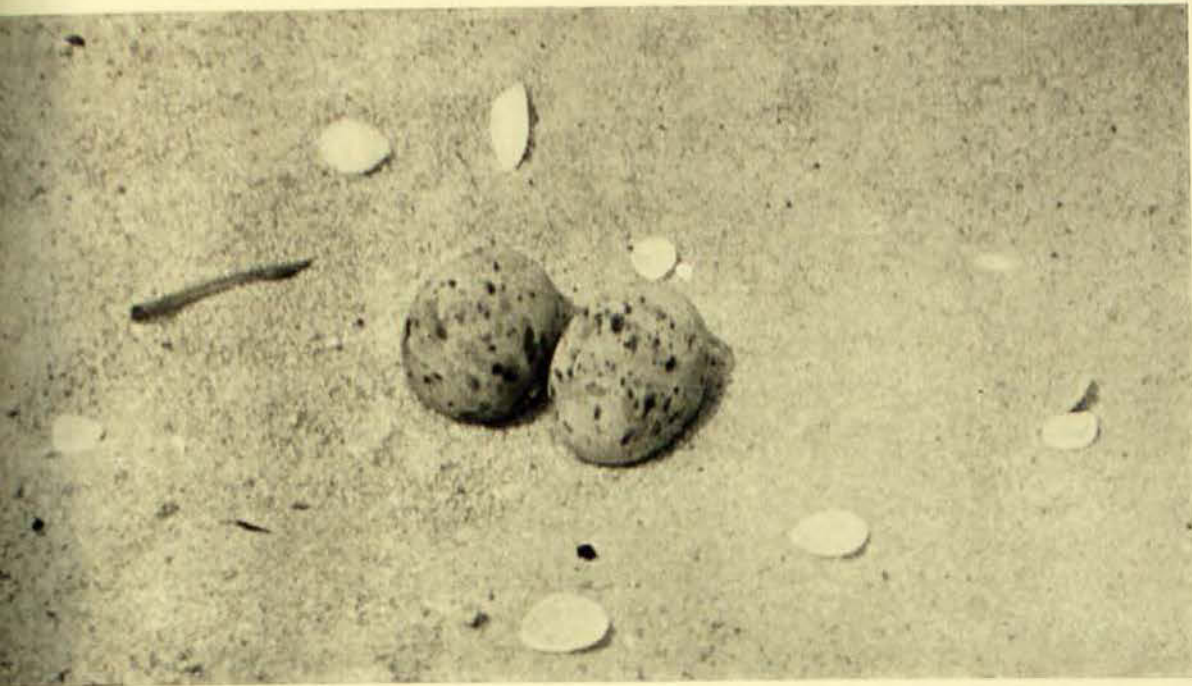
black cap is a prominent feature, and in some more than others, for a few species have the whole of the head black, others have white lores and forehead, and young birds have the black head streaked with white. Furthermore, the legs of terns are much shorter than those of gulls. Seldom, if ever, will you find a tern parading up and down a beach or wading in shallow water as the gull does. Terns' legs are not fitted for much walking; when the birds alight on an object their short legs would seem to have been telescoped into the body, giving them a squatting appearance. Their bodies and wings have become adapted specially for flight, and their legs and feet have suffered in consequence. Thus, when perching, they look unproportioned. But when they launch themselves into the air from some rock or jetty and move out across harbour or bay they are seen in their true environment, with their wings propelling them in swift and easy flight, their graceful white bodies flashing in the sun, beaks and eyes directed at the water as they watch for fish, all specially equipped for a maritime existence, and essentially creatures of the sea.

TERN NESTING COLONIES.

Different kinds of sea terns breed on islands, capes, sandspits, and the like, along the entire Australian coast, as well as on islands in adjacent seas; while the Marsh and Gull-billed Terns, which prefer freshwater for their feeding, have their nesting colonies in swamps and lagoons in the interior.

It is always a fascinating experience to visit a nesting ground of terns in early summer, if only to observe the contrasts in the home-life of these birds. I once visited a small, tide-washed island in Port

* Photographs by the author.



Eggs and "nest"
of a Tern on a
beach.

Phillip Bay, Victoria, where the Fairy Tern was nesting, and became on intimate terms with this delightful little sea-nymph, whose silver plumage so matches the sea and sky as to make the bird almost invisible from a little distance.

When I landed on the island the tide was out, leaving wide levels of wet ribbed sand, with shining trickles and land-locked pools reflecting a cloud-flecked sky. The air was still and the silence of noon was hardly broken by the murmur of the surf on a nearby beach. A flock of black-and-white Oyster-catchers flew by, whistling in shrill chorus; a company of Grey Plover, in winter plumage, rose on strong wings and flew round a point to settle again on the wet sand; and a gull, with warning cry, swung gracefully over the landing boat. But as I reached the shore and walked along the beach, there came from above a thin, querulous note, answered by another, and then a medley of voices, shrill and agitated, clearly a protest against trespass on guarded territory. Looking up, I espied long narrow wings and forked tails, glistening like snow in the sun, and crossing in rapid swooping flight—shapes that looked like albino swallows. The terns had come to meet me. They gathered till

there was a crowd of flashing plumes overhead. As I walked along and approached their nesting area, some came within a few feet of my face, and others landed on the beach, with wings half-raised ready to lift themselves into the air at a moment's notice.

I stopped and watched them for a while, and, later, I made out an egg here and another there, coloured exactly like the beach sand; and near a tuft of grass a small object which I had overlooked suddenly came to life, as a nestling rose on unsteady legs and waddled away in response to shrill calls from its parents flashing overhead.

This clamour of parental anxiety is a mistaken policy. If the birds did not call attention so noisily to the presence of their eggs or young many people would never know that nesting was going on. The eggs are surprisingly difficult to find, and a searcher, despite the utmost watchfulness, may easily step on a clutch before he perceives it at his feet. The eggs, generally two in number, are laid points together in a shallow depression scooped in the sand, sometimes among pebbles just above the drift line of high tide, and in their blotched stone-grey and dark umber markings so closely resemble the sand or stones that the unpractised



Little Tern at its nest on a beach.

eye may look directly at them and pass on unawares.

There is no attempt at nest-making, but sometimes a little circle of white fragments of shell which litter the shore is arranged about the eggs. The young chicks, clad in grey and buff and speckled down, are no less attuned to their environment than the eggs from which they are hatched. Their discovery, hiding among the seaweed or stretched flat on the sand where they are almost invisible, is a fine test of eyesight and observation, and has a seductive interest in the pitting of human powers of detection against the protective devices of Nature.

LESS ELEGANT NESTERS.

But a visitor to an island where the larger terns are nesting—the White-fronted, Crested, and, perhaps, Sooty species—will have quite a different experience. There is the same display of alarm and anxiety on the part of the parents, who dart at one's head and

almost deafen one with their high-pitched screams. Eggs and chicks, however, take little finding. The eggs are scattered in apparent confusion over a large area of sand, turf or rock. Some of the adults in the background are sitting on them, others, nearby, are standing alongside, while those in the immediate vicinity are screaming about one's face, and they come so close at times that it is possible to catch one by a leg!

In all this confusion, the young ones are trying to conceal their dark bodies among the grass or bushes which surround, and often intersect, the colony; and as you walk it is extremely difficult to avoid treading on them, or crushing eggs underfoot, so thickly are they huddled, or placed, together. The parent birds rise screaming as you walk towards them, hover above, and settle as you pass, so that they resemble one long foaming billow, rising and falling, and gradually spreading out. So dazzling are their white bodies against the sky

that the brightness of them hurts the eye. If you remain still, they will quickly settle down, with black hoods and grey mantles so closely interwoven that the ground is almost blotted out.

TERN CHARACTERS.

Now let us consider some of the exterior features of terns and the characteristics which distinguish the different species.

The largest and most handsome species is the Caspian Tern. Some twenty inches long, it possesses a stout orange-red bill, pearl-grey plumage and, in summer, a jet black head, which, in the non-breeding season, becomes streaked with white. Common in southern Australian waters, it may often be seen seeking fish up estuaries and rivers a long way from the sea.

Next in size is the Crested Tern, about nineteen inches. It is specially common in Sydney Harbour, where from ferry steamers it may be seen diving for small fish. Again pearl-grey, it has a white forehead and black crown, and when excited is able to elevate these black feathers, which then resemble a crest; this, of course, has given the bird its vernacular name. It breeds extensively on one of the Five Islands, off Port Kembla, but several other islands along the coast are favoured nesting spots, and it is to be seen about them all the year. It occurs only sparsely in Tasmanian waters, where its place is taken by the White-fronted Tern (eleven inches long), a bird similar in most respects to the foregoing species, except that it does not have a "crest".

The Fairy Tern and Little Tern, both common species, are so much alike in size, appearance and habits that it is hazardous to mention any single characteristic by which they can be distinguished with absolute certainty whilst on the wing. Each is approximately ten inches long, thus sharing the distinction of being the smallest members of the Sternidae in Australian waters. It may be mentioned, however, that the Little Tern has a black tip to its bill,

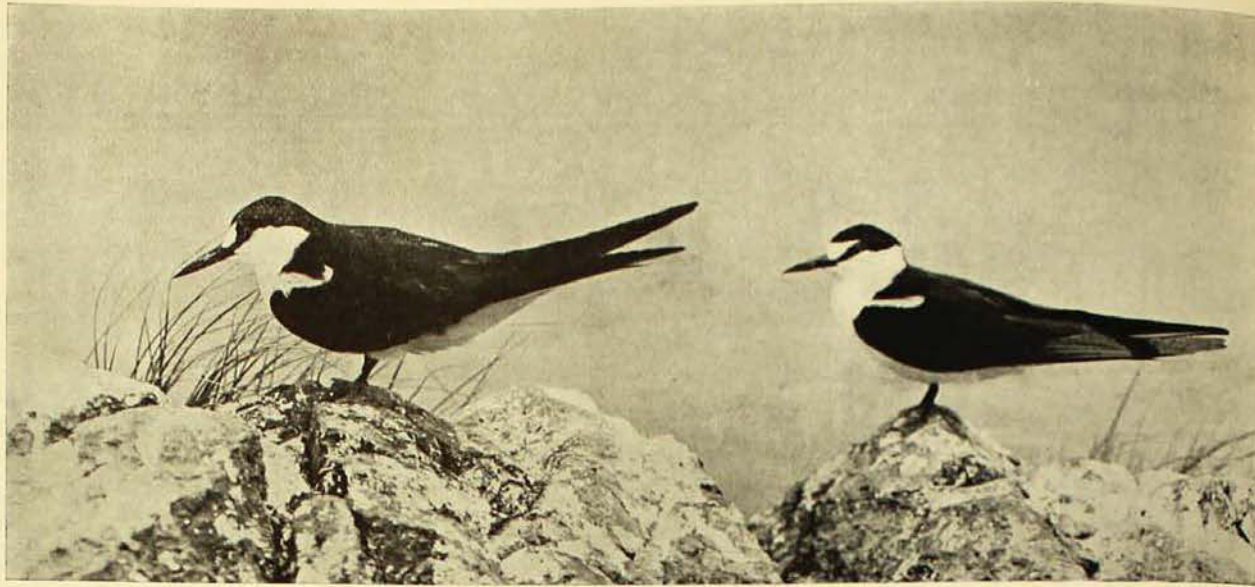
whereas the Fairy Tern has not; and that the first-mentioned is believed to belong to northern coastal waters, from Cape York down to Eden, on the eastern coast, and Broome on the western coast, while the Fairy Tern is considered to be confined to southern waters. The distribution of the two species has, however, not yet been determined satisfactorily, and it is possible that one may overlap the range of the other. And who knows but what ornithologists may in the future, because of their close affinities, decide that instead of being two species, the birds are one and the same?

SOOTY TERN'S DISPLAY.

The Great Barrier Reef, with its innumerable cays and islands, constitutes the principal nesting place for terns and other seabirds in northern coastal waters. Here, among the bleached coral and on sandy reaches, birds of many species assemble each year to breed. The famous "wideawake" fair of Ascension Island, off the African coast—a notable event in natural history—where the Sooty Tern breeds in multitudes, is rivalled on more than one island off the Australian coast. Several writers and observers have described the same kind of thing on the Barrier Reef and on islands elsewhere in our waters. The Sooty Tern, a graceful creature with black head, back and wings, white forehead and snowy white underparts, outnumbers other members of the family on any nesting island along the Reef, and when a person lands and begins to walk through the colony, the birds rise in flocks that almost darken the sky by their density and numbers.

The Sooty Tern, one of the greatest feathered travellers, also breeds in the Lord Howe group. It leaves these islands in the autumn and is not seen again till the following spring, when, like the shearwaters, or "mutton-birds", it arrives home almost to the precise day each year. To islanders living in the Pacific the first Sooty Tern that appears after winter has the same significance as the first returning swallow or cuckoo in southern Aus-

Pair of Sooty Terns.



tralia. It is a harbinger of spring; consequently the islanders have come to listen for and appreciate its musical "wideawake" calls. On Willis Island, off Cape York, the Sooty Tern has two breeding seasons—one in spring and one in autumn.

Among the other black-headed terns that inhabit the Barrier Reef, the Roseate, Bridled, and Lesser Crested species may be mentioned. They nest on the coral strands in considerable numbers, their habits being much the same as those of the other kinds.

CURIOUS NODDY TERNS.

Now, there exists in Australian waters another group of terns which possess several different features from those of the black-headed, pearly-grey terns. This group consists of Noddy Terns. So strikingly do most of the species differ from the other terns that I believe they warrant separation into a distinct family.

There are four species—the Noddy, White-capped Noddy, Lesser Noddy, and Grey Noddy. The Noddy is very common on certain islands on the Great Barrier Reef, nesting among the scrub; the White-capped Noddy occurs on Raine Island, at the northern end of the Barrier, and on the Capricorn Islands, at the southern end of the Reef. The Lesser Noddy is an Indian Ocean bird and breeds on Houtman's Abrolhos, in Western Australian waters; while the Grey Noddy, perhaps more familiar to islanders as "blue billy", breeds in the Lord Howe

group. None of them breeds in southern Australian waters. All of them, except the "blue billy", which is silver grey, are deep chocolate-brown in colour and have white crowns to their heads. Thus we find the colour scheme reversed. The white terns have black caps; the brown, or brown-black terns have white caps.

Compared with other members of the family, the Noddies are competent nest-builders. In fact they go to quite a lot of trouble to collect grass and leaves and particles of seaweed for their nest or nesting platform, which they build among small trees or scrub or in herbage on the face of an island cliff. Sometimes they breed in rock cavities, in which case they seldom bother to make a nest, merely laying their egg on the bare floor.

I have not dealt fully with all the habits of terns or with all species of terns, for there is not sufficient space for so much detail. This outline of their habits and characters may, however, induce a closer study of these delightful birds, of which there are many different kinds distributed over the seas of the world. Some of the Australian species are identical with those nesting on the shores of England and Scotland. They range from the Arctic Circle to the seas on the fringe of the Antarctic, and are known on every coastline. This is only natural, for their distribution is limited by no land boundaries. Equipped with long and powerful wings and subsisting on fish and other ubiquitous marine food, they are free to roam wherever their inclination takes them.

Australian Shells

Rock Shells, Smoke Shells and Trophons

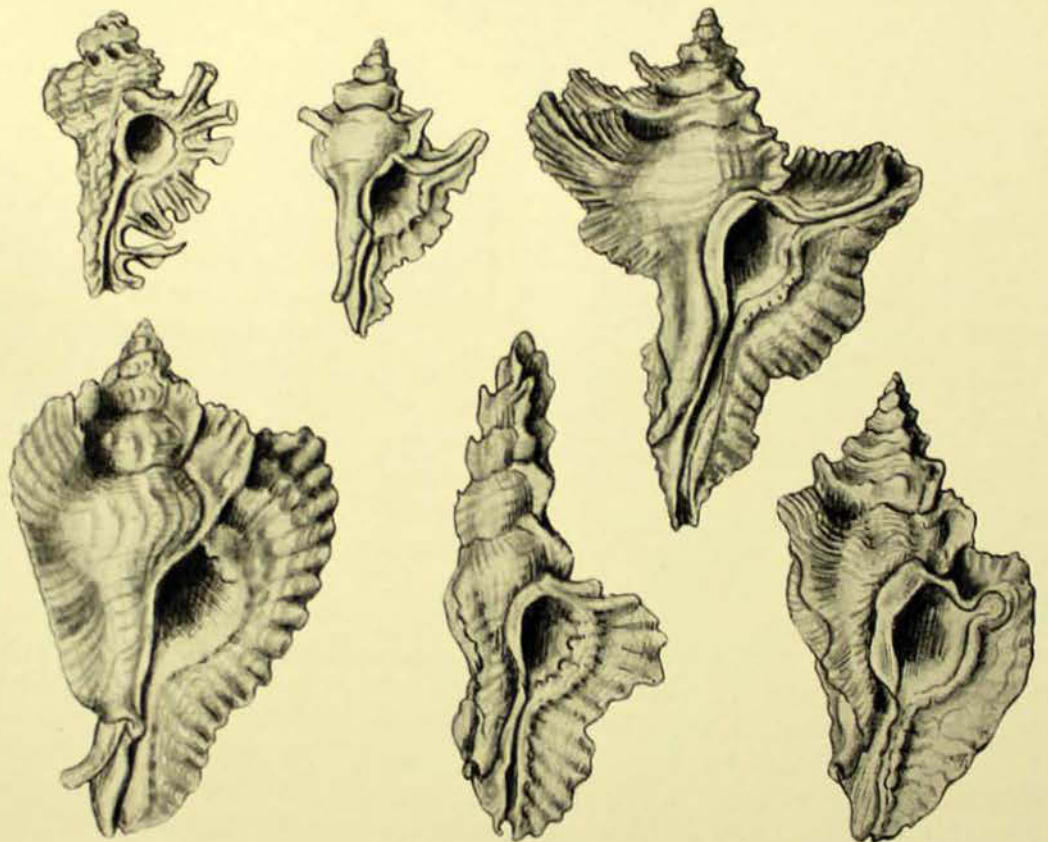
By JOYCE ALLAN*

THESE three groups are only a portion of the large family Muricidae, marine carnivorous shells which live chiefly in warm waters; the remainder will be dealt with in a later article. Many shells of the family are strikingly handsome and large, particularly the Rock shells, which form the main group in the present article. Over-

being a miniature of the adult. Observers have noticed that some species of the Muricidae sit on their eggs.

ROCK SHELLS.

The rich colouring and elaborate sculpture of many of the Rock shells becomes, as with other families, more pronounced as the warmest waters are



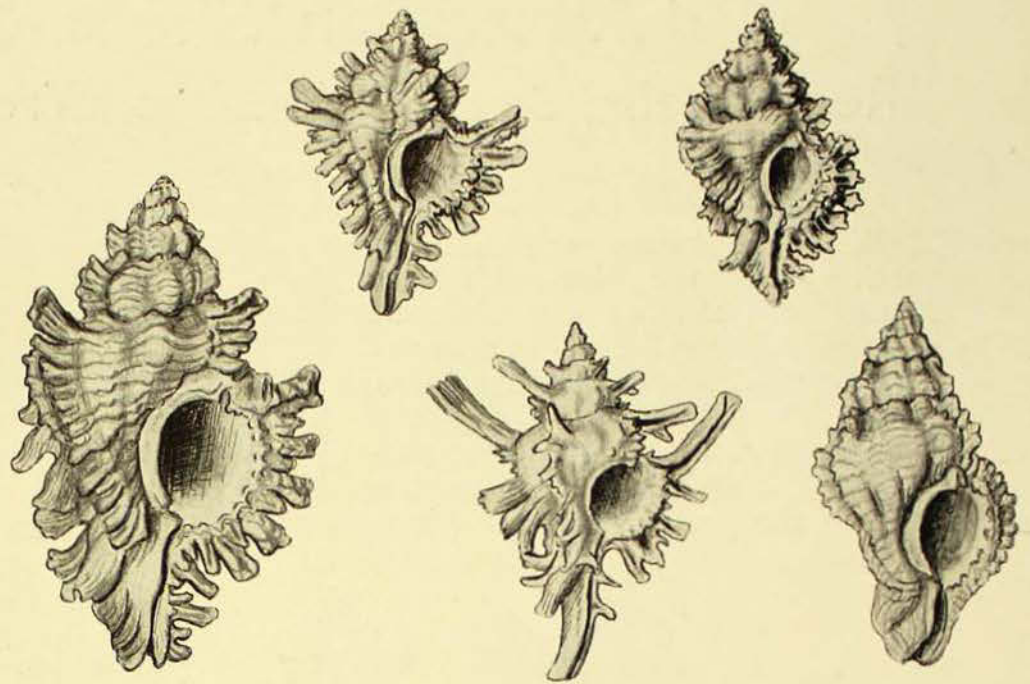
Rock Shells. In the top row are *Pteronotus lamberti*, a young form of *Pterochelus acanthopterus* and next to it the adult *acanthopterus*. In the bottom row are *Pterochelus bednalli*, *Marcia clavus*, and *Pteronotus triformis*.

shadowing other genera in elaboration of sculpture and number of species, the chief genus *Murex* has at various times been subdivided by authorities into numerous subgenera or sections. These, however, are not always employed for popular use. The sexes are separate, as is the case in the majority of Mollusca, and the eggs are generally enclosed in tough leathery capsules, within which they undergo their larval development, the contained shell

reached. Many fine species are found throughout the Indo-Pacific, but it may be said that some of the most striking occur in the warm waters of the West Indies and California, where black is often an additional or predominating colour amongst them. Australia, particularly along the Great Barrier Reef and the surrounding South Pacific Islands, is rich in species belonging to this family, including the largest species of all, *Chicoreus ramosus*, the Branched Murex or Rock shell, a solid, pink-lipped species,

* Illustrations by the author.

The two top species of Rock Shells are *Murex australiensis* and *Torvamurex extraneus*; in the bottom row the large shell on the left is *Chicoreus scaber*, the middle one is *Murex damicornis*, and the one on the right is *Naquetia permesta*.

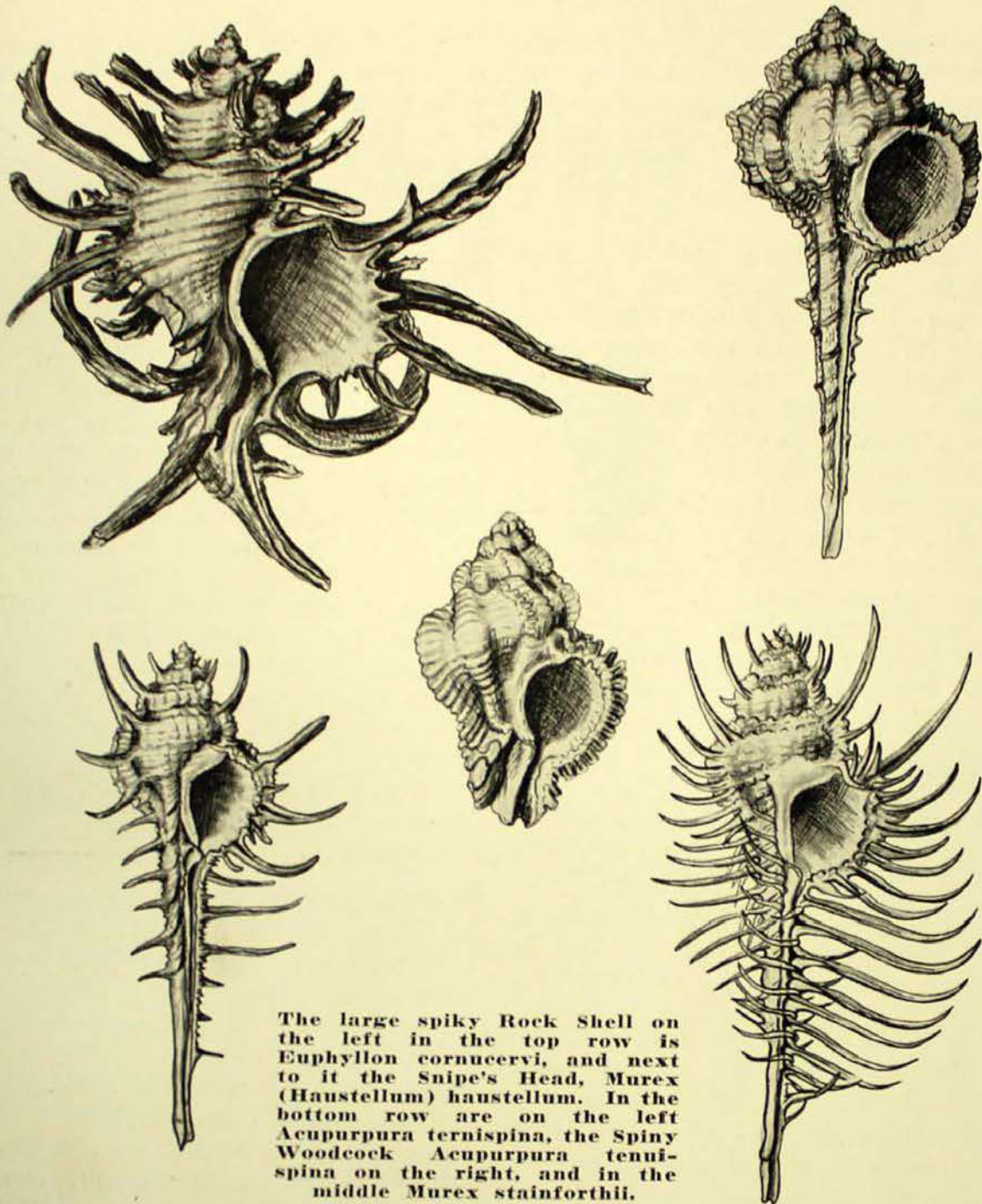


which reaches a foot in length and extends in its range to Japan. It is a great favourite with collectors, as it makes a fine cabinet exhibit.

The chief characteristic of Rock shells is the extraordinary ornamentation of their whorls by spiny processes or heavy nodules. These are arranged mostly along ridges or varices which mark the end of a period of growth in the shell, and sometimes almost completely cover them. Between the usual large varices are frequently noticed smaller ones, which some authorities regard as marking a stage of comparative starvation. Where there is an abundance of varices, it has been suggested, there may have been a considerable struggle for food, and that after all, richness of apparel is the badge of poverty and privation. Whether this is so or not is a moot question, but the fact remains that the majority of Rock shells are elaborately ornamented, and individuals are specifically and subgenerically placed on account of this factor. Some varices may be simply low ridges without any perceptible prolongations, others may be expanded into wing-like formations, pronounced knobs, or spines, either slender and long, short and stout, or divided.

Rock shells are, in the main, very solid and generally lined with smooth enamel, which lacks, however, the pearliness found in members of some other families. Though the outside of many of them may with age become bleached or decorated with marine growth which masks their normal colour, when apparent this varies from red-brown to black effects, and the inside is in most cases brilliant flesh to rose pink, either entirely, or surrounding the lips only of the shell. It is worthy of note that the striae, spines, nodules, and ribs which form the ornamentation on the shells result from similar formations on the mantle of the animal. Upon close examination, for instance, of the spine of a Rock shell, it will be found to have a longitudinal seam upon its front face showing that it was formed by a corresponding digitation of the mantle, which in life extends up into the tip of the spine.

Some members of the family, especially the smaller ones, have been found to do considerable damage to oyster beds. For those who are unfamiliar with their method of attack, it provides an interesting study. The Muricidae possess a many-toothed rasping tongue, and by means of this the animals bore a hole through the shell of their victims and



The large spiky Rock Shell on the left in the top row is *Euphyllon cornucervi*, and next to it the Snipe's Head, *Murex (Haustellum) haustellum*. In the bottom row are on the left *Acupurpura ternispina*, the Spiny Woodcock *Acupurpura tenuispina* on the right, and in the middle *Murex stainforthii*.

suck out their juices. It has been noticed abroad that about four hours is normally taken to drill a hole. Commencing near the hinge-line of their victims, the body of the borer sways from side to side until the hole is bored by means of the tongue, assisted, it is thought by some authorities, by a special dissolving acid present in the salivary glands. Young borers have been noticed on young victims and old ones on adults, and when they have sucked the juices from one unfortunate, they go in search of another. The hard muscular part of the now exhausted or even dead

victim is meanwhile left to other prey, crabs, fish and various sea scavengers, who, not so fussy concerning the freshness of their food supply, carry out a "mopping up" process in the wake of the borers. These predatory creatures do not confine their activities to oysters alone, but choose any number of defenceless bivalves and even small snail-like shellfish, attacking them in a similar manner.

The famous Tyrian Purple dye of the ancients was obtained from certain small members of the family. The dye is made in a special colour or purple gland which

either accompanies or is a modification of the mucous gland, and lies near the respiratory cavity. The Tyrian Purple industry was explained in detail in an earlier number of this magazine,¹ to which readers who may be interested are referred.

Rock shells have been used in many countries for making fancy shell articles and carving cameos, the beautiful rose-pink underlying surface rendering them suitable for this latter purpose. Some of the smaller species found in numbers along the Adriatic shores are eaten by the poorer classes.

As mentioned in the beginning of this article, the largest Rock shell is *Chicoreus ramosus*, which, fortunately, is found in tropical Australia. Though it reaches twelve inches in length, it is commonly found measuring about four to six inches, the normal size of several well-known and closely related species in American waters. Rock shells can be arranged quite easily into groups, such as those resembling this species, others which are slender with long spines, and others with winged ornamentation.

A rather isolated species from the Indo-Pacific, which reaches to Queensland in its southern distribution and extends up to Japan, has a round body with a very long spineless canal. This is the Snipe's Head *Murex* (*Haustellum*) *haustellum*, a shell between six and eight inches long and so conspicuous that an illustration alone will serve to identify it. This long canal in certain of the Muricidae is significant and serves to form a well-defined group in the family. It is generally regarded as an indication that shellfish possessing a long canal to their shells corresponding to a long fleshy siphon in the animal are carnivorous, and that those with a rounded opening and no canal are vegetable feeders. Amongst these long-canalled species of the family, the most beautiful undoubtedly is the Spiny Woodcock or Venus's Comb, *Acupurpura tenuispina*, an Indo-Pacific species found along the Great Barrier

Reef and also in a slightly different form in Japan. As it is more spinose than others of the group it is easily recognized, and its numerous, long graceful spines extending the full length of the shell almost seem to bear out the belief that these serve to protect the animal from hungry fish.

Its nearest ally is *Acupurpura tenuispina*, with a range throughout the Indo-Pacific extending to Japan, a more solid shell with shorter, stouter, and much fewer spines. This species has several related forms, such as the common Queensland species, which is *Acupurpura macgillicrayi*, with still shorter and fewer spines, and *Acupurpura troscheli*, a much larger, altogether heavier species, which is also recorded from Japan. One of the largest Rock shells occurs in the Northern Territory and North West Australia. This is *Euphyllon cornucervi*, a very spiky shell about four inches high, irrespective of spikes, several of which curl back in a most marked manner. It is easily identified as no other species resembles it.

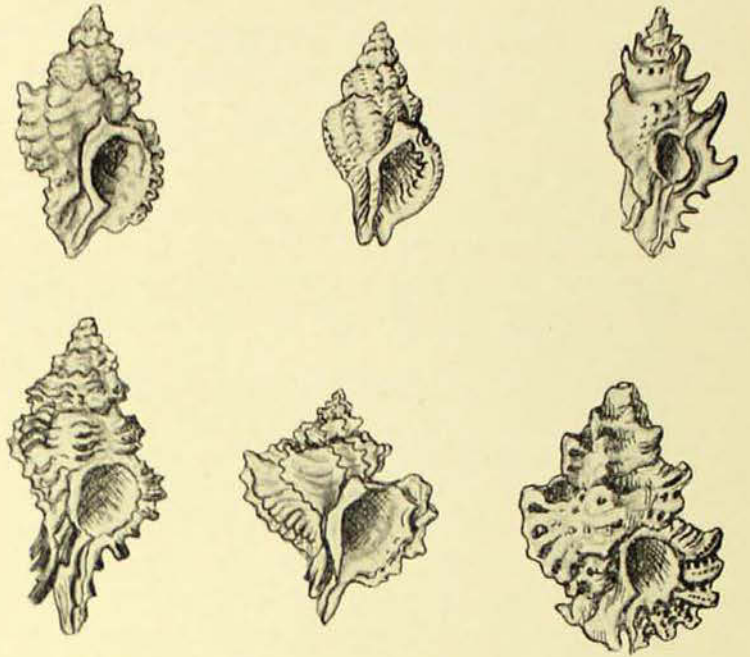
Before we go on to the winged group of Rock shells, the West Australian species, *Murex stainforthii*, a heavy solid shell about three inches long, is mentioned here. The most outstanding characteristic about it is its colouring, bright tan ribs and pink mouth. A winged type from the South Pacific, *Pteronotus lamberti*, has a rather unusual apex and can be identified from an illustration, as can the winged species *Pterochelus acanthopterus* from New South Wales, Queensland, and North West Australia. *Pterochelus bednalli*, a striking looking Northern Territory shell, a very narrow elongated species *Marcia clarus* from the South Pacific and a southern Australian shell *Pteronotus triformis*, which is intermediate between *acanthopterus* and *bednalli*, can be recognized at sight. Other winged species occur in the South Pacific, but space permits of only these few being mentioned.

Another well-established group includes those which are solid and heavily

¹ Allan: AUSTR. MUS. MAG., Vol. v, 5, 1934, p. 147-151.

sculptured with short prolongations along the numerous varices. These species are usually brownish on the outside and pink to red inside the mouth. There are many species in this group, mostly closely related, and as with the previous winged group, only a few outstanding ones are mentioned. *Chicoreus scaber*, an Indo-Pacific shell extending in its range to Japan in the north and Queensland in the south, is brown with a white mouth and resembles a larger species from Queensland, *Chicoreus torrefactus*. A smaller, very rough looking species, *Torvamurex extraneus*, which appears to have a distribution restricted to New South Wales, Victoria, Tasmania, and South Australia, is common round Sydney at dead low tide. It is interesting to note here that Mr. Melbourne Ward, while collecting recently at Kurnell, near Sydney, found numbers of these alive, crawling about on the higher rocks left bare by the outgoing tide, a most unusual place for them to be. Other species in this grouping are *Naquetia permesta*, a less spiky shell from northern Australia, which has been found alive among mangroves on the Queensland coast; *Murex australiensis*, a pinky brown one from the South Pacific and a more delicate species with longer spines dredged in about twenty fathoms in Shoalhaven Bight, southern New South Wales, and named *Murex damicornis*. It also occurs in deep water in the other southern States of Australia.

Among Rock shells measuring an inch or two in length (of which there are quite a number, but again only a few are mentioned) are *Chicoreus rubescens*, a reddish-tan shell with brown-black markings on the ribs, from the South Pacific; *Emozamia licinus*, a very delicate shell with wing-like longitudinal varices, and a small, extremely solid rare shell, *Favartia brevicula*, from North West Australia. *Emozamia licinus*, which lives in southern Australia, has been dredged in deep water off Gabo, Victoria. The smallest Rock shells found commonly in southern Australia are probably the quarter-inch high *Murex brazieri* from New South Wales, and *Pterochelus angasi*, which may grow



Smaller members of the family Muricidae. The three top ones from left to right are *Murexsul umbilicatus*, *Ergalatax recurvens*, and *Pterochelus angasi*; in the bottom row are *Chicoreus rubescens*, *Emozamia Heinus*, and *Favartia brevicula*.

to an inch in length and is extremely common in most rock pools round Sydney. The remaining two figured species of Rock shells are *Murexsul umbilicatus*, a small solid shell from South Australia and Tasmania, with a pronounced umbilicus at the base of the shell, and a more slender Sydney Harbour dredged species, *Ergalatax recurvens*.

Included in the large family Muricidae are, besides the big group of Purpura-like shells which will be dealt with in a later article, numerous small species of various genera, such as the Oyster Drills, Smoke shells and Trophons, but only a few are mentioned in this account.

THE OYSTER DRILLS.

Though several different species of shells do considerable damage to oysters in Australia, apart from the purpuroid species *Morula marginalba*, the most deadly enemy of the oyster beds along the east coast is the Oyster Drill, *Bedeia hanleyi*, of New South Wales. This occurs in countless thousands along the coast, and enormous piles are collected throughout the year by oyster growers to prevent their stock becoming completely

destroyed. Practically no area is free from them, and at certain times the surface of oyster shells and rocks are covered with their small dome-shaped egg capsules. The ravages to which the oysters are subject along our coastline from these small shells and other enemies make interesting reading, and a good account of the subject was written by Mr. T. C. Roughley for an earlier number of this magazine.¹

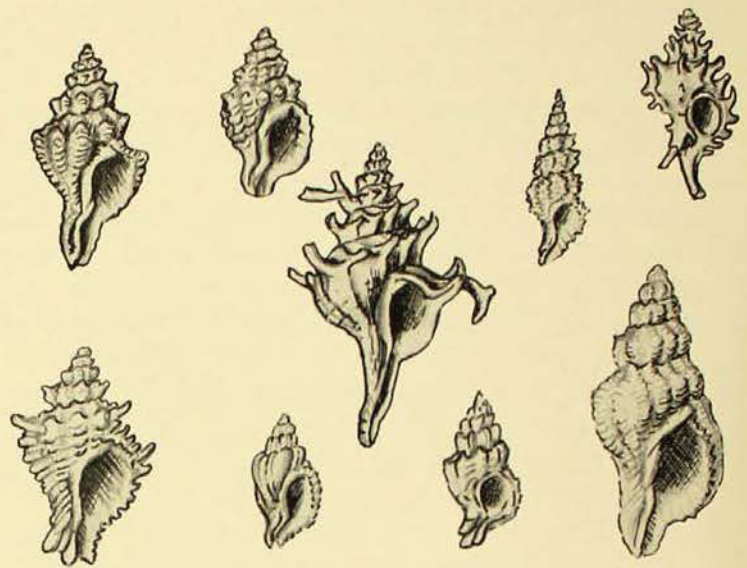
Recently at Shellharbour I found a *Morula marginalba* perched on top of a Black Periwinkle, *Nerita atromarginata*, and when I pulled it off, I found that the Boring Whelk, as it is called, had almost completed boring a perfectly round hole towards the apex of its extremely hard-shelled victim. There is in Queensland a larger species, *Bedevea contracta*, which in appearance is like a northern form of *Ergalatax recurvens*.

SMOKE SHELLS.

These are small oblong shells, usually with projecting hollow tubes between spinose varices and a rounded mouth with a long closed canal. There are only a few species, which are distributed in warm seas of tropical America and the Indo-Pacific. The Australian species figured here is *Typhina phillipensis*, which occurs in Victoria and South Australia.

TROPHONS.

Only a few Trophons have been chosen to represent that group of the family Muricidae in this article, as many of them are so closely related that differences, unless fully described as well, would not show to any great extent. Trophons are small light-coloured shells living in colder water than the previously



Oyster Drill, Smoke Shell and Trophons. The Oyster Drill, *Bedevea hanleyi*, is on the top left with three small shells next to it, *Lepsiella vinosa*, *Benthoxystus columnarius*, and the Smoke Shell, *Typhina phillipensis*, the last on the right. The larger shell between the two rows is a Trophon, *Enixotrophon carduelis*, and in the bottom row is *Lataxiena lataxiena* on the left, then comes *Galfridus speciosus*, a small Trophon, *Litozamia goldsteini*, and *Bedevea contracta* on the right.

mentioned members of the family, and are quite heavily sculptured. The species figured are a very narrow buff one, *Benthoxystus columnarius*, dredged in 100 fathoms off Cape Pillar, Tasmania, and another dredged species, this time in about 300 fathoms off Port Jackson, *Enixotrophon carduelis*, a very graceful spiky shell. Another species is a small shell, *Litozamia goldsteini*, from New South Wales and southern States of Australia.

The remaining species of the family included here are *Lataxiena lataxiena*, a New Caledonian species; a small white shell with distinctive longitudinal ribs, *Galfridus speciosus* from southern Australia, and a grey-white species with heavy cancellation and a brown mouth, *Lepsiella vinosa*, from Tasmania.

¹Roughley: AUSTR. MUS. MAG., Vol. ii, 8, 1925, p. 277.

Australian Insects

VII. Orthoptera: 2. The Mantids

By KEITH C. McKEOWN

FEW insects in the bush attract so much popular interest as the Mantids. So much has been written of them that it might be considered that any further account of their life and ways is unnecessary; but the scheme of this series of articles renders their inclusion

body is perched high upon long, slender legs, which, in the case of the females of the larger species, seem too thin to adequately support its weight; the thorax is narrow and greatly prolonged, and is terminated by a remarkable triangular head, two angles of which are formed by

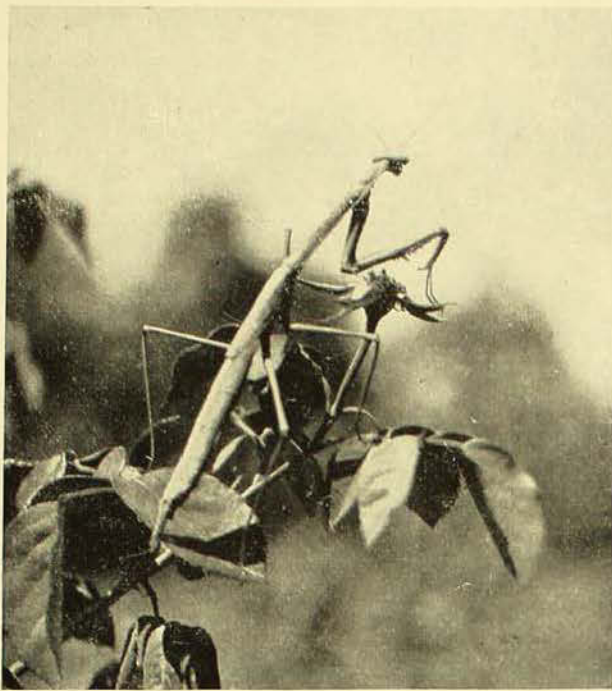


The Long-winged Praying Mantis (*Tenodera australasiae*). The coarser fore-wings, when at rest, cover the more delicate and gauzy hind-wings.

imperative. On the other hand, it should be realized that much remains to be discovered and recorded regarding our native species, especially among the smaller forms; so, it is hoped, that this article may, at least, provide a stimulus to further observation.

The Praying Mantis, observed in its living state and among natural surroundings, is a bizarre-looking creature. Its

bulging compound eyes, the third by a pointed mouth armed with sharply pointed mandibles—jaws typical of a carnivorous insect. This head is especially interesting, since it is set upon a slender, mobile neck, which enables it to be twisted and turned about from side to side, a feat almost, if not quite, unique among the insects. But it is the forelimbs that hold our interest most strongly. The



Mantis (*Archimantis latistyla*) awaiting its prey. The photograph shows clearly the spined raptorial forelegs.

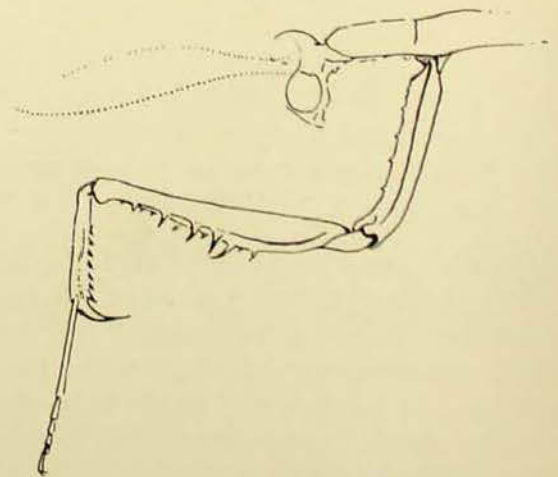
Photo.—K. C. McKeown.

tibia is studded with slender, needle-sharp spines of varying length; the femur is deeply grooved longitudinally, with the edges of the furrow also acutely spined. When the two portions of the limb are closed, one upon the other, the edge of the tibia fits snugly into the grooved femur, as the blade of a pocket-knife fits into its handle, the spines interlocking on either side. It is a perfect insect-trap, and a beautiful example of adaptation of an appendage to a specialized purpose. When at rest, the forelegs are closed and held closely pressed against the under-surface of the thorax in an attitude of prayer.

Watch one of these insects as it seeks its prey. It is rendered very inconspicuous among the foliage by its green or brown coloration and slender form—a disguise that not only protects it from its enemies, but aids it in its hunting. Its movements are deliberate and stealthy, and it creeps upon its victim like a cat stalking a mouse. A leg is tentatively extended, the foothold is tested and found secure, and the insect moves forward a fraction of an inch; but every action is so

cautious that it reminds one of slow motion in a cinema film. At last the mantis is within striking distance of its prey; the forelegs, which have been held folded throughout the advance, now shoot forward, and the unfortunate fly or other insect is locked in their spined grip—a grasp from which there is no escape. Its struggling body is drawn up to the mantid's greedy mouth, and slowly, and with evident relish, devoured. The wings, and perhaps the harder and more chitinous parts of the body, are discarded. The appetite of the mantis is insatiable, and is not confined to members of other insect families; mantids of its own species are devoured with equal readiness, and in its amours the female mantis has earned an evil reputation.

The female mantis is much larger and more heavily built than her mate, who is slender and equipped with quite expansive wings, the fore- or wing-covers coloured green or brown, the hind-wings large and fan-like. In the female the wings are so much reduced in size that they are practically useless for flight, and can, at most, be used as a parachute to break the force of a fall from the branches. In some forms the females are completely wingless. After pairing, or sometimes even during the nuptials, the female devours her mate. It is, indeed, seldom that he manages to make good his



Foreleg of mantis showing the interlocking spines which form a trap for unwary insects.

Nancy B. Adams, del.



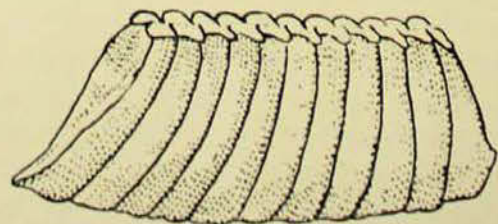
A Praying Mantis (*Archimantis latistyla*) in its natural surroundings.
Photo.—K. C. McKeown.

escape. The lady is not faithful to one mate; she will take several husbands—as many as may present themselves—in succession, and treat each as she did his predecessors, not as an honoured guest at the wedding breakfast, but as the feast itself!

Within a week or so of the wedding, the female, now bulky and slow in her movements, must prepare for the establishment of a further generation of mantids—the eggs have to be laid. She selects a suitable twig as a foundation for her work, and proceeds to exude a gummy fluid from the extremity of her abdomen. This fluid mixed with air-bubbles forms the substance of her egg-capsule, and, drying rapidly, forms a light, frothy, weatherproof mass of a papery nature, in which the eggs are embedded in regular rows. Along the upper surface is a longitudinal ridge, formed, in some species, of loose overlapping plates, through which the young mantids will subsequently emerge. The

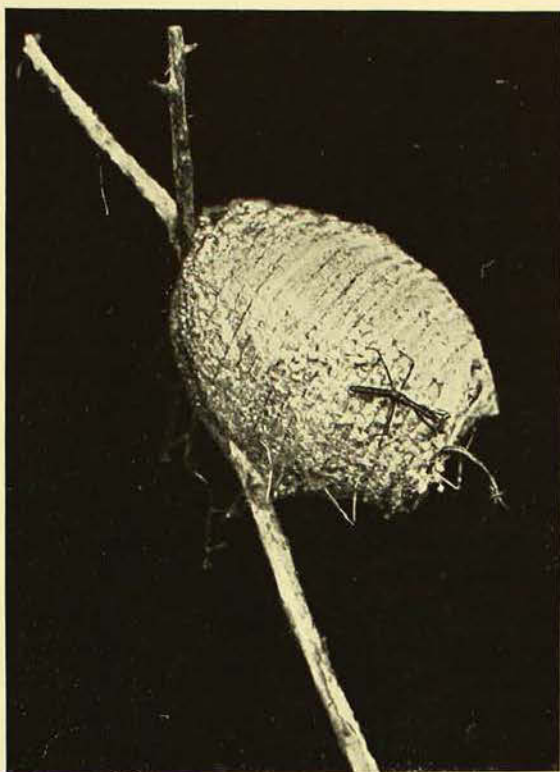
details of the actual construction of the capsule are difficult to follow during the progress of the work, since the builder keeps the end of her abdomen embedded in the frothy mass. It is possible that the two feeler-like appendages at the rear of her body aid her in the delicate operation of placing the eggs and forming the enclosing walls about them. The shape and size of the completed egg-capsule vary greatly according to the species responsible for its manufacture. In the large Brown Mantis (*Archimantis latistyla*) the capsule is an irregularly rounded papery mass, about the size of a large walnut, and of a very pale greenish colour—a beautiful object when set among dark green foliage. The egg-mass of the slender *Tenodera australasiae* is generally very similar in appearance, but is smaller and more yellowish in colour; the small Green Mantis (*Orthodera ministralis*) makes a case that is hard, brown, and elongated, and somewhat like an upturned boat in shape. It is frequently found attached to fence-posts, the weathered surface of which it matches closely in colour.

Within a few weeks, or sometimes months, according to weather conditions, the eggs hatch out, and the tiny pale insects emerge from the stout walls that have sheltered them. But this operation is not as simple as the words may convey, since each of these insects is enclosed in a close-fitting wrapping of the finest skin which is attached to the capsule by a slender thread, by which the little creatures hang suspended while they struggle out of their swaddling clothes. A capsule from which the young have recently emerged is decked with these



Egg-cases of small green mantis (*Orthodera ministralis*).

Nancy B. Adams, del.



The nest of the Mantis with several young soon after hatching. The cast and shrunken skins of the insects may be seen as small, white, bubble-like structures adhering to the surface.

Photo.—A. Musgrave.

threads, cast skins and, possibly, the bodies of those unfortunate individuals which have failed to extricate themselves from their wrappings, but the wind soon tears away these evidences of birth and leaves the case bare and empty.

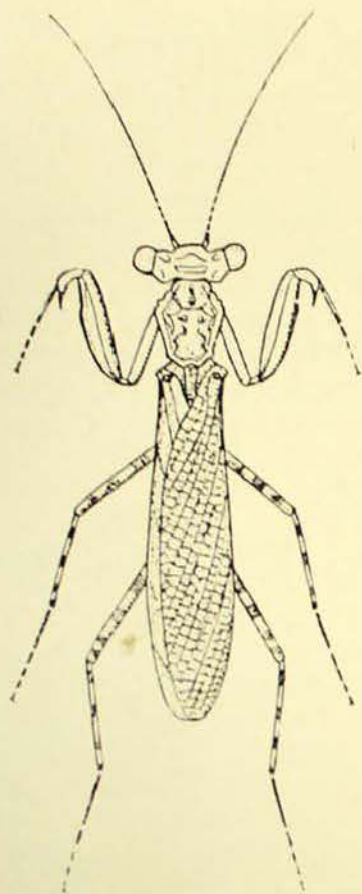
Although the capsule enclosing the eggs is stout, it does not form a complete protection from all enemies, and many unborn mantids fall victims to the activities of a tiny Chalcid wasp. Capsules which have suffered from the depredations of these insects may be detected by the rounded pin-holes cut in the walls through which the little wasps have made their escape. Several hundred may emerge from one egg-capsule.

The baby mantids on hatching are delicate little creatures, slender, elongate, green, straw-coloured, or brown, and run about rapidly or sway gently from side to side on their thread-like legs. Like other members of the order Orthoptera, they are wingless miniatures of their

parents, their growth punctuated by a series of moults, when the old skin is divested, and the insect reappears in a new suit of larger size which will permit expansion for a further period. Wing-pads are gradually acquired, and then, casting the last skin, they emerge as perfect insects. Once they are safely clear of their infantile wrappings, the little insects scatter into the bush, for their tendencies are cannibalistic, and close association would soon prove fatal to the weaker members of the family. At first their food consists of small insects commensurate with their own size, but, as they grow, larger prey can be efficiently dealt with. The duration of the life-history does not appear to be definitely known, especially in the native species, but I believe that it occupies somewhere about eight to twelve months. Unless the insects are bred from the egg it is difficult to estimate their rate of growth, but there is no doubt that this depends directly upon the abundance of food. When food is scarce they grow very slowly.

The coloration of the mantids is unquestionably of the greatest value to the insect in approaching its prey, so closely does its body, often large and bulky, blend into its surroundings. Certain tropical species have their bodies decked with leaf-like expansions and coloured with bright tints, so that they rival the orchid blossoms upon which they rest to capture their prey. But the coloration of the insects has another, and equally important, survival value; it serves to render them inconspicuous to their own enemies. That this is so has been proved by experiment. Equal numbers of brown and green mantids were tethered by threads upon green foliage, a similar number upon brown, and it was found that upon green foliage the brown mantids were devoured by birds, upon dry and brown vegetation, the green.

Some eighty species of mantids have been described from Australia, but the following are possibly the best and most widely known.



Small Brown Mantis (*Phthersigena conspersa*).
Nancy B. Adams, del.

The small Green Mantis (*Orthodera ministralis*), readily recognized by its wide and flattened prothorax and bluish-green colour, and measuring less than two inches long, is common in the bush.

The large Brown Mantis (*Archimantis latistyla*) has a very wide distribution in Australia, extending from the coastal districts to the more inland areas, where

it is the dominant form. It is a large insect, measuring over four inches in length, and of a general pinkish-brown colour. The wings of the male are well developed and capable of extended flight, but those of the female are small, reaching less than half-way down the abdomen, and of but little use for flying.

Tenodera australasiae, a species lacking a popular name, is, perhaps, the most common form around Sydney. It is a long, slender insect, shorter than the preceding species, with the tegmina or wing-covers bordered with pink and green, while the gauzy, fan-shaped hind-wings are mottled with brownish-black, with the fore-margin bordered with pink.

Some of the most remarkable of the smaller mantids are the little bark-frequenting species which belong to the subfamily Perlamantinae. These are curious little creatures, all of dull brown or blackish hue, varied with specks and mottlings to match their surroundings. They run rapidly over the trunks of trees, and seem to have a wonderfully keen perception of the approach of possible danger, and make every effort, usually only too successful, to keep the bole of the tree between themselves and the observer. *Phthersigena conspersa* is quite adequately winged in both sexes, but members of the genera *Paroxyphilus* and *Myrmecomantis* have wingless females, which often have the abdomen broadly expanded, giving them a remarkably distorted appearance. Nothing appears to be known regarding their life-histories.

Sydney and its surroundings are almost devoid of mineral occurrences. There is only one place which is easily accessible to the mineral collector, and that is at Prospect, distant about 20 miles on the Great Western Highway. Here a laccolitic intrusion of analcite dolerite has been quarried for many years to provide "blue metal" for concrete and road construction. Every now and again the quarrymen open

up a cavity in the solid rock in which beautifully crystallized minerals are found. Recently Mr. J. J. Johnston, an enthusiastic collector, secured for us a specimen of apophyllite, a mineral not previously found here. Another collector, Mr. A. Chapman, brought to the Museum some fine specimens of analcite and natrolite of such excellence that we have replaced the existing specimens in the Gallery by them.

Fishes in Flights of Fancy

By GILBERT WHITLEY

IN a broadsheet entitled *Emblems of the Distracted Times* and published 300 years ago, one of the superstitious marvels indicating the unsettled conditions of the year 1642 (not 1942!) was the alleged flight of fishes through the air:

"Eeles and Gudgeons flie a mighty pace."

In the distracted times of the present day,¹ it is statesmen, rather than fishes, who 'flie a mighty pace', which naturally recalls Munich, where the original idea for this article of mine arose. Appropriately enough, there is in the wonderful Deutsches Museum in Munich a remarkable series of exhibits showing the evolution of flight, from the falling winged sycamore-seed to the man-made kite, balloon, or aeroplane. And in some of the cases are illustrated the ideas and fancies men had concerning flight long before any human ever achieved that ideal: the beautiful Greek legend of Icarus and Daedalus, the ancient Chinese conception of a kite-like chariot in the clouds, the winged men of Egyptian, Assyrian, Roman, and mediaeval sculptors, the experiments of Leonardo da Vinci, and the models used by the Australian pioneer, Lawrence Hargrave, at Stanwell Park—these are but a few of the subjects shown. The early attempts at flight by man were, we usually think, inspired by birds or bats, yet it seems that even the humble fishes have played a part in the development of aviation. Fanciful pictures of flying men, drawn by ancient artists of several nationalities, attracted my attention at Munich, and I noticed that sometimes the fliers were shown travelling through the air on fishes, rather like a witch astride a broomstick. I therefore collected all the cases I could of these "fishes in flights of fancy" and reproduce thumbnail sketches of them here; there seems to

be a story behind them which has yet to be unravelled. I had long known of an unexplained woodcut in Yarrell's *History of British Fishes* (Vol. i, 1836, p. 402; 2nd. Ed., 1841, p. 457) of a "flying fish" of carp-like appearance which transported two persons in a gondola over a scene



A fanciful picture of a carp-like 'flying fish' from Yarrell's *History of British Fishes*, 1836.

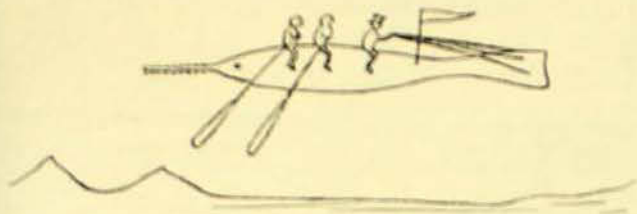
reminiscent of Italy; this I had dismissed as a humorous caricature until similar figures cropped up in various out-of-the-way places.

Balloons in the form of fishes were thought of, and doubtless constructed, in 1784, when there appeared a German engraving of "Fischballones" contemporaneously with a French "Poisson aerostatique", showing a Sawfish (*Pristis*) in mid-air. These prints are exhibited in the Deutsches Museum.

In the Rijksmuseum, Amsterdam, I noticed a picture of the school of Hieronymus Bosch (about 1460-1516 A.D.) in which was a fish, with fins like a gurnard's, flying with a rat-like passenger on its back. In the Musée des Beaux Arts, Brussels, there were several variants of this early flying-fish motif in a triptych after Hieronymus Bosch show-

¹ This article was written in 1938.

ing the Temptation of Saint Anthony, a favourite subject of Bosch's, in which he ran riot with his painted monstrosities assailing the saint from land and air. The original of this masterpiece is in the Museum at Lisbon, Portugal,² and amongst the weird figures of demons and hobgoblins one notices in the air a fish



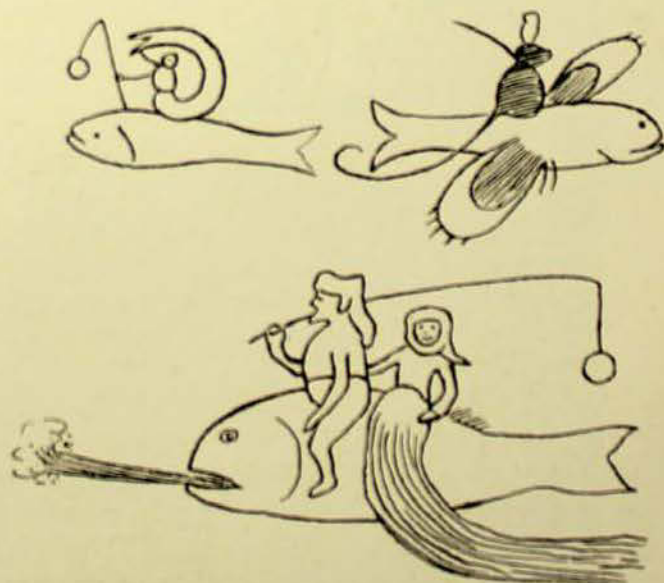
The fish-balloon, a French and German idea of 1784, perhaps based on a model constructed for entertainment purposes.

bearing a man and woman on its back and belching forth smoke. A somewhat similar device appears in Bosch's "Pleasure Garden" (*Der Garten der Lüste*) which is (or was) in the Escorial Gallery, Spain. The fact that the fishes in these pictures have smoke coming out of their mouths suggests that Bosch may have seen decorated paper bags of curious shapes filled with smoke so that the heat would make them rise in the air after the manner of the Montgolfier balloon manufactured many years later.

Murray's *Oxford English Dictionary* informs us that in 1634 a person named J. Bate issued instructions "How to make Balloones, also the Morter Peece to discharge them . . . Into this Balloone you may put Rockets, Serpents, Starres, Fiends, Petards." Hieronymus Bosch's flying-fish-balloons belong to the fifteenth or early sixteenth century, long before most stay-at-home Englishmen or Europeans knew anything of the real flying fishes of the open ocean, which were then only just beginning to be discussed and believed in, although the ancient Greeks knew the Mediterranean ones and called them *Exocoetus* (from *ἐξω*, out of, and *κοιτος*, dwelling), recalling the legend that the flying fish came ashore to sleep every night!

"What is the earliest published figure of a flying fish?" My friend, Dr. E. W. Gudger, in reply to this question, pulled down a curious old tome from a shelf in the American Museum of Natural History, New York. It was Cube's *Hortus Sanitatis*, published in 1536, and the picture he showed me is, with his permission, reproduced here. The artist must have made his creature up from imagination or from second-hand accounts, for he seems to have combined bird, fish, and squid to illustrate his story. Easily recognized flying fishes appear on some old maps, such as that of Descelier's in 1550. Primitive folk doubtless drew the flying fish in very early times and in many lands: the subject is represented in faience in the shrine of the Snake-Goddess at Knossus in Crete, whilst at Tongatabu, in the Friendly Islands, I have seen flying fishes with wings like windmills figured in the tapa cloth.

From the snowy Central Park West in New York to the sunny streets of Sydney I continued my quest for flying fish lore. Here the Public Library research officer, Miss N. B. Kibble, kindly searched through many volumes, from Greek classics to modern aeronautical literature, to swell my growing list of references to this fascinating if unimportant subject. Miss Kibble found that in 1883 Professor



"Fishes in flights of fancy" in pictures after Hieronymus Bosch (c. 1460-1516).

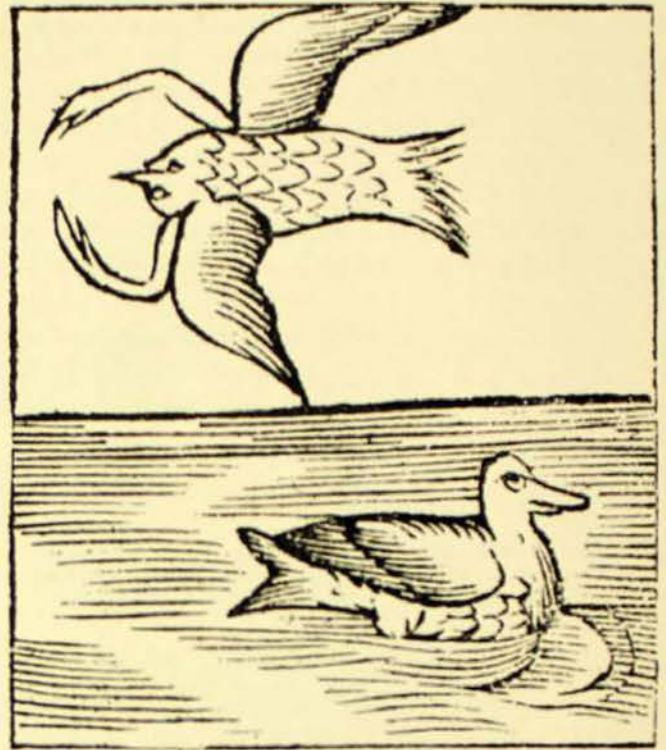
²M. J. Friedländer, *Die Altniederländische Malerei*, v, 1927, p. 84, pls. lvii and lxxii.

Wellner, of Brünn, calculated that a 'fish-balloon' 150 feet long and 50 feet in diameter might reach a speed of ten miles an hour. This balloon was designed in the likeness of a fish, complete from head to tail, and is illustrated in A. Hildebrandt's *Airships Past and Present* (1908, p. 41 and fig.). At that time sceptics were talking of "another balloonic attempt to cross the Channel".

Then in the *Sydney Morning Herald* for Friday, July 29, 1864, p. 8, I find the following quaint paragraph:

A Flying Man.—A gentleman, who is to fly up and down the vast nave of their palace, is now in treaty with the Crystal Palace Company; and, from what we hear, he will accomplish his task. Our present adventurer copies not a bird, nor an animal, but a fish. Fishes fly through the water—that is, they propel themselves through an element lighter than the heaviest part of their own bodies; and we may hint so far—with our second Icarus, upon cylinders not spheroidal, but flattened, and with paraboloidal ends, we hope soon to see an aerial voyage accomplished, and that which the Greeks, Romans, Venetians, and French have failed to do, accomplished by John Bull.—*Illustrated News*.

In 1868, a constellation of stars in the Southern Hemisphere was named the Flying Fish, but nowadays these stars wink down on giant aeroplanes making great ocean crossings, the shadow of their wings frightening the flying fish below, as Chichester noted on his solo flight from New Zealand to Norfolk Island. And the next time I fly over the sea (as I hope soon to do) I shall think of the flying



The earliest published illustration of a living flying fish. The curious concoction from Cube's book, *Hortus Sanitatis*, published in 1536.

By courtesy of the American Museum of Natural History.

fishes down below and our little debt of gratitude to them for the part they have played in man's imagination in the years gone by. Let Leonardo's 15th century prophecy be fulfilled:

The human bird shall take his first flight, filling the world with amazement, all writings with his fame, and bringing eternal glory to the nest whence he sprang.

GEOLOGY AND ALLIED SCIENCES: A Thesaurus and a Co-ordination of English and German Specific and General Terms. By Walter Huebner. Part I, German-English. (Veritas Press, New York City, 1939.) Svo, pp. xvi + 405. Price \$7.50.

In his preface the author says that there is a "lack of a comprehensive and up-to-date thesaurus of geologic terms in any of our modern languages". The *Geologische Nomenclator*, edited by L. Rutten and published at The Hague in 1929, was a praiseworthy attempt to compile a

geological nomenclator in four languages, Dutch, German, English and French, but it was much less complete than the present work, which contains more than 25,000 entries and omits few terms (if any) that should find a place. It is bound to be of the greatest service to English-speaking geologists when consulting German geological writings, and its usefulness is increased by its wide scope, for in addition to geology proper consideration has been given to the terminology of the many kindred sciences, such as geography, biology, chemistry, physics, and others.

C.A.

Ice Clad Continents

By R. O. CHALMERS, A.S.T.C.

ABOUT 1,000,000 years ago great ice sheets formed in Europe and North America and commenced to advance over areas now occupied by man. At times the ice retreated considerably and then advanced again to its former extent. During the third retreat, or interglacial stage as it is called, Neanderthal man, our primitive ancestor, appeared in Europe, surviving the relentless final advance and the rigour of a sub-polar climate. Much later, approximately 11,000 B.C., when the ice was retreating for the last time, but the climate was still very severe, man was a cave-dweller, decorating the walls of his home with remarkable works of art, while the mammoth and reindeer still roamed in France and Germany. At the present time half the effects of this great climatic change are still with us in the shape of the Greenland and Antarctic ice-caps, which opens an interesting field of speculation. Will the ice-caps again advance over Europe and North America, or will

the two existing ice-caps gradually melt away? Should this latter happen the whole earth, including the poles, will again enjoy the moist semi-tropical climate which has been characteristic during the greater part of geological time, excepting when on rare occasions a combination of conditions has caused an ice-age.

Other ice-ages have occurred in the past. Two hundred and fifty million years ago the countries of the southern hemisphere, including Australia, were even more heavily glaciated than were the northern countries during the last ice-age. During that time Antarctica and Spitzbergen enjoyed a warm climate, as is evidenced by the presence of coal seams there today.

LAND ICE.

There are two main types of land ice. Firstly, glaciers, which are veritable rivers of ice formed in the valleys of high mountain ranges. Examples abound

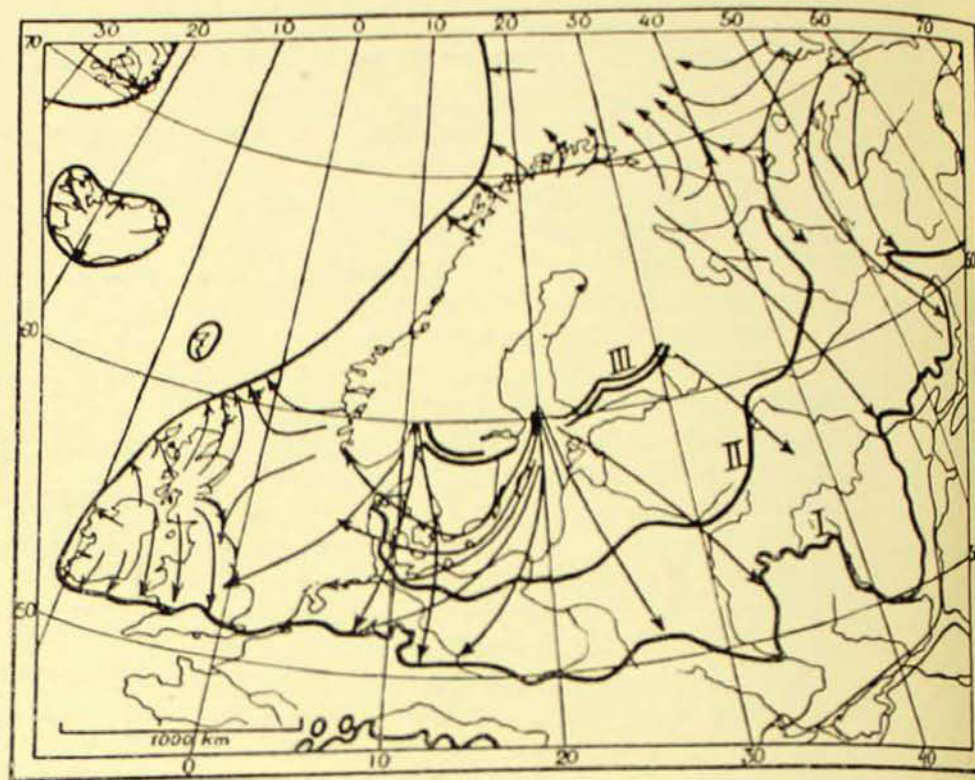
A large dumped boulder, or glacial erratic, on the western side of the Dungog road, about one mile north of Seaham. A comparison with the height of the fence posts gives an idea of its size.

Photo.—R. O. Chalmers.



Extent of the European ice cap during the maximum of glaciation (I); during the maximum of the final glacial stage (II); and the stage when the varves were deposited in lakes along the ice-front in Sweden and Finland (III). Arrows show direction of flow of the ice.

(Adapted from Daly, "The Changing World of the Ice Age".)



in the Alps, the Rockies, the Andes, and the Himalayas. Glaciers flow along and carve their valleys just as rivers do, only the mechanism of erosion is different. Rock material in the form of avalanches falls on the glacier surface, and boulders drop down crevasses until they reach the bottom, where they are gripped as in a vice and used as tools to scour and scrape the valley floor. In the process the boulders become roughly faceted, and the rock floor is scratched or striated. When the glacier melts the whole conglomeration of rock fragments is dumped in a mixed-up heap known as a "moraine". Some of the larger dumped boulders are known as glacial erratics, because they are unrelated to the rock types in the neighbourhood, having been carried for perhaps hundreds of miles. Glacial valleys have a distinctive shape, just as though a giant steam shovel had made a great scoop, leaving a U-shaped trench behind.

The other main type of land ice is the great continental sheet, with which we are most concerned. These are of large extent and great thickness. They mostly form on low ground and have not necessarily any connection with mountain

ranges. They move along very slowly, just as glaciers do, sometimes travelling only one mile in twenty-two years, and scour the country beneath in the same manner.

PLEISTOCENE GLACIATION IN THE WORLD.

The Pleistocene period commenced about 1,000,000 years ago, and at the same time great ice sheets formed. In Europe there was one great sheet, the Baltic or Fennoscandian, which had a maximum extent of 2,000,000 square miles and was 10,000 feet thick in the centre. In North America there were three great sheets. These coalesced at the time of greatest cold and formed one huge cap, 4,000,000 square miles in area and 12,600 feet thick at the centre. The chief evidence that these countries were once covered with ice is furnished by the presence of what is called "drift", "till", or "boulder clay". This is the conglomeration of material dumped at the edge of the ice sheet as it retreated, and in time it has been consolidated into a clayey rock with boulders of all varieties and sizes. These ice-caps were not formed concentrically around the pole, because most of Siberia escaped

glaciation, so that it must not be thought that the great sheets were merely extensions of the present-day polar cap. Their formation cannot be explained in such a simple way.

INTERGLACIAL STAGES.

The Pleistocene was by no means an age of unbroken refrigeration. There were four major glacial epochs, and three interglacial stages or retreats, excluding the time from the last retreat to the present, which may or may not be the commencement of a fourth interglacial stage. The second interglacial stage lasted for some 70,000 years, and during this time the ice retreated almost completely. Since it is only 9,000 years since the ice retreated last time, it is by no means certain that it will not advance again.

Although the major glaciation was in the northern hemisphere, the snow-line was lowered all over the world. On every high mountain range the glaciers were larger and descended to lower levels than at present. Tasmania was quite heavily glaciated, and there was a small ice-cap at Kosciusko.

THE ANTARCTIC CONTINENT.

For several reasons Antarctica deserves special mention. It has sometimes been called Australia's heritage, although she of all nations makes least use of its great natural resources. It is the largest ice-cap of all, having at present an area of 5,000,000 square miles, and is smaller than it was at the time of maximum cold. Naturally there is no evidence of interglacial stages, since the ice still covers the continent except for a narrow fringe of coast line here and there. Not one flowering plant or land animal exists in Antarctica. In America and Europe plants and animals, including man, had plenty of time to retreat south when the ice was advancing. However, the unfortunate inhabitants of Antarctica had nowhere to retreat, since the whole continent was covered, or if they managed to emigrate, they certainly had no wish to return.



The Antarctic ice sheet, to the east of the winter quarters of the 1911-14 Australian Antarctic Expedition, Adelle Land.

(From Mawson's "Home of the Blizzard".)
Photo.—Frank Hurley.

PLEISTOCENE CHANGES OF SEA LEVEL.

At the time of maximum glaciation there was 9,000,000 cubic miles of ice on the various continents. This is equivalent in water to one-seventh the volume of the Atlantic Ocean, which represents quite a large withdrawal of water from the sea, the world's reservoir so to speak. Another way of putting it is that the level of the ocean was lowered the world over by 292 feet. As this water was gradually returned to the ocean the geographical changes were extremely striking. The British Isles became separated from the

rest of Europe, and Tasmania became separated from Australia. Numerous valleys along the eastern Australian coast were inundated or "drowned", and thus magnificent harbours such as Port Jackson, Twofold Bay, Broken Bay, and others were formed. It might also be mentioned that there are still 4,000,000 cubic miles of water missing from the ocean, in the shape of the Antarctic and Greenland ice-caps. Should these melt at some future date no doubt fresh international crises would be precipitated on account of the loss of territory that would result the world over.

TIME OF DURATION OF THE ICE AGE.

Various methods have been used to estimate the actual time that the ice took to advance and retreat. Niagara Falls, for instance, have been in action since the ice sheet left that region and have cut back along the valley seven miles since then. The annual rate of cutting is known, so that by simple arithmetic we know that the ice sheet left Niagara for the last time 25,000 years ago. A much more accurate method was developed in Sweden some years ago by Baron de Geer. A feature of the ice retreat in Sweden was the formation of large lakes along the ice front, which became frozen over in the winter only. During the summer sediments were carried into the lake and the coarse material sank straight away, and in the winter, when no more material was coming in, the finer rock flour sank very slowly to the bottom, being quite undisturbed. Thus seasonal deposition went on every year. At present the lakes no longer remain, but these sedimentary deposits are now consolidated and banded, consisting of alternating coarse and fine bands, each pair of bands representing one year. These interesting sediments are known as varves.

PERMIAN GLACIATION.

Varves are found at Seaham, near West Maitland, New South Wales. These were deposited 250,000,000 years ago during the Permian Ice Age. This was a more severe glaciation than the Pleistocene and lasted longer. The records of course are



Varve shales at Seaham, New South Wales. These show contemporaneous folding in parts, caused by disturbances due to movement of the ice-sheet which was close at hand. Due to the efforts of the late Sir Edgeworth David, this quarry was made a national reserve. The notice proclaiming this fact can be seen in the background.

Photo.—R. O. Chalmers

less complete, but many interesting facts are known about it. For instance, the continents that escaped heavy glaciation during the Pleistocene, namely, India, South Africa, South America and Australia, were ice-covered during the Permian.

The undoubted evidence of the Pleistocene Ice Age when first revealed had induced a wave of pessimism in philosophical and scientific thought throughout Europe and America during the last century. Adhering to the old fallacious conception of a slowly cooling earth, the prophets and seers saw in the Pleistocene Ice Age the beginning of the end. They said that the day would be not very far distant when the last few survivors of the

human race would be warming their chilled hands over the last miserable fire, dismally awaiting complete extinction, so that in 1859 the announcement of the discovery of glacial deposits in Central India, today one of the hottest regions of the earth, raised a storm of abuse and disbelief. Nothing perturbed, the investigators went on to show that this glacial period was Permian in age, and that the glacial tillites were overlain by coal seams, proving that India had reverted to an equable climate after the Ice Age. Thus it was indubitably proved that glaciation is a cyclical phenomenon, interrupting on rare occasions the usual mild semi-tropical state of the earth. The host of problems connected with Permian glaciation cannot be gone into here. The peculiar distribution of the glacial deposits suggests that the poles must have been in a different position in these far-off times. We are here touching on one of the highlights of imaginative geology, because to explain these problems many geologists, notably Alfred Wegener, have stated that both poles and continents have moved their positions since Permian time. However, space will not permit touching on this, one of the most controversial questions in modern geology.

CAUSES AND EFFECTS OF ICE AGES.

In late Pre-Cambrian time, 360,000,000 years earlier than the Permian, there was another Ice Age. Evidence of this is found in various parts of the world, including South Australia. This huge time gap serves to show how rarely the uneventful, almost monotonously mild, climatic conditions of the earth have been broken by times of extreme refrigeration. Only about six times in 1,400,000,000 years has the temperature been sufficiently low to cause an Ice Age. The three that have been mentioned were the most severe.

A whole article could be devoted to the countless theories that have been put forward to explain glaciation. Some investigators have had recourse to geological arguments, such as the cooling of the earth and the elevation and depression

of land masses. Others have staked their lives, as it were, on the directions of storm paths, winds and ocean currents, the effects of clouds, and the presence of volcanic dust and various gases in the earth's atmosphere. Yet a third group have pinned their faith to purely astronomical causes, the shape of the earth's orbit, the degree of inclination of the earth's axis, and so on. One prefers to be guided by the late A. P. Coleman, the eminent Canadian geologist, who after a lifetime of study, admitted that no single theory explained every feature of glaciation, and in fact refrained from offering any fresh theory of his own.

The effects of Ice Ages are so intensely interesting that one can almost willingly forgo a satisfactory explanation of the cause. Ice Ages have been invaluable as a test of the fitness of the inhabitants. The dinosaurs, giant grotesque cold-blooded reptiles, became extinct because of a slight glaciation 55,000,000 years ago, and left the way clear for the progressive development of warm-blooded furred mammals and feathered birds. Had this temperature dip not occurred, the Pleistocene Ice Age would certainly have put an end to the reptiles, but there would not have been time enough for the mammals to have reached the wonderful degree of specialization that they display at present.

It is singular that the Pre-Cambrian Ice Age came at the close of a period during which primitive life must have existed; little evidence of it, however, is available. The Permian Ice Age came at the close of a period which in its later stages at least might well be called the Age of Fishes and Invertebrates. Then came the above-mentioned temperature dip which put an end to the Age of Reptiles. The Pleistocene Ice Age, which commenced 1,000,000 years ago and may be still in progress, has been closely associated with the development of modern animals and man himself. On each occasion the way has been left clear for new types of life to evolve and develop. Ice Ages may be imagined as

lengthy days of judgment, when all Life is weighed in the balance by Nature, and those found wanting are ruthlessly destroyed.

Looking at the question broadly, Man has acquitted himself well, up to the moment, before the great tribunal of the Pleistocene Ice Age, but it is problematical whether he will survive another ice-clad Europe as well as did his cave-painting ancestors. Of course under these conditions there would be territory lost in Europe and America. The seriousness of this loss is a matter of opinion, because

with the resulting increased rainfall over the rest of the world such places as the Sahara, Arabia and the Gobi Deserts would become grassy rolling plain country, where fresh and possibly wiser civilizations could evolve.

Probably the most severe trial would be the complete withdrawal of the present polar ice-caps and the return to world-wide moist, tropical conditions. Certainly this has never been the case since man has been on earth, and it may be the special test which Nature has reserved for our present civilized selves.

AN AUSTRALIAN BIRD BOOK: A Complete Guide to Identification of the Australian Species. By J. A. Leach, D.Sc. Revised and Edited by Charles Barrett, C.M.Z.S. Eighth Edition. (Whitcombe and Tombs Ltd., Melbourne, 1939). Svo, pp. 200, with 20 coloured and 27 half-tone plates, 1 map. Price: 8s. 6d.

All ornithologists and bird lovers will welcome this new edition of Leach's well-known Bird Book. The first edition appeared in 1911 under the title *An Australian Bird Book: A Pocket Book for Field Use*, and since that time it has done splendid service as a complete and handy guide to the birds of Australia. The chief features in which this edition differs from its predecessors are the inclusion of a short biography of the author, and a new series of half-tone illustrations from photographs by the editor (who has done so much for nature study in Australia), and other leading bird photographers.

The arrangement and classification are those of Bowdler Sharpe's *A Hand-List of Birds*, but the scientific and vernacular names are those used in *The Official Checklist of the Birds of Australia* (Second Edition) issued by the Royal Australasian

Ornithologists' Union. By a system of numbers and abbreviations (explained in the Introduction, pp. 9-11) great condensation has been achieved and an astonishing amount of information is contained in this *multum in parvo*.

The celebrated essay on the birds of Australia, which in the first edition was scattered through the systematic part of the work, is here collected in pages 101 to 183, a great improvement.

There is a very full general index to families and to generic and vernacular names, as well as indexes to the coloured plates and to photographic reproductions.

C.A.

THE WEST AUSTRALIAN NATURALIST, vol. I, no. 1, September, 1939 (Official Organ of the West Australian Naturalists' Club, Western Australian Museum, Perth, W.A.). Svo, pp. 1-20.

This, the first issue, is in our hands. Its contributions are varied, geology, zoology and botany being dealt with in a number of interesting short articles and paragraphs. Apart from this it is a record of the doings of the club. It is a creditable publication and should do much to foster a healthy interest in natural history.



Pack camels crossing a high sand-ridge.

The Simpson Desert

By H. O. FLETCHER*

THE term desert usually conjures up in one's mind an area of extreme desolation, bare shifting sand-ridges and high temperatures. In Australia we have many inland areas which have been designated desert country, but in the majority of cases the country is not as bad as it is painted. Many cattle and sheep are raised and fattened on so-called desert areas for our markets.

I would say that the Simpson Desert is one of Australia's most arid spots—that is, the country inside the routes of previous explorers. Time and again the early explorers of Central Australia were turned back or diverted from their originally planned course by the high sand-ridges of the desert. Now that this previously unknown area of Australia has been penetrated by the Simpson Desert Expedition, we know that it is beyond all permanent occupation, and that its chief characteristics are level plains covered with high sand-ridges, with spinifex as its chief vegetation.

It is a strange paradox that the chief obstacle met with in crossing this desert was rain and then more rain. The season chosen to make the desert crossing, the winter of 1939, followed and was during one of the best seasons known in the

history of that country. We saw parts of the desert covered with a luscious vegetation. The crests of the sand-ridges where the loose or live sand is found supported a heavy growth of annual flowering vegetation of many types and colours, the majority heavily perfumed. We saw that the desert under the influence of good rainfall can bloom like a rose.

In 1929 Dr. C. T. Madigan, of the University of Adelaide, made an aerial reconnaissance of the Simpson Desert by making a flight over the centre of it. He flew from Birdsville in the south-west corner of Queensland to Alice Springs in the Northern Territory, his course lying right across the centre of the Simpson Desert. He made other flights, taking aerial photographs and making important notes with a land expedition in his mind to follow.

He then defined the desert and named it in honour of Mr. A. A. Simpson, C.M.G., then President of the Royal Geographical Society of Australasia (South Australian Branch), as it was with his help and under the auspices of the Society that the first investigations were made. The land party which Dr. Madigan successfully led across the desert was also financed by Mr. Simpson.

The limits or margins of the Simpson Desert are defined by Dr. Madigan as the Mulligan River in the east, the

* Photographs by the Simpson Desert Expedition, under the leadership of Dr. C. T. Madigan, copyright.



An aerial view of the south-eastern margin of the Simpson Desert with Goyder's Lagoon in the background, taken from a height of 5,000 feet.

Photo.—C. T. Madigan.

Diamantina and the Kallakoopah in the south down to Lake Eyre, the Finke River as far upstream as the Hugh Junction in the west, the MacDonnell Ranges in the north-west, and the Marshall River in the north. These margins enclose the Simpson Desert, its area being approximately 56,000 square miles. Most of it occupies the south-eastern corner of the Northern Territory, but it extends eastward into the south-western corner of Queensland and southward into South

Australia, coming to a point at Lake Eyre. The desert, therefore, occupies portion of three States.

In May of this year the expedition left Adelaide under the leadership of Dr. Madigan to cross the desert and carry out scientific investigations. The scientific work included, in addition to the mere feat of crossing the desert, the mapping and description of the desert features, the study of the sand-ridges and their mode of origin, the ecology and pastoral value of the land and the biology of the area. The party consisted of Dr. C. T. Madigan, geologist and navigator; the writer as second-in-command, palaeontologist and biologist; Mr. R. L. Crocker, soil surveyor and botanist; Mr. R. A. Simpson, wireless operator; Mr. D. Marshall, photographer; A. Hubbard, cook; A. J. Bejah and Nuri Moosha, Afghan camel men; Andy, a blackfellow from Marree.

We left the Alice Springs express at Abminga and proceeded by motor truck to Charlotte Waters, where we came up with the camel string which had left Marree on May 7. Our next rendezvous was Andado Bore No. 1, where we were to meet again on June 4. The scientific party proceeded to Andado Station, where

Annual growth of flowers in the Simpson Desert which were flourishing after heavy rains.





The junction of the Macumba and Warburton Rivers north of North Lake Eyre. Flood conditions.

preliminary work was to be carried out and the biology of the country investigated. Andado Station is owned by Mr. Bob McDill, and he very hospitably looked after us during our stay. The station is situated between two very high sand-ridges and is actually well within the western margin of the Simpson Desert.

We had been surprised by the luxuriant growth of the country traversed, particularly in the Finke River area and Mayfield's Swamp. This swamp is actually a backwater of the Finke River, and during its last flood it received a large quantity of water. The bed of the Finke is now dry, but the swamp contained a good deal of water.

The party assembled at Andado Bore No. 1, 25 miles north-east of Andado Station, on June 4, and there was much activity packing the equipment into suitable loads for the camels. Our water supply consisted of fourteen 16-gallon and two 4-gallon canteens, making a total of 232 gallons to start with. The camels had made good progress from Charlotte Waters and looked fit and well for the long journey before them. It was here that members of the expedition were for the first time introduced to their mounts, and there was much conjecture as to whom would be given the two young camels with buckjumping tendencies. One was assigned to me and the other to

Hubbard, and for the whole of the trip we caused a humorous diversion in attempting to keep control, but not so humorous to ourselves as to others.

Camels are the only possible means of transport in this country; it would be impossible for horses to cross the desert and carry packs over the high and steep sand-ridges. One always finishes an experience with camels with a decided prejudice against them, although one must admire their tenacity, their untiring marching powers, and, more important still, their ability to travel long distances without water.

A South Australian surveyor, Charles Winnecke, made an extensive journey in 1883 into the eastern margin of the Simpson Desert. This journey was carried out entirely with camels, and at one period they marched 278 miles in 16 days without water in country which Winnecke described as "the heaviest and worst sandhill country in Australia". The Elder Scientific Expedition of 1891-2 marched their camels 537 miles in 34 days without a drink, an amazing test which shows the endurance and strength of the Australian-bred camel. In East Africa it is considered that a fortnight is a maximum for which a camel will go without water in a dewless country without injury.

We finally moved off on June 5 from Andado Bore No. 1, after saying farewell



A clay-pan in the centre of the Simpson Desert. A large sand-ridge about 80 feet high is in the background.

High sand-ridges near the Mulligan River. The phenomenal rains had caused the valleys to become boggy marshes.



to Tom Kreuse, the motor truck driver, who had to return to Abminga and then make his way to Yunta in South Australia. The camel string consisted of nineteen camels, and as we proceeded north to our first objective, the junction of the Hale and the Todd Rivers, we looked quite a respectable and formidable expedition.

An aboriginal named La Li was taken with us from Andado Station to show us the position of a soak in the bed of the Hale River. We crossed over sand-ridge country, small sand-ridges, and, continuing a northerly course for several days, came to "gibber" country with low-lying tablelands to the east. It was found that with the heavily laden camels it was practically impossible to travel more than ten to fifteen miles a day, a day's travelling consisting of seven or

eight hours; in the desert proper our speed was reduced to even less than this.

The members of the party had now settled down into the routine of their duties. The wireless operator had made contact with Harry Ding at Yunta (Station VHU9), and every evening at 7 p.m. our position was given to him in case of emergencies. The biological work could be carried out only by walking a good deal of the day, and I was always accompanied by Andy, our blackfellow, who was of great assistance and had a fund of information. He was brought up at Kopperamanna Mission Station and could speak German fluently, much to our amazement and his amusement.

La Li guided us to the soak, which was further up the Hale River than we had anticipated. A large hole was dug in the sandy bed, and in that dry country it was

a pleasure to see the cool and crystal clear water slowly running in until the hole was full. Our canteens were filled and an attempt made to give the camels a drink, but in the strange surroundings they refused even to look at the water.

After farewelling La Li, who was to return to Andado Station, the party on June 10 turned due east to make the desert crossing. After leaving the Hale River we climbed the low tableland and traversed stony country for several days before finding ourselves in the sand-ridge country of the Simpson Desert. In the journey across the desert to the Mulligan River and then south-east to Birdsville we crossed a monotonous succession of sand-ridges totalling in all 743.

During this crossing we were surprised to find areas which had apparently missed the wonderful rains that most of the country had experienced. The sand-ridges were much higher and steeper than we expected, and even the spinifex was dead or dying. There was no feed for the camels, and after a time they began to feel the strain of no food or water. At this time we were making very few miles a day and it was thought that a crisis would soon arise. Should we give some of the weakest camels water from our drinking supply, or attempt to get through with fewer camels?

This question was taken out of our hands when at Camp 8 we experienced unprecedented rain, which continued for three days. Unfortunately no water collected in the sand and it was not until several days later that we entered an area with luxuriant growth and clay-pans filled with water that the weaker camels were saved. The riding camels rushed to the water quite out of our control. It was a perfect day, and it was decided to stay at this spot for a day and allow the camels to feed and drink to their heart's content. From this point to the dry bed of the Hay River we repeatedly found clay-pans containing water, filled from the recent rains, but rapidly drying, as the depth of water in a clay-pan rarely exceeds a few inches.

Sand-ridges and spinifex are the chief characteristics of the Simpson Desert. The ridges are straight and parallel and run practically north and south for hundreds of miles, rising to heights varying from sixty to as much as one hundred feet. The intervals between the sand-ridges varies somewhat. At times the bottom of one sand-ridge led at once on to another, while again the ridges were at times separated by flats as much as a quarter or half a mile wide, a feature more common towards the east and western margins of the desert. Fortunately for us the steep slope of the sand-ridges was on the eastern side and the easy slope on the western side, so that our camels had the easy ascent to climb on our journey from west to east. It would be almost impossible for a party to travel across the desert from east to west, a fact which makes it hard to believe that Ludwig Leichhardt would persist with horses in attempting to make a crossing. It has been supposed that Leichhardt's remains will be found in the Simpson Desert, but there appears to be indisputable evidence that Leichhardt and his party were killed in Queensland by the Comet tribe of blacks, and that the blazed trees further to the west, and near the eastern margin of the desert, were marked "L" by Landsborough.

On June 24 the expedition had arrived at the Hay River, and, travelling down the dry bed for two days, turned east for the Queensland border fence. The country was now rather flat and supported good cattle feed. The border fence at this point consisted of posts placed in the ground every quarter of a mile. This fact was unknown to us and we crossed the border, but later came up against the rabbit-proof fence. From here we carried on east and arrived on the bank of the Mulligan River on June 28. The desert crossing had been completed and one of the last unknown areas in Australia had opened its doors to white men seeking scientific knowledge and surveying the country. The results were not of great importance economically. We had proved the country to be inhospitable,

consisting entirely of a succession of sand-ridges.

During our first night at the Mulligan River we suffered our second heavy rain during the expedition. It rained for several days and the Mulligan slowly and sluggishly began to run. During a spell of fine weather we left camp and travelled south-east down to the Mulligan River to the deserted Anandale Station and thence to Birdsville. The going was very heavy and in the flats the camels were plunging through marshy ground. We remained here two days with rain consistently falling, but finally got away again in cloudy, windy, and cold weather. We took a compass course towards Birdsville and found ourselves again in heavy sand-ridge country outside the eastern margin of the Simpson Desert. It was hard work for the camels to be plunging through boggy valleys and then climbing sand-ridges, but by this time our food and water was depleted and they had little weight to carry. On July 6 we arrived at Birdsville, where we were welcomed by a gathering of the townspeople.

After several days' spell at Birdsville it was decided to travel approximately 480 miles by camel and investigate the behaviour of flood-waters in the vicinity of the northern part of North Lake Eyre. This decision was made because of the phenomenal wet season and because of the lack of knowledge regarding the drainage of flood water which rivers carry down towards North Lake Eyre. The party followed the Birdsville-Marree cattle track as far as Mount Gason homestead, now deserted, and thence north to the Warburton River. It had been an interesting trip from Birdsville, water was plentiful, and the waterholes were covered with wild game. The Diamantina River, which carries flood waters from as far as Winton in Queensland, ends in the Goyder's Lagoon plain, across which it sends its waters in numerous channels to the Warburton. As a result Goyder's Lagoon plain was more or less flooded and we had about three-quarters of a mile of exceptionally deep bog to get the

camels through. On the southern side of the lagoon we got on to stony country for the first time since leaving Hale River.

In the distance we saw a motor truck with a wireless mast nearby. It turned out to be the Birdsville mail from Marree, still struggling to get through and only about a month late. Each mail truck has a transmitting wireless set, so that its whereabouts are always known.

We crossed the Warburton River and followed it down for some distance and re-crossed it to reach Corowie Station. The country was in wonderful condition and it was a pleasure to be travelling through it. From Corowie Station we set a course for the junction of the Warburton and the Macumba Rivers. The Macumba drains the country to the north-west, most of the drainage from as high as the MacDonnell Ranges finally finding its way into the Macumba. At this point there is really a junction of three rivers, as Kalweenie Creek runs south to Lake Eyre from the junction of the Macumba and Warburton, the three rivers forming a Y.

The rivers were full and some of the stretches of water extended for miles. We followed Kalweenie Creek down towards North Lake Eyre. Sand-ridges which we had been travelling over since Corowie Station continued right to the creek. The ridges in this area, however, were hardened with gypseous material and were solid. Even after the heavy rains there was little or no vegetation, and it was a scene of aridity and desolation which was almost overpowering. And through this country extended Kalweenie Creek, a broad sheet of beautiful water, strangely blue in contrast to the whiteness of the surrounding country. Nearing North Lake Eyre we were amazed to find that the water was flowing back towards the junction, and came to the conclusion that the water is held in these rivers like a gigantic dam, extending back for a great many miles.

Kalweenie Creek ended as far as we could see in a maze of clay-pans of great size, but not containing water. The

Refilling water canteens from a soak on the Hale River.



The camels enjoy a drink and a rest at a clay-pan in the centre of the desert.

surface level must have been higher here than further to the north. It now became a struggle for the expedition to make any southing, for we were constantly finding ourselves in a dead end surrounded by clay-pans; this meant retracing our steps and pushing out towards the east. We crossed the Barcoo or Cooper's Creek near its entrance into Lake Eyre, but, strange to say, although the river was in flood near the Birdsville track, only a short distance upstream, no water had flowed through the mouth into Lake Eyre. We turned west after the crossing and

came up to the eastern shore of North Lake Eyre. There was no sign of water, and although several of the party walked out on to the lake for a number of miles, there was no indication that any water except that precipitated by rain had covered the bed for countless years.

In attempting to reach the narrow channel which connects North Lake Eyre with South Lake Eyre we had to get the camels across portion of the lake. The surface looked firm and safe, but it was with trepidation that we advanced with the camel string. Half-way across one

camel became bogged, and before long excitement was intense. As quickly as we got one out another would begin to sink, as the surface of the lake bed became disturbed. After a worrying time we were able to retrace our steps and camped on the bank. Dr. Madigan, Crocker, and myself then decided to walk to the channel, a distance of eight miles. There was abundant proof that no water had passed through this channel for many years; it would appear that the water seen every year in South Lake Eyre from the Alice Springs train is drained there by rivers from the south. It had originally been supposed that the water was derived from North Lake Eyre, which in turn secured its supply from rivers to the north.

During our return to the camp we looked out across the flat expanse of Lake Eyre and saw extending from the bank to the horizon a set of wheel tracks. These proved to be the tracks of a utility truck that Dr. Madigan had taken on to the lake in 1929. He had come to this

position from Muloorina, and, although we had been looking for signs of one of his camps, we had not expected to see the tracks of the truck.

Darkness had set in by this time and we were very pleased to see away in the distance a signal fire which had been lighted by the people at the camp. We arrived back at camp at 10.30 p.m. after our 16 mile walk, which, added to eight miles during the morning, made my record 24 miles for the day.

We now turned east and skirted a very large arm of Lake Eyre, crossed the Clayton River, and two days later arrived at Muloorina Station.

The scientific party travelled from Muloorina to Marree by truck while the camels followed. After travelling about ten miles at a speed which to us seemed break-neck after camel speed, there was a loud report and a back tyre blew out. We realized then, rather sadly, that once again we had reached civilization and all the amenities that go with it.

A COLLECTION OF JAPANESE SHELLS. With Illustrations in Natural Colours. By Shintaro Hirase. (Matsumura Sanshodo, Tokyo, 1938.) 8vo, pp. 14 + 2 + 217, 128 colour plates. Angus and Robertson Ltd., Sydney. Price 15s.

This work is to appear in two volumes, the first of which is now to hand. The plates are reproduced by colour photography, with the exception of one of sketches painted by the author. Their reproduction is so excellent that no difficulty should be experienced in identifying the shells depicted, particularly as their sizes in millimetres is given. The second volume is to be a treatise on mollusca generally.

The volume conforms to the high standards set by Japanese workers in various branches of science. Complete in itself, it is simple enough for a junior to

follow, yet it will be of great value to every conchologist. As it was printed mainly to cope with the increased interest in shells in Japan, the names of the figured species are arranged in the language of that country under the plates, but the English translation is at the end of the book. It will be helpful not only to Japanese conchologists, but also to those throughout the Indo-Pacific region. Most of the common shells found in Japan occur throughout this region, even extending into tropical Australia. Australians, therefore, who, owing to the costs of publication and its restricted demand, have not so far had the use of a similar but locally produced work, will benefit considerably.

A tribute should be paid to the publisher for his part in producing this excellent publication.

J.A.