SEPTEMBER 15, 1957

The AUSTRALIAN MUSEUM MAGAZINE

VOL. XII, No. 7

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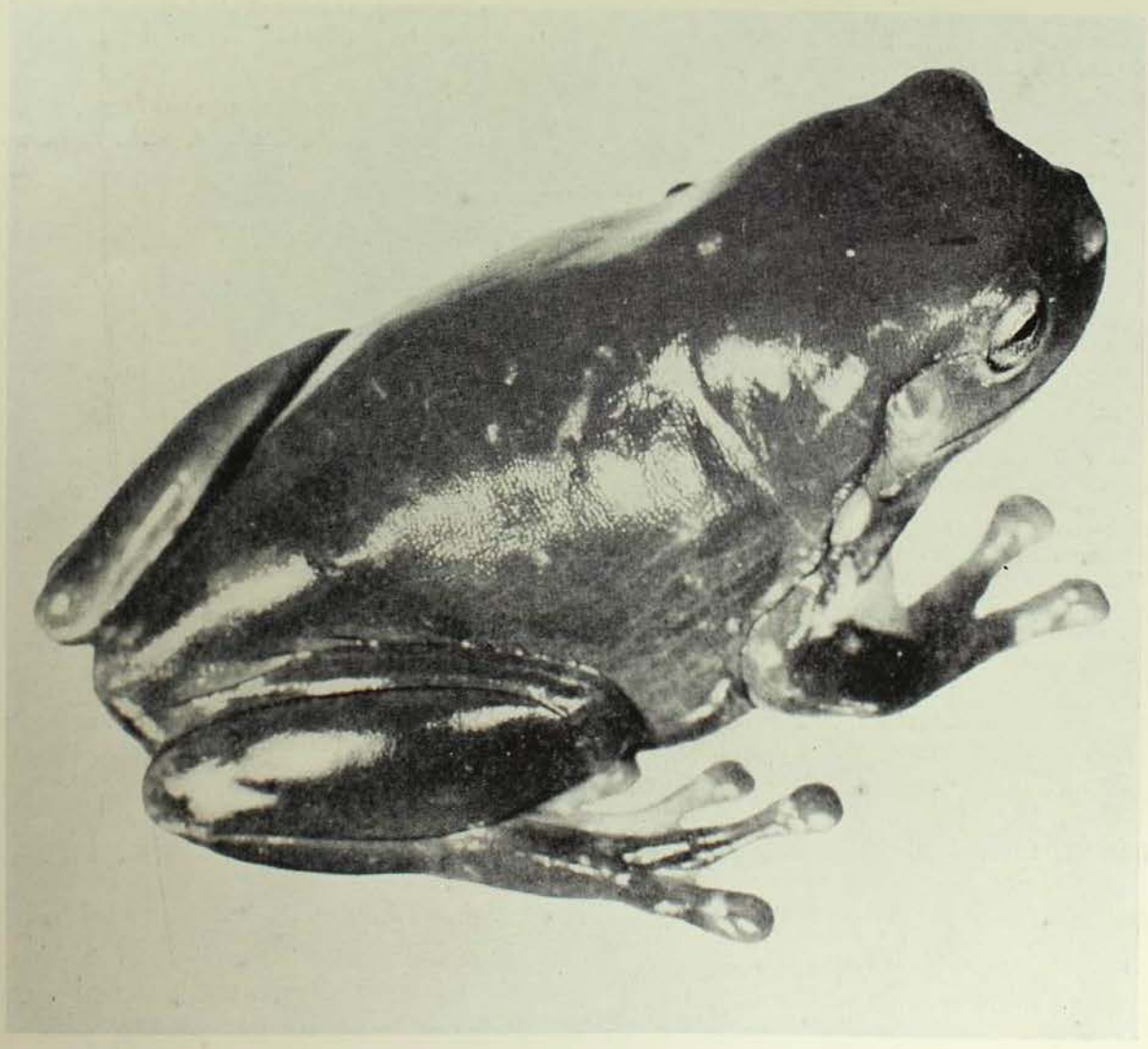

***Hyla caerulea*, one of the largest Australian frogs.** **(See Article on Page 212).**

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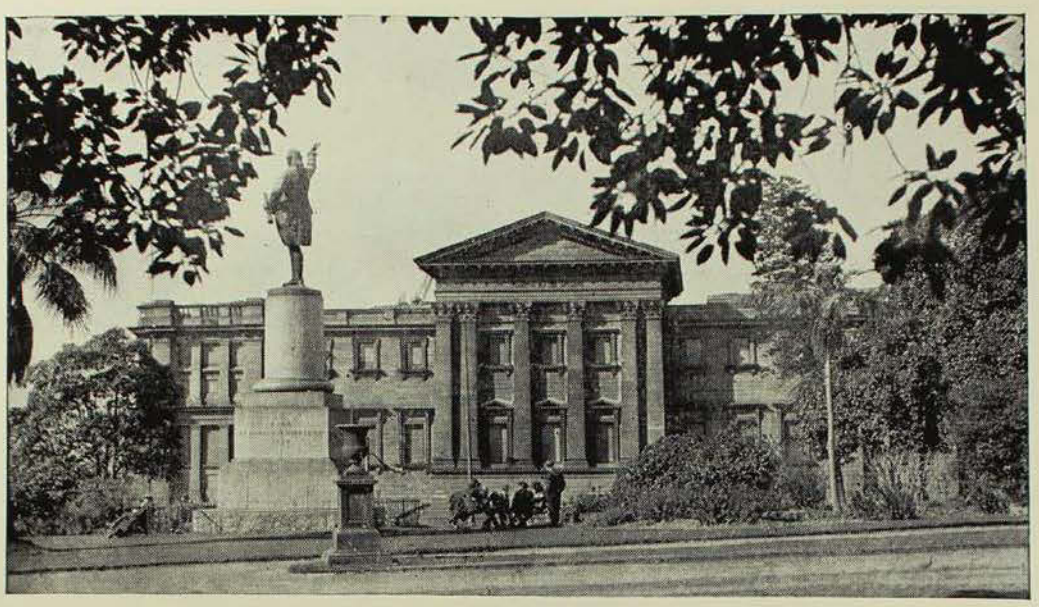

THE AUSTRALIAN MUSEUM MAGAZINE

(Photography, unless otherwise stated, is by Howard Hughes, A.R.P.S.)

OUR FRONT COVER.—One might expect from its name *Hyla caerulea*, that this frog would be blue in colour. The living animal, however, is leaf-green above; the name is based on the colour of the preserved animal. If *Hyla caerulea* is placed in alcohol it does become blue, so we must forgive the describer, who had only the preserved specimen at his disposal. This is one of the largest Australian frogs, the body being three inches or more in length. The call is a harsh "crawk, crawk, crawk", repeated slowly. (See article page 212.)

VOLUME XII, NUMBER 7 SEPTEMBER 15, 1957

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Published by the Australian Museum - - - - College Street, Sydney

Editor: J. W. Evans, Sc.D. Annual Subscription, Post Free, 9/-

VOL. XII, No. 7 SEPTEMBER 15, 1957

The Causes of Locust Outbreaks

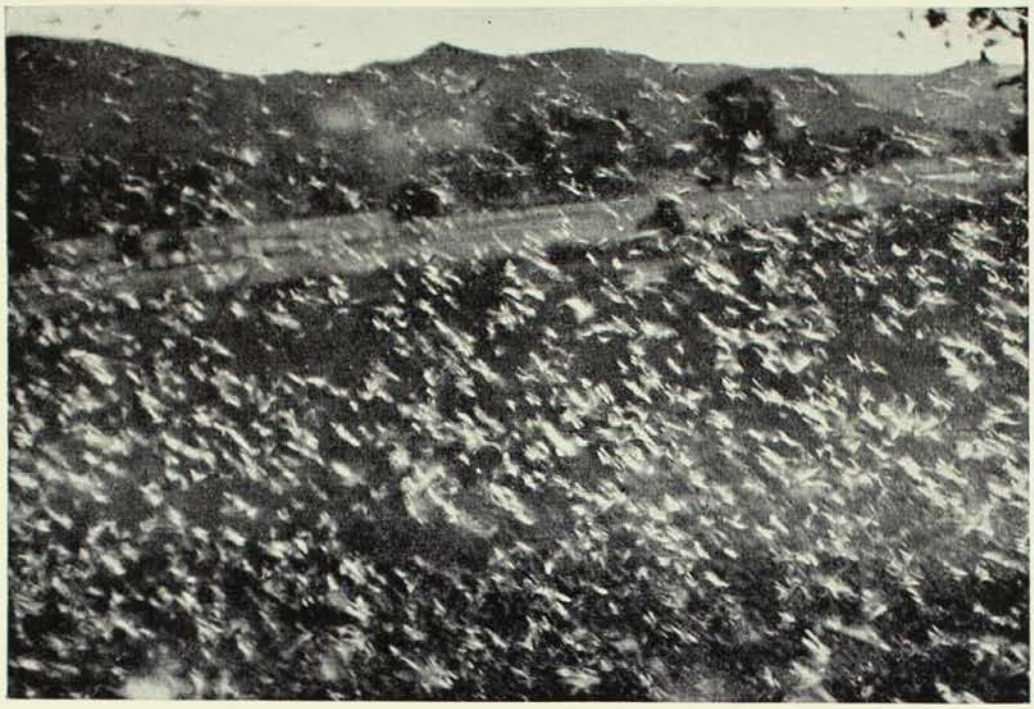
By K. H. L. KEY

LOCUST outbreaks have plagued mankind since the dawn of agriculture, and in Australia since the early days of settlement. Their effects are so spectacular that it must be almost impossible for a citizen in any modern community to avoid acquiring at least some information about them. Yet it is only within the last thirty years that an understanding has been gained of their causes.

What we call an " outbreak " of locusts has three characteristics: the insects are present in unusual *numbers*, they are present in unusual *places*, and they are present in *swarms*. We may take these three components separately and consider their causes, referring more particularly to the most injurious of the Australian locusts, which goes under the scientific name of *Chortoicetes terminifera*.

The presence of any animal in unusual numbers must be ascribed to the occurrence during its few preceding generations of conditions exceptionally favourable to its survival and reproduction. To a locust, the most important of such conditions is the rainfall. Locusts lay their eggs in the ground. They will hatch only if the soil is adequately moistened by rain during at least part of their developmental period. The young locust " hoppers " and the winged adults into which they develop depend for their survival on the availability of green plant material (mainly grasses), from which they derive their requirements of both food and water. Moreover, an amount of food and water just sufficient to keep a locust alive is not sufficient to enable it to reproduce. Thus the number of locusts hatching, the number surviving to the adult stage, the number reproducing, and the number of progeny all depend on a satisfactory quantity and distribution of rain.

However, the numbers of locusts are affected unfavourably by too much rain, as well as too little. Locusts are subject to certain fatal bacterial and fungal diseases that spread rapidly through the population during wet periods, with catastrophic effect. The relevant factor here is the dampness of the insect's immediate environment: a high rainfall can be tolerated much better when the herbaceous vegetation is open, so that the locusts can bask in the sun on patches of bare soil, than when it is uniformly tall and dense. Too much water may also be bad for the eggs if waterlogging of the soil results. Consequently we find that the preferred sites for oviposition are warm, well drained, and sparsely vegetated.



A swarm of locusts at Bulga, near Singleton, New South Wales.

Photo.—I. Eather.

Although locusts have to avoid uniformly dense pasture, at times they need fair-sized plants, such as large grass tussocks, for shelter from both excessive heat and cold. They also need sufficient plant growth to provide ample food. The eggs do not need either of these things, and so in practice we can distinguish two different habitats in country very favourable to locusts: the *food-shelter* habitat, consisting of tussocky vegetation with bare ground between the tussocks, and the *oviposition* habitat, comprising larger areas of bare ground, with only low, scattered plants. Locusts can become abundant enough to give rise to outbreaks only in types of country where these two kinds of habitat occur in a sort of patchwork, so that the insects can find whichever they require without going far. Areas with such characteristics are called "outbreak areas". When moisture conditions in the outbreak areas are favourable over a sufficient period, our first component of a locust outbreak may be achieved: unusual numbers.

The occurrence of locusts in unusual places during an outbreak is due to *migration*. Locusts have an inherent tendency to migrate, and will do so even when they are by no means abundant, if the weather is hot and dry and they are short of food. However, migration is more evident when the insects are in swarms, and has been studied chiefly under those conditions. Swarms of *Chortoicetes terminifera* may travel hundred of miles, their direction of flight being determined by the predominant direction of hot, strong winds. In practice this means that in south-eastern Australia they move towards the coast. Since the outbreak areas, or foci of origin of the swarms, are mainly located in the inland pastoral country, this means that they invade the wheat belt, which is thus suddenly confronted with a major threat to its crops.

The function of migration appears to be to enable the locusts to tap new sources of food before the supplies at their point of departure become exhausted; this is in agreement with the direction of migration, which is consistently towards regions of higher average rainfall. However, ultimately the insects (or their descendants) enter regions where unfavourably wet conditions commonly prevail, and it is then only a matter of time before they are destroyed by a wet spell.

This brings us to the third characteristic of outbreaks: the occurrence of swarms. A swarm is not just a large group of individuals. It is a group possessing a definite coherence and behaving as a collective unit, like an army unit. It owes these characteristics to the *gregariousness* of the

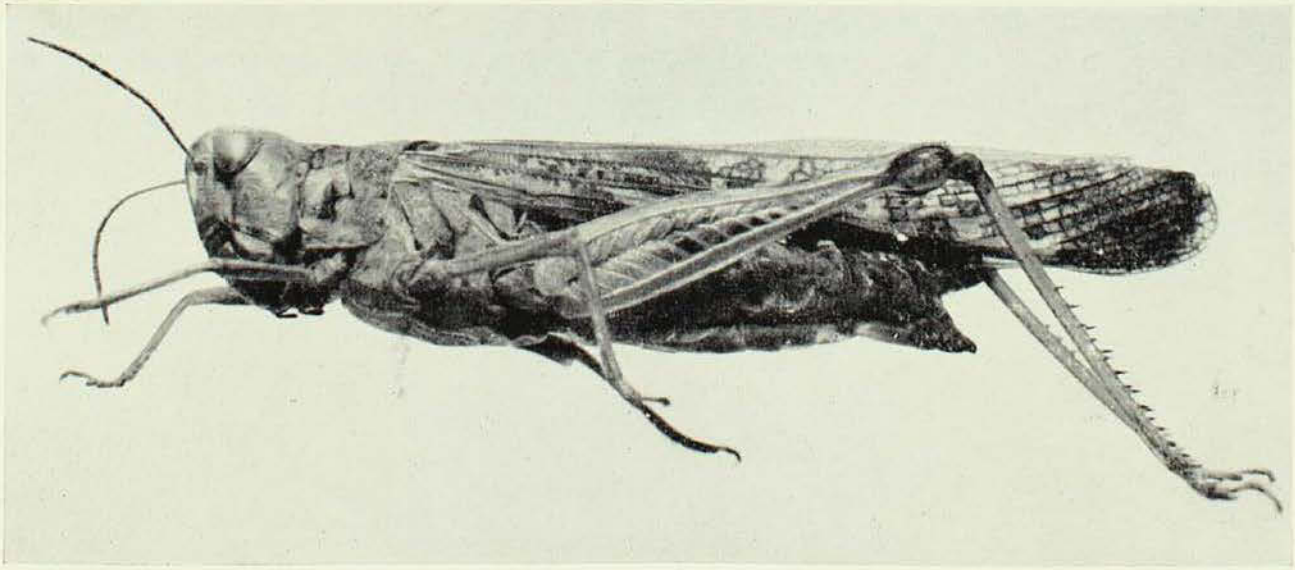
locusts, which leads them to keep close together, to sit and move parallel to one another, and to synchronise their periods of rest and activity, so that the swarm as a whole can be said to have a direction of movement.

However, locusts are not gregarious under all circumstances. In sparse populations they behave quite independently of one another. The gregariousness they exhibit when in swarms has to be acquired. What happens is this. During a period of favourable weather in the outbreak areas the insects increase in numbers. When the favourable period passes, the grass dries out, but it remains green for some time in low-lying areas. The locusts from the surrounding country concentrate in these restricted green " islands ", where they may reach high densities. Forced in this way into frequent contacts with one another, they first become accustomed to each other's company, so to speak, and then come to demand company. Within a couple of weeks they have been transformed from independent, solitary-living creatures to highly gregarious ones.

Hand in hand with this development of gregarious behaviour there goes a remarkable transformation in the colour pattern and bodily proportions of the locusts. Locust hoppers living in isolation may be of different colours, often matching quite closely the colour of the vegetation or exposed soil on which they are living. But in dense swarms they all have an almost identical pattern, which does not resemble the background at all, being largely black, variegated in some species with conspicuous patches of yellow or orange. It is as though a motley group of civilians had donned military ceremonial dress. This swarming " uniform " is largely lost in the adult stage, but the adults have relatively longer wings than their non-swarming fellows.

It is not known precisely how this extraordinary change in pattern is brought about. We do know, however, that an essential element in the process is the constant mutual stimulation—both visual and tactile—that is experienced by every individual locust in a swarm. In some way this sensory stimulation alters the normal hormone balance within the body and this leads to the deposition of new types of pigment in the skin. Even less is known about the function of the pattern change. We cannot suppose that such a striking and complex mechanism can be without meaning in the life of the locust, but none of the theories that have been proposed offers a really satisfactory explanation of it.

K. H. L. KEY is a Principal Research Officer in the Division of Entomology, C.S.I.R.O. Appointed to the Division in 1936, he has carried out investigations on the biology, ecology and taxonomy of the Australian locusts and grasshoppers and published many research contributions in this field.



The Australian Plague Locust (*Chortoicetes terminifera*). This illustration of a female insect is roughly three times natural size.

Photo.—A. Musgrave.

Monarch of the Lakes

By ALLEN KEAST

As mother incubates, father keeps guard near by.

Below: The mother swan is a picture of grace and elegance as she incubates her eggs. *Right:* House-proud, she is ever rearranging the material of the nest.

THIS series of photographs of nesting swans was taken on Longneck Swamp, near Pittown, New South Wales, in June of last year. A pair of birds had built a large nest of rushes and other water-weeds in the centre of the swamp and, as the water-level steadily fell, the nest came to stand higher and higher in relation to its surroundings. The birds' domestic life was carried on in full view of the busy Windsor-Wiseman's Ferry road. Motorists were forever stopping to look at the swans but the birds had stalwart allies in neighbouring farmers and this, combined with the swans' natural ability to defend themselves, made all go well for several weeks. Then it rained, and a great volume of water came down the Hawkesbury River, which burst its banks not far from Pittown. Many acres of farmland were inundated and overnight the farmers lost crops that had been months in preparation. The waters swelled into Longneck Swamp and rose about the swans' nest. For a day the birds worked frenziedly to raise the nest but it was of no avail. Next morning the whole swamp was a lake and the swans could be seen consoling each other in a far-off corner.

Black Swans extend through the southern two-thirds of Australia. They are common in Tasmania and have been introduced to New Zealand. Swamps, lakes and estuaries are their home. During summer and autumn parties of dozens, even hundreds, occur where the food is plentiful. In winter and spring the birds disperse through lagoons and swamps to breed. It is a fine sight to see a formation of swans in flight. They form a perfect "V"; the neck is extended, the flap of the wings is slow and measured and the birds honk periodically as they pass through the air. They prefer to do their travelling just before dusk although undoubtedly much takes place at night.

Australia has the world's only black swan. It created a sensation when stories of it reached Europe. The first explorer to see the Black Swan was a Dutchman, Willem de Vlaming, in January, 1697, and he did so on the river in Western Australia later to bear the name Swan River. There are many references to Black Swans in the diaries of early voyagers, including that of Bass and Flinders who, in Bass Strait in 1798, sailed through a flock of from 300 to 500 birds which, as they were moulting, were unable to fly.

Top: When danger threatens the sitting swan raises herself to her full height.

Centre: Head of female swan; the scarlet bill and eye stand out from the brownish-black feathers. The swan's long neck is used for securing plant food from beneath the water.

Bottom: Mother repels the attacker. The feathers are fluffed up, the wings are extended to show flight feathers, and the bird seems to be twice her normal size. She hisses angrily. When the intruder comes within range she lunges forward at him with her bill.

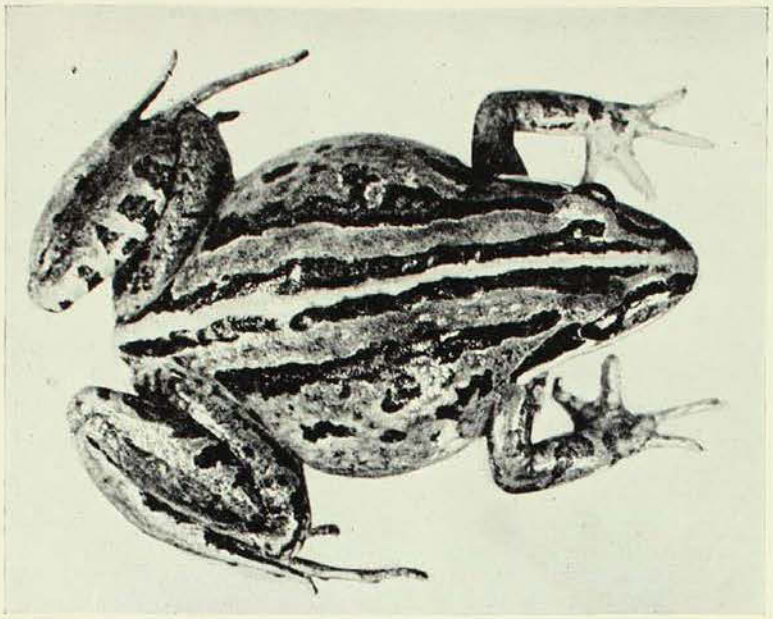


Fig. 1. *Limnodynastes peronii*, "a secretive and solitary species".

Fig. 2. *Limnodynastes tasmaniensis*, "greenish with dark spots on the back".

Frogs of the Sydney Region

By JOHN A. MOORE

Professor of Zoology, Columbia University, and Research Associate, American Museum of Natural History, New York.

THE fauna of Australia is so extraordinary and diverse, and the number of zoologists studying it so few, that even today there are huge gaps in our knowledge of it. These gaps are all the more extensive when one is dealing with a "minor" group, such as the Amphibia.

The frogs of New South Wales, and all of Australia except the northern part, belong to two large families, the Hylidae or tree frogs, and the Leptodactylidae or southern frogs. The tree frogs are abundant in Australia, North America, and South America; elsewhere they are represented by only a few species. The southern frogs are confined primarily to Australia, Africa and South America. The fact that the frogs of Australia are more closely related to species now living in South America and Africa than they are to species living in Asia is a real zoological puzzle. We know that Australia's connection with the other land masses was by way of south-east Asia. How did the tree frogs and southern frogs reach Australia? There are no southern frogs and very few tree frogs in Asia today.

It is probable that more than three-quarters of all species (as defined by our present standards) of Australian frogs have been described. Naturally it is dangerous to give a figure that is based on what we do not know, so this can be little more than a guess! The species of New South Wales and Western Australia are the best known. As we move from these centres, our knowledge becomes less certain. The region from Sydney to Adelaide and from Brisbane to Cairns are two areas from which more observations are badly needed.

Much of what I have referred to as "knowledge" of Australian frogs consists only of descriptions of the animal's appearance. In nearly every case the describer, who had probably never set foot on the Australian continent, had only a dead frog for his studies. There is very little in the literature on the habits or life history of Australia's extraordinary frogs. New South Wales is more fortunate than other States. It had two students of living frogs, Mr. J. J. Fletcher and Professor Launcelot Harrison. Both of these men died many years ago but their writings are treasures to anyone interested in the frogs of the Sydney area.

I was fortunate in being awarded a Fulbright Fellowship several years ago to study Australian frogs. Most of my time in Australia was spent in Sydney. I worked in the Zoology Department of the University and in the " spirit house " of the Australian Museum. At least that is where I was during the day; most of my evenings were spent observing frogs near Killara.

The first few months of my stay were ideal for a herpetologist—it never stopped raining! This was most stimulating for the frogs and it was a rare evening when less than six species could be observed. By extending the area of field investigation one can find about two dozen species in the Sydney area. I should like to introduce you to some of them. Most of the species do not have well-established common names so the scientific names will be used. The southern frogs will be mentioned first.

The most common and widely distributed species is *Crinia signifera*. Its body is about the size of the outermost segment of one's little finger. In coloration it is rather drab, being dark brown or greyish-brown above. In the Sydney area this species has three different colour patterns. The female, which is the larger, is almost uniformly dark in colour. The male has a broad band extending along his back. In the third type the back is pale. These colour differences are not associated with sex.

Crinia signifera seems to breed whenever there is rain. The eggs are deposited in a variety of places, but generally in tiny puddles and small streams. In this species and all others that will be mentioned, there is a typical tadpole stage. Eventually the tadpole develops legs and loses its tail to become a frog. The call of this species is a chirping, " crick-crick-crick " that suggests an insect rather than a frog.

While dealing with diminutives, we should mention another common species, *Pseudophryne australis*. To me this is one of the most charming of all Australian frogs. The body length is usually less than one inch. Most of the back is a rich dark brown but there is a brilliant red patch on the head, at the base of each arm, and a stripe of the same colour along the posterior part of the spine. On the ventral side there is a boldly contrasting pattern of black and white.

Pseudophryne australis is a secretive animal. Even when emitting his harsh call, a nasal " ank-ank " it is generally below ground or in some tiny crack. Its eggs are not laid in water, as is the case with *Crinia signifera*, but in a nest in the wet earth near a tiny puddle or stream.

There is a similar species, *Pseudophryne bibroni*, that might be described as *Pseudophryne australis* without the red markings. The two are also similar in their breeding habits and calls.

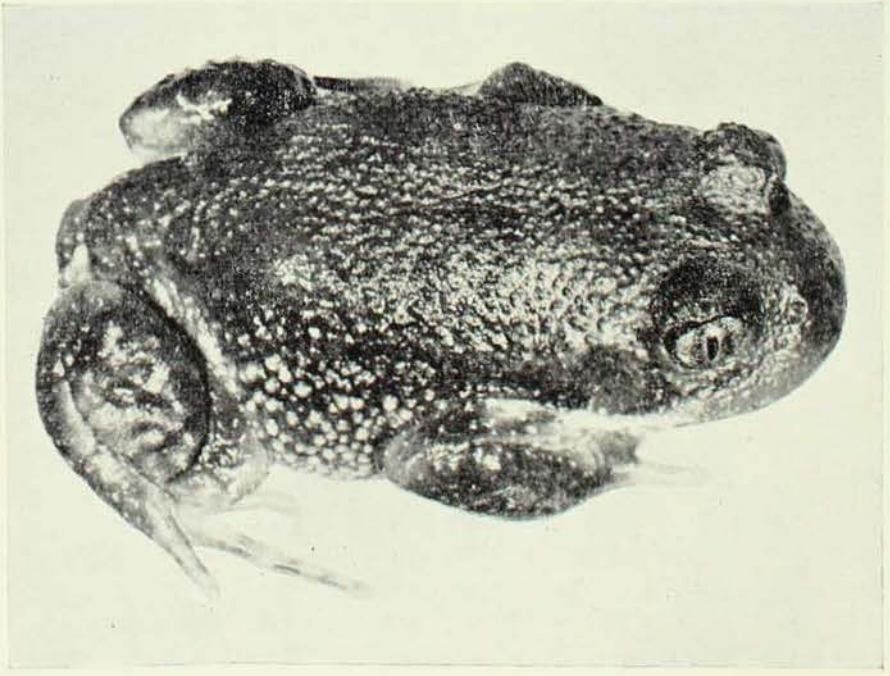
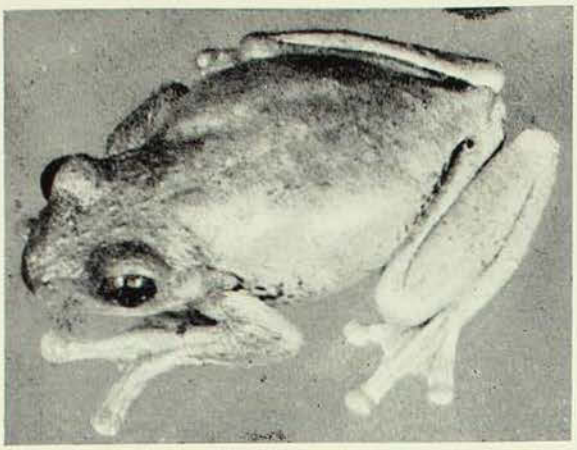


Fig. 3. (*Right*): *Heleioporous australiacus*, " uniformly greyish-brown ". Fig. 4. (*Below*): *Hyla phyllochroa*. Its call is " a loud whirring ' wrk-wrk-wrk ' ".



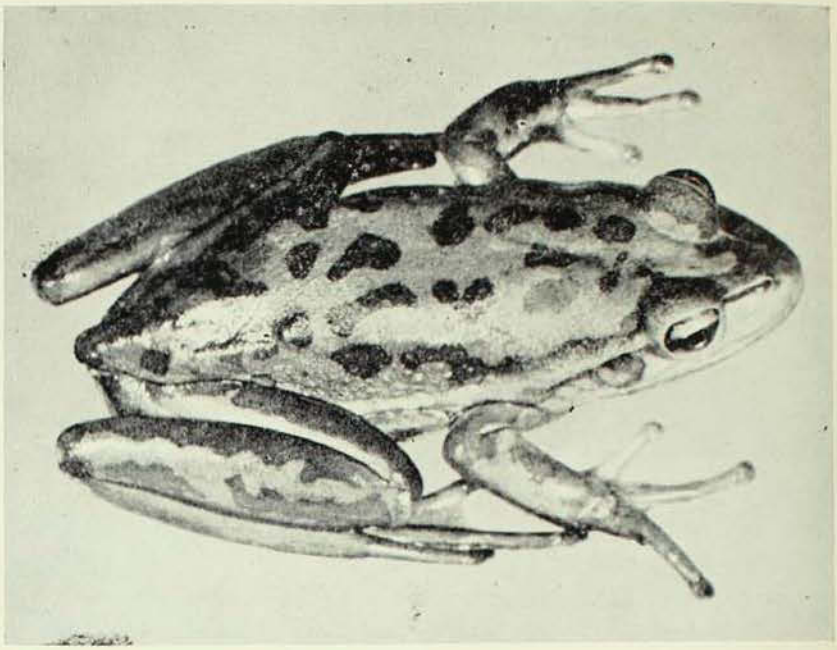


Fig. 5. (*Above*): *Hyla peronii*, "common in the Sydney area". Fig. 6. (*Right*): *Hyla aurea*, "a tree frog that has lost its ability to climb".

Photos.—Author.

There is an interesting relationship between these two species that was pointed out long ago by Professor Harrison. *Pseudophryne bibroni* ranges from Queensland to South Australia. *Pseudophryne australis* occurs near Sydney and nowhere else. Within the Sydney area the two species generally replace one another. *Pseudophryne australis* in characteristic of the sandstone areas and *Pseudophryne bibroni* of the shales. It is unusual for them to occur together but occasionally they are found in the same place, as they are in Killara.

Limnodynastes peronii is one of the largest of the Leptodactylidae found in the Sydney region (body length about 2 inches). It has a striking pattern on the dorsal surface (Fig. 1). Usually there is a white median stripe and on each side lateral to it a dark band, a light band, and finally another dark band. There is also a dark band that extends from the nostril through the eye and back to the arm. Many frogs in different parts of the world, including the common frog of England, have a similar dark band in the eye region.

In spite of its large size, *Limnodynastes peronii* is a secretive and solitary species. When calling, the males are usually hidden under a rock or in a crevice near a puddle or small stream. Their voice has a doomsday ring, being a slow and deep-pitched "toc-toc-toc". The male has an interesting adaptation associated with breeding.

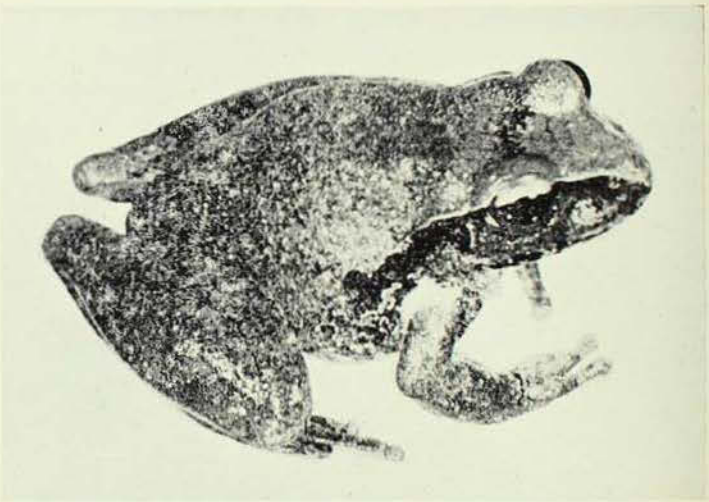


Fig. 7. *Hyla lesueurii*, "can usually be found on wet nights along the sandy shores of the creek that crosses the St. Ives road and flows into Middle Harbour".

The long bone of the thumb protrudes through the skin to form a sharp spine. This enables him to maintain a better grip on the female when mating.

This species, as well as the other members of the genus found near Sydney, lays its eggs in a foam nest that floats on the surface of the water. This is a mass of frothy bubbles that the female makes by whipping a jelly-like secretion from her cloaca with her appendages (probably with her arms, but I have never watched the process). The embryos are embedded in the foam until they reach the tadpole stage. Then they drop into the water below and continue their development.

Limnodynastes tasmaniensis is a smaller species than *Limnodynastes peronii*, having a body length of about one-and-a-half inches. It is a greenish frog with dark spots on the back (Fig. 2). This is not a solitary species like the last. Many occur together in their typical habitat—the grassy borders of ponds and streams. One may see dozens of their foam nests crowded together in the vegetation at the edge of the water. The call sounds like a small boy imitating a machine gun, being a rapid " uk-uk-uk-uk . . . . ". If you are perplexed about the species name, *tasmaniensis*, for a New South Wales frog, the problem is easily answered. Some of the first specimens to reach England and be described were from Tasmania.

A third member of the genus is *Limnodynastes dorsalis*. This is a burrowing species and it comes out at night. It is a greyish frog with warts on the back. The best way to identify it is by the large oval wart that is on each hind leg.

The last of the southern frogs that I will mention is perhaps the strangest of all, *Heleioporus australiacus*. I was aware of its presence at Killara months before I ever saw one. Apparently this frog spends most of its life beneath the surface of the earth. On spring and summer nights I could hear its mournful owl-like call, " hoo-hoo-hoo ". Sounds coming from beneath the earth are difficult to localize and I spent much time trying to dig out one of the creatures. The Killara individuals seemed always to have their burrows in crevices in the sandstone and it would have taken dynamite to get them out. It was not until they emerged to breed that I finally caught one.

This frog is uniformly greyish-brown (Fig. 3). It resembles *Limnodynastes dorsalis* but lacks the large oval warts on hind legs that characterize that species. The body is about three inches in length. The male has very large nuptial spines on his thumbs. The pupil is a vertical slit.

The geographic distribution of *Heleioporous australiacus* is puzzling. In eastern Australia it occurs only in the neighbourhood of Sydney but frogs that seem to be identical are found in a small area in south-west Australia. When the relationship of these eastern and western forms are better known, we should have some interesting facts to weave into theories on the evolution of species.

The remaining species that will be mentioned are Hylidae or tree frogs. The typical species have pads on their fingers and toes Figs. 4, 5 and cover illustration) and are quite adept at holding on to trees and even to vertical walls. On the other hand some of the Australian species have their pads much reduced and they never climb (Fig 6).

Next to *Crinia signifera*, *Hyla ewingii* was the most abundant frog at Killara. On rainy evenings its joyous, whirring, " read-read-read " repeated 9 to 14 times could be heard in the bush and gardens. The adults are about an inch in body length. The dorsal surface is brownish and there is a darker patch in the centre of the back that begins at the level of the eyes and extends to the hind end of the body.

Another common species and one that behaves more like a typical tree frog is *Hyla phyllochroa*. It was usually found sitting on leaves near streams. The dorsal surface is a beautiful leaf green and there is a narrow golden line that extends from the nose, through the eye and back along the side of the body to a point just behind the arms (Fig. 4). The body length is about one inch. The call is a loud whirring " wrk-wrk-wrk ".

Along the sandy shores of the creek that crosses the St. Ives road and flows into Middle Harbour one can usually find *Hyla lesueurii* on wet nights. This is larger than the two hylas already mentioned, the body being about two inches in length (Fig 7). The males are much smaller than the females. The colour above is a uniform dark brown. A black stripe extends from the nose through the eye and back along the body. The call is a soft, purring " gr-i-i-i-i-ch ", that lasts two or three seconds. It is so gentle that I could not hear it when more than ten feet from the males.

Hyla peronii was not encountered in Killara though it is common in the Sydney area. It is a friendly animal that is grey in colour (Fig. 5). The iris, which is

golden, is divided by a black cross. The body is two inches or more in length. The call is a prolonged and whirring " wr-wr-wr-wr " that becomes higher in pitch and slower in tempo as the end is approached.

When one is describing a number of Australian tree frogs the supply of superlatives is exhausted quickly. This is regrettable when one finally reaches *Hyla aurea*. Figure 6 probably conveys the impression of an attractive animal but of course there is no evidence of colour. In the living animal the background colour is leaf green and the spots are golden. It is a most handsome species. The body is about three inches long.

Hyla aurea is a tree frog that has lost its ability to climb. The finger and toe pads are much reduced compared with those of a typical climber such as *Hyla peronii* (Fig. 5). The adults frequent the grassy edges of streams, marshes, and lakes. The call reminded me of a banjo string being plucked, " bonk-bonk ".

One might expect from its name that *Hyla caerulea* (see cover) would be a blue frog. The living animal, however, is leaf-green above. The name is based on the colour of the preserved animal. If *Hyla caerulea* is placed in alcohol it does becomes blue, so we must forgive the describer, who had only the preserved specimen at his disposal. This is one of the largest Australian frogs, the body being three inches or more in length. The call is a harsh " crawk, crawk, crawk " repeated slowly.

Many of the frogs found near Sydney are restricted to the wetter areas of Australia. This is not the case with *Hyla caerulea*. It has a wide distribution throughout the continent and it is found around waterholes in areas that are decidedly dry.

It might also be mentioned that *Hyla caerulea*, as well as many other species, is capable of considerable colour change. An individual that is pale green at one time may be dark brown a few minutes later. The difference is due to the degree of expansion or contraction of the pigment cells in the skin.

The thirteen frogs that have been mentioned in this article are the most common and distinctive ones of the Sydney area. There are additional species not mentioned that are equally interesting. Little is known of the life-history and habits of any. Perhaps these few remarks will enable the reader to identify some of the familiar species and to learn something of their lives and habits.

MUSEUM PREPARATORS in conference at the Australian Museum last May. At the head of the table are Mr. F. R. Morrison (Director, Museum of Applied Arts and Sciences, Sydney), Dr. J. W. Evans (Director, Australian Museum), and (standing) Mr. H. K. Coughlan (Secretary, Australian National Advisory Committee for UNESCO).

The three-day conference was held under the auspices of the UNESCO Committee for Museums. Eleven museums in six Australian States and the Capital Territory were represented. Speakers included Mr. Paul Lawson (Preparator, South Australian Museum) who described techniques which he had studied recently in a number of American institutions; Mr. G. Sebestyen (N.S.W. Department of Public Works) who spoke on "Lighting Applied to Museums and Art Galleries"; and Mr. S. G. Bishop (East Sydney Technical College) whose subject was "Design and Display".

Whence Australia's Mantle of Green?

By EDMUND D. GILL
Curator of Fossils, National Museum of Victoria

AUSTRALIA is often characterized as a broad flat land of very ancient rocks, an ageless continent which carries a fauna and flora that are " living fossils ". Australia has been called the oldest country in the world, and the impression given that its plants and animals have a vast antiquity too. It is true that Australia has a core of the most ancient rocks, but it cannot be said that it is earth's oldest land because other continents possess rocks that are just as old. And when we inquire into the story of Australia's characteristic eucalypt and wattle trees, we discover that this flora is not as ancient as is commonly supposed, for Australia's present mantle of green is a modern one. From the point of view of the history of the earth, the story is short, like that of man himself.

When Australia was a Fernery

In tracing the origin of our present flora, let us start back in the time of the dinosaurs—those huge reptiles so fantastic that one museum visitor thought they were just creations in plaster of Paris, invented by curators of fossils! In those ancient times the reptile was king of the beasts. He was not much of a king, being as stupid as a lizard and more ungainly than an ox. Yet he was king in that he was the supreme animal. There were no mammals then, much less man.

The dinosaurs fed on the plant life of the time, or on each other. The vegetation, like the animal life, was comparatively primitive. There were no angiosperms, that is, flowering plants, so no bees. Ferns and mosses, horsetails and cycads, characterized the landscape. Some of the tree-like forms were giant club-mosses. Conifers were present, but it was only at the end of the reptile era that they came to be of importance.

Eucalypts are characteristic of Australia's " mantle of green ".

Photo.—Author.

A characteristic plant of that time has survived to our day but was on the verge of extinction until widely cultivated by nurserymen. Now available in our shops, it is called the Maidenhair Tree (*Ginkgo* by the botanists), and is probably the world's oldest living kind of tree.

Earth Changed her Mantle of Green

Then came an epoch-making change, for the fern-like forest of dinosaur days was displaced by the types of trees and plants we know today. Earth changed her mantle of green. The angiosperms came into prominence, with conifers occupying an important place in many landscapes. Thus it was that when the Cainozoic or modern era of plants began about 70 million years ago (as measured by the uranium " clock " of the geologists), the flora of Australia was recognizable, contrasting with the earlier floras that looked as though they belonged to some other planet.

Australia's vegetation in Permian times looked like "something from another planet".

Reconstruction by author; painted by Vern Hayles; by courtesy Colorgravure Publications.

In the earlier part of this era, the brown coal deposits of Australia were laid down. They are famous as containing the thickest known seams in the world of this valuable fuel. At Yallourn, in Victoria, the brown coal is made up to a large extent of the conifers that massed in the swamp land of the great basin in which the brown coal was formed, but the pollen content of the coal shows that the slopes round about were clothed with great beech forests. So thick was the cloud of pollen from these beech trees that at times it formed pollen coal. The climate was warmer and wetter than it is at present.

EARTH'S NEW FEATURE—THE GRASSY PLAINS

In the middle of the Cainozoic era, a new feature developed on the earth as a result of a vegetational change. The grasses came into prominence, and wide areas of the earth that formerly were covered with scattered herbaceous plants now became great open plains—the prairies of North America, the veldt of Africa, and the steppes of Eurasia. The grasses provided a wealth of food. As these plants contain numerous small masses of silica they caused wear on the teeth of animals feeding on them. Also the grasses made the ground firm. There was continuous hard ground instead of patches of herbaceous plants with soft ground between.

For this new niche of nature there evolved new animals suited to this special environment. In the Northern Hemisphere a group of small browsing animals gradually developed to take advantage of these wide open spaces, and their fossils preserved in the rocks tell the whole wonderful story. From being browsers, they changed into grazers that lived on the grasses. They gradually developed longer teeth able to stand the wear caused by the hard grasses.

In the wide open spaces there was plenty of room and they developed as a group into larger animals. To suit the hard plains they developed hooves, and legs specially built for speed. They ran on their toes, and the muscles were bunched at the top of the leg. These animals we call horses, and man has made much use of them for both work and pleasure.

KANGAROOS ARE AUSTRALIA'S "HORSES"

Grassy plains developed in Australia as in other parts of the world, but there were no placental mammals here that could take advantage of this new ecological setting.

Australia had been cut off from other continents for so long that marsupials were the only mammals present. So it was marsupials which took advantage of the ecological niche that the horses filled in the northern hemisphere. The kangaroos were the "horses" that occupied the grassy plains of Australia. They did not run but hopped, yet nevertheless were in the same way fast-moving animals. They grew to large sizes too, for some of the Miocene kangaroos were larger than the living ones, and the Ice Age 'roos were the biggest of all. Their teeth were accommodated to the rasping grass diet by a lengthening of the cusps, so that they did not wear out, leaving the owner to die of malnutrition. They did not develop hooves like horses, of course, but they did develop, from the five-toed foot, the powerful three-toed foot of the kangaroo. At the same time there evolved the balancing tail.

THE ICE-AGE BROUGHT EUCALYPTS TO THE FORE

There have been many records of fossil *Eucalyptus* leaves from early Cainozoic sediments, but these are now somewhat suspect. Pollen analysis fails to provide evidence of the presence at this early time of *Eucalyptus* and *Acacia*, our characteristic gum and wattle. It is quite possible that their forerunners were there, but playing no conspicuous part in the landscape. The forests of those times looked more like the present forests of New Zealand or New Guinea, than like the forests we see. In New Zealand and Tasmania there are living today many of the genera of trees that contributed to making up the brown coal of Yallourn.

It was not till the Pleistocene, or recent Ice Age, which began only a million years ago, that Australia came to possess *Eucalyptus-Acacia* forests. The change of climate that took place then seems to have given the eucalypt and wattle their chance, and suddenly they came into great prominence, giving Australia its characteristic flora.

The period before the Ice Age was the Pliocene, and it was not till then that *Acacia* is known in the geological record, and it is not till then that we have *Eucalyptus* as we know it today. Near Hamilton, in Victoria, an ancient forest of Upper Pliocene age has been fossilized beneath a thick basalt flow. In places, moulds of the trees can be found in the solidified lava. A tree in position of growth has been analyzed for its wood structure and proved to

Queensland Kauri (*Agathis*). This genus was common in southern Australia in Tertiary times.

Photo.—Author.

be a *Phyllocladus* or Celery Top Pine such as still lives in Tasmania. Analysis of a pond deposit for pollen showed that there was a mixed forest consisting of roughly half the older conifer forest of brown coal times and half of the eucalypt and wattle forest that we know today. This was the time when the change-over was occurring from the old-type forest to that we know today. In the fossil soil under the basalt there was found, too, the tooth of a cuscus, an animal which is now found only in Cape York and New Guinea.

AUSTRALIA'S CHARACTERISTIC TREES

Earth, once lifeless and bare, has now a mantle of green on every continent except Antarctica. Australia's mantle is quite different from that of any other continent. It is characteristic of our long isolated land, but for all that it is new. Australia has had a number of mantles of green in ages past and we know of them from the evidence of fossilised plants, but our cherished eucalypt and wattle species are not ancient plants, but among the latest products of plant evolution.

Nature Quiz

Q.: What are some well known cases where the popular name "worm" is incorrectly applied?

A.: Three common examples come readily to mind and are concerned with animals as widely apart as reptiles, molluscs and insects. The name "Slow-worm", for instance, has come to be used in Australia for a harmless kind of snake-like reptile, probably through its superficial resemblance to a certain legless lizard known in England by the same name.

There are many kinds of so-called slow-worms in Australia (family Typhlopidae). They reach an average length of 10 to 12 inches and the largest kinds may be 30 inches long. The body is always pinkish in colour, very shiny, and covered with minute scales. These reptiles lead a comparatively sluggish life, hiding away from light deep in the leaf mould and loose earth of forest floors and in the earth nests of ants and termites, where their insect food is found. Associated with their mode of life is degeneration of the eyes which probably can do little more than distinguish light from darkness. This has given rise to the alternative name of Blind Snake.

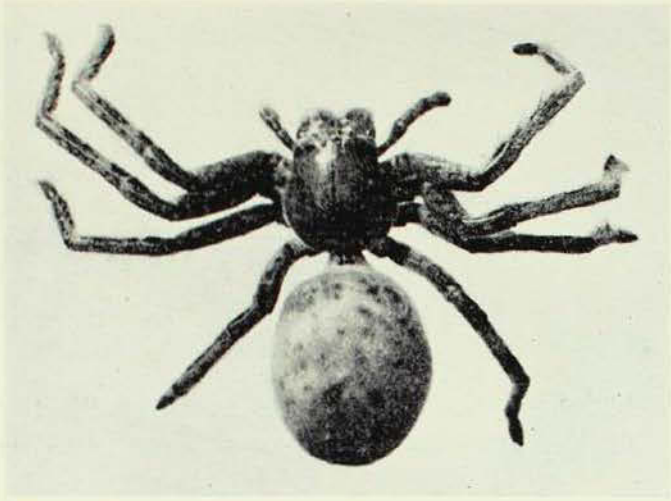
The deceptive popular name of "Shipworm" is one in world-wide use. For centuries it has been incorrectly applied to certain elongate kinds of destructive timber-boring molluscs (shellfish). Every sea has its quota of these well known pests, and through the ages man has had to combat their ravages in the hulls of ships, the timbers of dykes and all sorts of harbour installations where wood is used. They all possess bodies which are certainly worm-like in form, but proof of their relationship with molluscs is seen at the head or mouth end which is enclosed between two well formed shelly valves. It is more appropriate to call these destructive borers *Teredo*, a technical name only occasionally used in the popular sense. This at least places them in correct classification as members of the molluscan family Teredinidae, even if all do not fall into the restricted compass of the generic name.

The third case of mis-application of the term "worm" concerns the so-called Glow-worms. As with Shipworms, this is another instance of an old world name being used for counterparts in the Australian region. In Europe many female members of a family of small beetles (Lampyridae) and sometimes also the larvae, are popularly referred to as glow-worms because of the lumineseent glow they emit. The specialised females, while fully mature, are wingless, retaining throughout their life-span a grub-like state (larviform). Representatives of the same family are also found in Australia, but here they are known as Fireflies. The reason is that both males and females commonly emit tiny flashes of light while flying. Only one record of a luminous larva of a lampyrid beetle has been noted so far in Australia (ref. this MAGAZINE xii (2) p. 67).

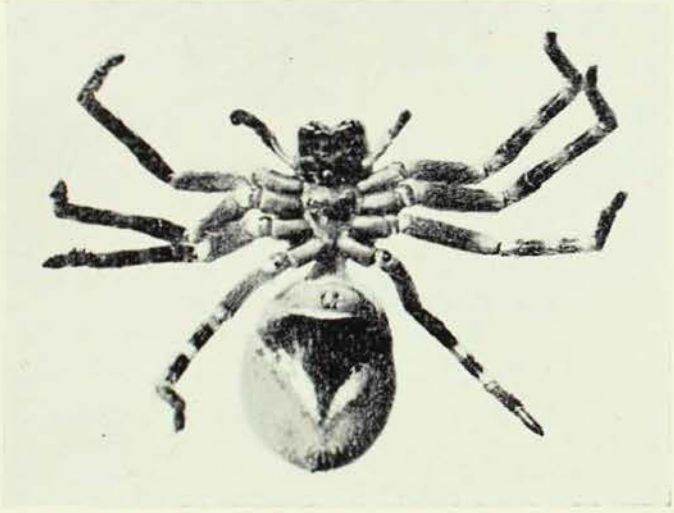
While the so-called glow-worms of Australia and New Zealand are also insects, they belong to a totally different group called Fungus Gnats or Shade Midges (family Mycetophilidae). A New Zealand species is famed for the display it makes in Waitomo Caves. There, and in other caves in New Zealand, the larvae emit bright light as they cling, or move actively about. Closely related Australian species provide similar displays of light where suitable conditions exist in caves or under overhanging earth banks along the sides of streams.

Some Huntsmen Spiders

By A. MUSGRAVE



Olios calligaster. Upper surface of female specimen from Jugiong, near Gundagai, New South Wales.



On the under-surface of the abdomen the female of *Olios calligaster* has an orange stripe on either side of a black field.

Isopeda vasta, L. Koch. A female specimen from Mittagong, New South Wales.

IN many Australian homes from time to time, and very often before or during rainy weather, large, hairy, flat-bodied, long-legged spiders may be seen to move sideways over the walls. If disturbed they may take refuge behind curtains, pictures, picture rails, or in ventilators. These are among the largest of our spiders, and are popularly termed huntsman spiders, giant crab-spiders, and " trantelopes ". This last cognomen is of Australian origin and has been in use for many years.

In a review of this group of spiders H. R. Hogg states:

> The members of this group are abundant in all tropical and subtropical countries. Their large size and hairy appearance enable them to inspire a sentiment of fear out of all proportion to their really timid nature and defenceless character. This has no doubt acted as a means of protection to them. Living originally about the trunks and under the loose bark of trees, they have adapted themselves readily to the shelter afforded by the houses of mankind, and find a congenial habitat under the eaves of most dwelling houses. In fact, wherever an undisturbed dry and darkish receptacle is available they are sure to be discovered, and where allowed to settle prove valuable assistants in keeping down the numbers of the house-flies —the pest of all hot countries.

Huntsman spiders constitute the family Sparassidae. These spiders have the first two pairs of legs longer than the two hinder pairs, an arrangement known as *laterigrade* and one which enables the spider to move sideways. The eye formula is 4-4, *i.e.*, the eight eyes are arranged in two rows of 4 eyes each. The tarsi, or last joints of the legs, are provided with a scopula or pad of short hairs, and the

metatarsus has a soft membrane at the end. The females may often be found under loose bark on gum trees, mounting guard over their white cushion-shaped egg sacs. No less than 97 species are known from Australia, 29 being from New South Wales, of which 23 occur about Sydney.

These species are grouped in a number of genera of which the largest in point of species is the genus *Isopeda* with 37 species, *Olios* containing 22 species, and *Heteropoda*, 9 species.

The size and disposition of the eyes are important in the classification of the family. Thus in the genus *Isopeda* the eyes of the straight or slightly procurved front row are all equal in size, though the lateral eyes may be slightly larger than the median eyes; the rear row resembles the front row but the rear middle eyes are always smaller than the others. The name "Isopeda" means equal legs, but this, we have seen, must be a misnomer for a member of a family in which the front two pairs of legs are unlike the other pairs in length.

Some of the huntsman spiders likely to be encountered in the Sydney district are considered below.

Perhaps the largest, and one of the species most commonly encountered, is *Isopeda immanis* (L. Koch), which occurs also in Queensland and Victoria. It is easily recognised by the black and white-banded legs, and by the dark-brown or black line extending down the centre of the abdomen.

Another rather large member of the genus *Isopeda*, and one which is frequently submitted to the Museum for identification, is *I. vasta* L. Koch, which has the sternum (the area between the bases of the legs) a deep black, a black transverse band on the underside of the abdomen behind the genital fold, while the mandibles in front are bare (covered with hairs in other species of *Isopeda*). This spider occurs in Queensland as well as in New South Wales.

The spiders of the genus *Olios* are smaller in size and not so compressed as those of *Isopeda*. The coloration and patterns are often "vividly bright and varied", particularly those on the underside of the abdomen. Among those forms most often submitted to the Museum are: *Olios diana* L. Koch, *O. calligaster* Thorell, and *O. punctata* L. Koch. In the two first-named species the eyes of the front row are of equal size and equidistant from one another.

In *Olios diana* there is a black field on the underside of the abdomen with two white stripes inside the black field. This spider is said to be widely distributed over the whole of the southern half of Australia.

Olios calligaster is the member of the genus most commonly met with and it has a wide range from Queensland to Western Australia. This spider has a black field on the underside of the abdomen and it extends two-thirds down the length of the abdomen which, in the male, is devoid of any ornamentation; in the female the abdomen has orange stripes, one on either side, which merge at the bottom of the field. White spots are conspicuous on the legs, blue spots on the under-surface of the patellae and two yellow areas separated by black patches are present on the underside of the tibiae of all the legs.

Olios punctata occurs in Queensland, New South Wales, and central Australia. In this species the front middle eyes are farther from the side eyes than from one another. This huntsman spider also has the black field reaching only two-thirds of the distance to the end of the abdomen and the black field is bordered by two white lines.

In the genus *Heteropoda* we have amongst the nine species *H. venatoria* Linnaeus,[1] which has a wide range in tropical and subtropical countries, its distribution being attributed partly to the Trade winds which carry spiderlings far afield, and to ships, in which adult spiders hide. In England this spider is popularly termed the Banana Spider as it enters that country in bunches of bananas from the West Indies.

1. This MAGAZINE, 1950, X (4), p. 121.

Bites.—Despite the ubiquity of huntsman spiders, records of bites are few in number for Australia. In an earlier article[2] a male example of *Olios calligaster* was recorded as biting a boy, while a specimen of *O. punctatus* was reported biting a woman on the hand through a glove. Since that article appeared a male specimen of *O. diana* has been submitted to the Museum as having bitten a woman on the finger while gardening. In this case no symptoms developed. It would appear that some of these huntsman spiders have the power to inject a venom sufficiently toxic to cause local pain and swelling, though it is questionable if fatal cases would ever result from bites of any of our Australian representatives.

2. This MAGAZINE, 1949, IX (12), p. 417.

Book Reviews

BIRDS OF NEW GUINEA: By Tom Iredale. Georgian House, Melbourne; (an Australiana Society publication). 2 vols. pp. 1-230 and 1-261. Illustrated by Lilian Medland (35 colour plates figuring 347 birds). Price £25/4/–.

Ornithological knowledge of an area develops by a series of stages. First comes the "exploratory" era when collections of specimens are made, when expeditions roam far into virgin country in search of new species, and scientists study and describe new forms. Somewhat later a book is written that figures the various species in colour, tells how they may be identified and where they occur. Only then can the keen field worker identify the species he sees. This provides a real impetus to carry out work on the birds and knowledge of ecology, nests and eggs, behaviour and seasonal movements can develop at an ever increasing rate. Ideally this stage should be followed by inexpensive field-books that bring "bird-watching" within the reach of all. This enables the natural appetite of the layman for knowledge of the birds about him to be gratified.

Thanks to the publication of Tom Iredale's *Birds of New Guinea* the ornithology of that island can now be said to have reached "stage 2;" accordingly its publication is a major landmark. Three hundred and forty-seven forms are figured in colour, or slightly more than half the 650-odd species occuring on the island. The figures and text combined will, however, enable the field observer to identify the bulk of the species. The plates are magnificient, the individual figures being large and showing abundant detail. The text, despite its accent on identification and distribution, is written in a refreshing and breezy style and abounds in fascinating information. In an engaging manner the author transmits his enthusiasm through the pages and succeeds in creating the atmosphere of looking through a window into a scientific wonderland, a vast new unexplored region. This is just the approach needed to inspire interest and Mr. Iredale is to be congratulated on his successful achievement.

A.K.

THE SNAKES OF AUSTRALIA: By J. R. Kinghorn. Angus and Robertson, Sydney, 1956. 197 pages; illustrated by Ethel King and the author; photographs by R. Mackay. Price £1/5/–.

This is the second edition of the well-known work published in 1929 and its reappearance in bookshops is most welcome. The size and format of the book have been materially improved, recent taxonomic changes have been incorporated, and the section on the treatment of snake-bite includes the more recent findings in this field.

The Snakes of Australia will prove of great interest to amateur and specialist alike. In an introductory chapter attention is given to aspects of the life of snakes in which the author, during his long association with the Australian Museum, found the public to be the most interested. Thus, we find sections devoted to the senses of snakes, locomotion, venom, fighting, reproduction, the largest snake, hibernation, hissing and the production of noise, aboriginal myths, and "tall" snake stories. Anyone wishing to name snakes will find this book an all-important companion. There are identification keys and the different species are illustrated with coloured plates. Species are individually described and the distribution and habits of each are summarized.

A.K.

A Primitive Ornithology

By RALPH BULMER

THE waving line of bird of paradise plumes in the headdresses of the dancers in a New Guinea "sing-sing" is an immediate clue to the importance of the bird life of the island to the native peoples. One of the things my wife and I were interested in when we set out to spend a year doing anthropological fieldwork in the Central Highlands was the extent and accuracy of native knowledge of natural history and especially of birds. We knew that the Highlanders set great value on plumes, that important men could be distinguished on ceremonial occasions above the rank and file by the splendour of their headdresses, that in some places birds of paradise were an obligatory part of the bride-wealth handed over by the groom's to the bride's family at time of marriage, and that through almost all the area plumes were a most important item in native trade. We had also heard glowing reports of the skill and knowledge of native assistants used by zoological collecting expeditions in these parts, so the topic seemed a promising one.

The decision that we were to work among the Kyaka (Eastern Enga) people on the northern slopes of the Mount Hagen range was taken on anthropological and not ornithological grounds. However, it is doubtful if we could have hit upon a richer and more interesting area ornithologically in the whole of Central New Guinea. Our camp was at 5,000 ft. above sea level in fertile and densely populated country in which almost all the climax vegetation had been replaced by native gardens, fallowing land under grass and self-propagating secondary bush of up to fifteen years standing, and a variety of cultivated trees including, notably, casuarinas. It is a very beautiful landscape. Three hours walk south from our camp took one to the forest edge at 6,000 ft., and a day's walk from there would take one by a tortuous and slippery track through the moss forest and up on to the open crest of Mount Hagen, above the tree-line at about 12,000 ft. An easy day's walk north from our camp took one down to the lowland forest, with its lawyer canes, stinging plants and noxious insect life, at the junction of the Baiyer and the Lai rivers at 2,000 ft. Half a day's walk east took one over the Baiyer Valley grasslands, now used by the Administration for experimental cattle breeding, and over the Baiyer River (the eastern boundary of the Kyaka people) into mid-mountain forest which stretches continuously from 3,000 to 6,000 ft. and gives one some idea of what Kyaka territory must have been like before its inhabitants destroyed their forests at these altitudes. This variation of altitude and vegetation within such a narrow compass provides a marvellously rich and varied bird fauna. I personally recorded over 150 species in this area, including seventeen birds of paradise, but it is probable that an exhaustive survey would reveal twice that number.

The author's tame Giant Frogmouth (*Podargus papuensis*). The frogmouth is a common bird in the Highlands of New Guinea.

Photo.—D. Vaughan.

The Kyaka express their interest in this remarkable fauna in two main ways. They eat it: and, as we have seen, they use it for personal adornment. No bird is too small for the Kyaka to consider as food: with the minor exception of two common garden birds, the Willie Wagtail and the Black Chat (*Saxicolla capratta*), avoided for superstitious reasons, everything from a full-grown cassowary to the half-fledged chicks of the Black Fairy Wren or the tiny

Myzomela honeyeaters is eaten with relish. Eggs of all sizes are also welcome food, though nests are most often left undisturbed so that young birds may be taken later. However, one must remember that the Kyaka are above all gardeners and pig-keepers living, for a primitive, recently stone-age, people, very prosperously as a result of their agriculture and especially of their sweet potato cultivation, so that wild birds and animals are only a much appreciated luxury in their diet and in no sense a staple food.

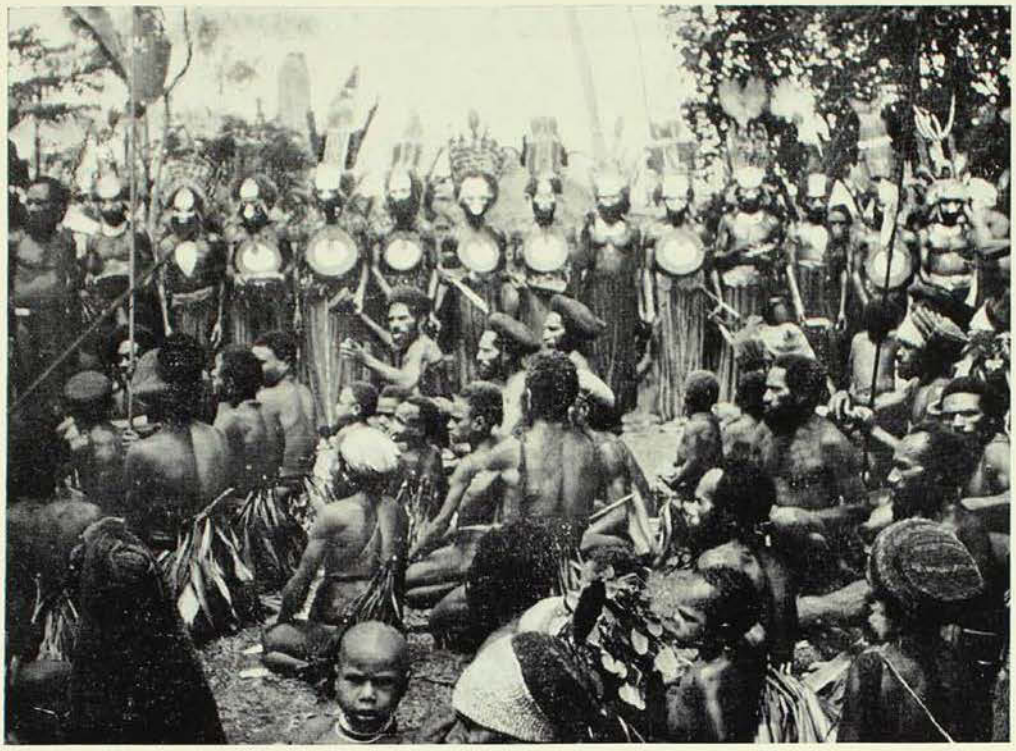
The feathers of any bird captured may be stuck into the hair as temporary personal adornment. Those of about forty or fifty species are systematically preserved. These include all the showy birds of paradise (there are some relatively dull ones too), most parrots, hawks, pittas, hornbills, dollar-birds, nightjars, owls, and several pigeons. A Red or Yellow Bird of Paradise or a headdress of eagle plumes may be worth an axe, or nowadays a pound. At the other end of the scale the wings of a small lorikeet or dove may change hands for a box of matches or its equivalent.

There are only two wild birds which are regularly domesticated by the Kyaka. Clans bordering the forest capture cassowary chicks and keep these around the homesteads, penning them in cassowary-coops when they are old enough to be dangerous and difficult to control. Eventually they find their way into the ceremonial exchange festivals, where they are greatly prized, being equivalent to large pigs, and after changing hands anything up to a dozen times or more and travelling as much as fifty miles, they are killed and eaten. Little is wasted when the meat has gone. Feathers are made into headdresses, quills into nose-ornaments, bones into knives, and claws into spear-tips.

Occasionally white cockatoos are kept as pets. They are fed on sweet potato and other household scraps and seem to flourish, though they are generally let fly free so that they can also forage for themselves. A tame bird in good condition is worth a steel axe.

Birds are also important to the Kyaka in less material ways. Some are associated with the ghosts of the dead, who are all-important in traditional Kyaka religion. The big *Harpyopsis* eagle is identified with the ghosts, and its plumes are valued above those of any bird of paradise. When one is captured it is not killed but is left pinioned until it dies slowly of starvation and its wounds. The bird is propped up on a wooden frame and pigs are paraded before it. It is anxiously watched to see if it will nod its head as an indication that the number of pigs displayed is sufficient as a sacrifice to the ghosts who have given it up to its captors. One eagle was taken by the men of the clan we were staying with, and I offered a goldlip shell and an axe for it, each worth a year-old pig or a month's wages, but was refused. Some birds are evil portents. There is a big owl which is believed to be sent by the ghosts and is taken as an omen of death for anyone who sees it. To walk under a tree at night and hear a Black Chat call from the branches is also ominous. Other birds are magically important. I was delighted to hear in a spell to cure sickness a reference to the Ribbon-tail Bird of Paradise hanging upside-down as it feeds on the fruit of the forest—which is precisely what I had seen this bird do, but had never read about in any book. Birds are often the chief characters in the rather hair-raising fairy stories which children are told at night. The four most popular are the eagle, the white cockatoo, and two striking and sprightly little birds, the Red and Black Flycatcher (*Peltops montanus*) and the little Water-flycatcher (*Monachella muelleriana*).

I recorded over 140 bird names used by the Kyaka, including about a dozen which were agreed synonyms, and there are doubtless many more, though I don't think I missed many in frequent use. The average man in the clan with which we lived, which had territory in the agriculturally cleared zone with no direct access to forest, would probably have upwards of a hundred bird names in his vocabulary. However, this is a very different matter from saying that he could identify with any certainty a hundred different species of birds, or even half that number, though he would seldom be at a loss to apply a name, or even a



Kyaka dancers "warming up" at the early stages of a ceremonial dance. Only men of some importance dance; others loan their plumes and come as spectators. Several dancers wear *Harypo-sis* eagle plumes.

Photo.—Author.

series of alternative names, to any bird he saw or that I could show him in my bird books and illustrated magazines. The Rosella on the jam-tin was always identified by the audience watching our meal as a "wulyakili"—a Palm Lorikeet.

It is true that some men and boys were very much more useful informants than others, both in identifying birds and in giving information about their habits. Women and girls were generally of very little use, though one girl of twelve became an expert at finding bower-bird (*Chlamydera lauterbachi*) bowers and nests, which I was particularly interested in, in the fallowing gardens. Nevertheless, I was surprised and at first disappointed to find how inconsistent even my best informants were in their identifications, if one systematically tested them.

Even allowing for occasional errors of identification, a suprisingly small number of bird names (only about sixty out of the hundred-and-forty) were applied consistently and exclusively to a single species or to two or more related species. About forty Kyaka names probably do apply exclusively to single species. In most of the other twenty or so cases of names which are unambiguously applied, the Kyaka lump together, often consciously, species which the ornithologist would agree to be related —as for example the Sacred Kingfisher, Macleay's Kingfisher and the Saw-billed Kingfisher, or the various species of green fruit pigeon (*Ptilinopus*); but occasionally generically unrelated birds go by the same name, as for example the little Water-fly-catcher (*Monachella*) and the New Guinea Magpie-lark (*Pomareopsis*), both of which are black and white and are found by water-courses, or the Friar-bird and the Oriel, birds markedly dissimilar in appearance but of roughly the same size, both frequenting tree-tops in native garden areas, and each having a noisy call-note.

Birds handled by the Kyaka terminology in a scientifically satisfactory manner include most of the birds of paradise (or at least adult males of these species), parrots and other brightly plumed birds whose feathers are valued, and for which, incidentally, a sort of primitive "reference collection" is provided by the communal display at the time of the ceremonial dancing; most of the common birds of any size which are found near the settlements and can thus be regularly observed and regularly eaten (cuckoo-doves, fruit-pigeons, larger honey-eaters, cuckoo-shrikes, etc.); and a few smaller birds which are both common and of distinctive appearance, such as the Willie Wagtail, the Black Chat (*Saxicolla*

capratta), the Red and Black Flycatcher (*Peltops*), the Grass Warbler (*Megalurus timoriensis*), the Black Fairy Wren (*Malurus alboscapulatus*) and the little grass-finch (*Lonchura spectabilis*). The dull-plumaged female and juvenile birds of paradise of different species tend, not unreasonably, to get confused, and there is in fact a special term for the females and juveniles of the two *Astrapia* species (the Ribbon-tail and Stephanie's Birds of Paradise), and another omnibus term which can be used for the females and juveniles of several of the smaller species—the Superb, the Six-plumed, the Saxony, etc., though these are also often referred to by the same names as the plumed males, but with an adjective meaning " plumeless " attached.

Excluding about twenty bird names which I only heard used on one or two occasions, there remained another fifty which were used with varying degrees of confusion—at least by my standards—including about thirty in common everyday use. One or two were general blanket terms which I myself found very useful in labelling unidentified specimens. Thus the " kusis " is any small brownish bird which skulks in undergrowth; the " kerumba " covers a multitude of sins, being any tree-dwelling insectivorous bird about the size of a sparrow—flycatchers, whistlers, bronze cuckoos etc.; and the " kalipunda " is any very small bird with some red in its plumage—notably the mistletoe-bird and the *Myzomela* honey-eaters However, it is characteristic of small birds that any single specimen may be given three or four quite different names, all of which may equally well be applied to birds of another species by another person and on another occasion. One favourite small bird name is " seebilly-billy ", applied to fantails, white-eyes and two or three other species which remain to be identified. Fantails however, but not white-eyes, are also known by the equally attractive names of " pinyalita " and " njirunjiru "—and so it goes on.

Of course there is little reason why the Kyaka should be particular in their classification of small birds which have no special individual value. It is perhaps surprising that they have the number of names for them that they do, however they apply them. There is one other category of birds in which I found equal confusion in the names, in spite of considerable native interest in them and value set upon them. These are the diurnal birds of prey, of which there are upwards of a dozen species present, and for which the Kyaka have seven names. Any hawk, or other bird of equivalent size, is a welcome addition to the day's diet, while the feathers of all are valued for headdresses, most prized by far being those of the *Harpyopsis* eagle.

The tallest headdress in the Western Highlands, formerly used in a special fertility cult. Over 4 ft. tall and held steady by a piece of string, it consists of a cone of red, white and blue feathers (parrot, white cockatoo and pitta) surmounted by a Stephanie's Bird of Paradise.

Photo.—Author.

The *Harpyopsis* is a very striking bird, and though not often seen far from the forest, when one appears there is never any doubt about what it is—it is a " kambi ". However the term " kambi " is also sometimes applied, often, I felt, as an expression of wishful thinking, to various other large

hawks. The only raptor with a native name applied exclusively and consistently to itself alone is the Sea-Eagle (*Haliastur indus*), which, with its red and white plumage, is if anything even more unmistakable than the *Harpyopsis*. Excluding these two eagles there are four common hawks which may be seen in the garden areas on almost any day; the Black Kite, the Brown Hawk and the Goshawk (all three the same as the Australian species) and the local small sparrow-hawk. All are very wary and tend to keep out of arrow-range, so that natives shoot few of them. I collected all four, and several specimens each of three of them. Each bird I collected was consistently graced with at least three different names, and some with four. These are rather picturesque. Thus a Goshawk might be a "yangopekipek" ("strikes his brother bird"), "mwingkiminyiminyi" ("frog-snatcher") or "ipwe pisyuwi" ("water-cuckoo"). The Brown Hawk was a "kyeke" (I think this name derives from its cry), a "yangopekipek" or a "frog-snatcher". When I shot a kite it was promptly identified as a "kambi" (eagle) by hopeful people who then wanted me to hold a pig-feast to celebrate the occasion, but this was not entirely wishful thinking, for the skin was again identified as a "kambi" a year later.

In time I discovered that these hawk names were applied more consistently to living birds than to the dead ones—which is a reversal of the general rule, but understandable in view of the fact that the Kyaka have plenty of chance to observe the creatures alive but fairly seldom succeed in shooting them. Thus a Black Kite, wheeling and soaring in flight, was never identified as anything but a "wulyasap", Brown Hawks playing and chattering in the sky were always "kyeke", while the sparrow-hawk was normally a "brother-striker" and the Goshawk a "frog-snatcher" or "water-cuckoo".

It is of course a temptation to "rationalise" the Kyaka list of hawks, and in fact their bird list in general, and conveniently ignore all but one term for each species or group of species as we know it, but this is not scientifically legitimate.

By and large Kyaka gain their knowledge of birds and animals from personal experience and not from traditional lore, so that there is wide variation in the extent and accuracy of the information which different individuals possess. Most adolescent boys and men can give a considerable amount of accurate information about the habitat, food and nesting sites of those birds which are adequately distinguished by their terminology and which they themselves have watched and hunted. They habitually make one or two curious errors. I was told many times that the Giant Frogmouth (*Podargus papuensis*) which we kept as a household pet, a big soft insectivorous bird who could put on a terrifying threat display but was quite harmless to anything larger than a beetle, would go out hunting for rats when he grew up; that bronze cuckoos make nests in treetops; and that mother birds remove their eggs and place them in new nests if they are disturbed.

Although there is a fairly marked winter dry season in most years, from about May to September, which is important to the native gardener, the Kyaka are not very conscious of the changing seasons in nature, and although there is in fact a marked breeding season for most birds from September to about March, they do not seem to be aware of this fact—though of course it is possible to find occasional nests of most common species right through the year. Similarly I found very few men who were aware of the seasonal migration of the Sacred Kingfisher, a common bird which is only normally present in the winter months, or of any other migratory bird but one; some men recognised that the Australian Rainbow-bird arrives in about April, at the time to plant the last sweet-potato gardens before the dry season commences.

In general I must confess that I was disappointed in the Kyaka as naturalists. At first I was suprised that, living in such an ornithological paradise and setting such a high value on plumes, they should not have more ornithological skill. Certainly there are other peoples in the Highlands of New Guinea who seem to be better naturalists, for example some of the Metlpa

peoples who live on the south side of Mount Hagen, and some of the peoples of the Wahgi and Jimmi Valleys. At the same time it is rather easy to over-rate native knowledge at a casual survey when one is oneself new to the country, so that it may be that the Kyaka suffer in my estimation through my over-familiarity with them compared to their neighbours.

I decided eventually that the reasons why the Kyaka were not as good bird men as they might be were probably largely social. One is that Kyaka men do not on the whole travel any very great distance, but spend almost all their time in the very limited territories of their own clan and its immediate neighbours, which limits the number of species of which they can have first hand knowledge. Secondly, although the fertility of their soil and the excellence of their climate give them a very easy living from the point of view of their garden work, so that they could have plenty of time to devote to hunting, in practice Kyaka society is such that any man who is of any importance, or who has any ambition to become of importance, must reside and be constantly available where he can take part in local politics, law courts, fights and other public business which may crop up. He simply cannot afford to be away for long periods on hunting expeditions. Thus, even in clans bordering the forest, hunting is very largely an activity for boys and for men of little social importance, and traditions of hunting and bush skills have small chance to develop.

If I have another opportunity to work in New Guinea, I should next like to see just how much better ornithologists a people would be, among whom hunting skills are important for personal prestige. But however good they are, I shall be surprised if they have better environmental opportunities than the Kyaka.

RALPH BULMER, with his wife, spent from January, 1955, to March, 1956, doing fieldwork in social anthropology in the Central Highlands of New Guinea, most of that time among the Kyaka people, as a Research Scholar of the Australian National University. He is a graduate in Anthropology of Cambridge University and has had a life-long amateur interest in natural history and especially birds.

Notes and News

Aboriginal Weapons Presented

The Australian Museum recently received a gift of aboriginal weapons from the late Mrs. H. C. Fitzhardinge of Wangolong, Mandurama, New South Wales. Our records show that gifts from her family began in 1905 when (and in various years afterwards) we received many splendid specimens from the late Mr. C. J. McMaster, Commissioner for Western Lands, and from his daughters, Mrs. Fitzhardinge and Mrs. C. W. D. Conacher. As a number of these specimens are old pieces from the Moree district they are particularly welcome additions to our Australian collection.

Giant Earthworms

A most interesting collection of giant earthworms was made by Miss E. C. Pope, Curator of Worms and Echinoderms, on a recent field trip to Kyogle. The worms were obtained by bulldozing in the State Forests of Toonumbar and on Richmond Range, where they seemed to be fairly plentiful. The longest worm taken measured 5 ft. 5 in. (unstretched) and had a diameter of 1in. The body colour was a bright olive green but, owing to the colour of contained red earth showing through, the worms appeared somewhat grey when torn from their burrows by excavation. It is hoped to have specimens determined by an expert to see whether they differ from the giant *Megascolides* of Gippsland, Victoria, one of which, at 12 ft. or so holds the world's record for the longest earthworm.

Staff Changes

Mr. H. O. Fletcher, Curator of Fossils, who became Assistant to the Director in October last year, was appointed in April to the newly-created post of Deputy-Director of the Australian Museum.

In March Dr. Allen Keast and Dr. D. F. McMichael were promoted to the positions of Curator of Birds and Reptiles, and Curator of Shells, respectively. At the same time Miss E. C. Pope, formerly Assistant Curator in the Department of Invertebrates became Curator of Worms and Echinoderms. This department has been formed by the division of the Department of Invertebrates. Mr. F. A. McNeill is now in charge of Crustacea and Coelenterates.

The Kangaroo Family

Kangaroos and Wallaroos

By ELLIS TROUGHTON

IN the final article of this series we arrive at the largest of living marsupials, to which the term " kangaroo " is restricted in the popular sense, although all the wallabies were originally included in the great-footed genus *Macropus*. However, as there is so little anatomical difference between a wallaby and a kangaroo, apart from considerable variation in tooth-structure, the giant species are classified mainly by size. The length of the adult foot, without the terminal nail, is regarded as invariably exceeding 10 inches, and the skull as measuring more than $5\frac{1}{2}$ inches in total length.

Authentic records of the size of " old men " 'roos are rare because estimates are affected by the method of measuring, whether from the nose to the tail-tip or toes, along the curves of the body, or from a flat-skin. The great bulk of the body was indicated by one old Forester reported as " standing " over 7 ft., and weighing well over 200 lb. In *Royal Natural History* the record length given for a kangaroo is 9 ft. 7 in., doubtless including body-curves. In the Australian Museum the largest skin of a great-grey kangaroo measures 8 ft. 8 in. along curves from nose to tail-tip, and the " red ", 8 ft. 2 in. A correspondent reported shooting several red 'roos measuring 8 ft. 10 in. from nose to tail-tip, and great-greys 7 ft. 10 in. He had heard of one 'roo 11 ft. long, rendered possible only by including the curves of a very large animal. The only satisfactory estimate is secured by measuring a kangaroo from nose to tail-tip, stretched on its back along a flat surface.

Authentic records of speed and the length and height of leaps are equally difficult to obtain. Kangaroos are usually paced over level ground, permitting speeds not sustainable over rough country. Up to 300 yards, the great-grey is stated easily to maintain 25 m.p.h., attaining a maximum of 30 m.p.h. When a kangaroo is hopping slowly its tail will lazily thump the ground, but with increasing speed the leaps may easily cover 26 ft., with the tail see-sawing in the air to counterbalance the slender forequarters, as depicted on the Australian penny. The length and height of leaps vary with the condition of the ground and obstacles encountered, and although leaps of over 40 ft. have been reported such records would undoubtedly be influenced by unusually favourable circumstances of take-off. According to a regular nature writer, " Mopoke ", a big 'roo chased by dogs hurdled a mass of timber $10\frac{1}{2}$ ft. high in a leap of 27 ft. An observer quoted in *Wild Life* for February, 1951, stated that a female Red Kangaroo or " blue-flyer " chased on a speedy horse, and carefully tracked over a dusty plain, averaged 37 ft. in a series of ten jumps, finally clearing an 8 ft. dingo-netting fence by a 42 ft. leap. But the blue-flyer is named for its slim speediness, and few heavier kangaroos are able to clear 8 ft., as shown by the number found entangled in high wire fences.

Kangaroos are not aggressive unless cornered, when their ability to " stand-up " on the powerful tail and strike with the toe-nails of both feet makes them dangerous to approach. After long pursuit a waterhole is the favoured refuge, where an old man 'roo will embrace an unwary dog and try to hold it underwater, or rip it open with one stroke of a hind-nail. The danger to man of such attack is well-known and was humorously exploited in Steele Rudd's " out-back " story where an old 'roo strikes and gets a " claw " caught in Dad's trouser-band. Experienced bushmen usually approach a cornered kangaroo with two strong sticks, feinting with one and striking with the other because a large 'roo will snatch away a single stick and fiercely attack his defenceless opponent. Apparently there is no record of an immediately fatal attack upon

man, probably because in its wild state a kangaroo only attacks when goaded by pursuit and cornered. However, it was reported in 1936 that a man had died in Hillston Hospital (N.S.W.) from a broken jaw and head injuries received in trying to rescue two dogs from a huge kangaroo. The first settlers were amazed at the ability of hunted kangaroos to handle attacks by dogs, an ability evidently acquired in the thousands of years after the introduction of the dingo.

Even when reared in captivity an old man 'roo may savage humans, as shown in a Sydney suburb some time ago when a constable was severly injured while assisting to rope a giant kangaroo which suddenly became savage. Even the old males of larger wallabies may become savage in temper and it is never wise to keep them as pets, especially where children are concerned. But female kangaroos and males of the smaller wallabies make delightful pets and most attractive inhabitants of sanctuaries and private parks. Like the dingo, foxes and wedgetail eagles prey on the weak and younger kangaroos affected by sickness or injury. Adults are often heavily infested with intestinal worms which may lower their resistance in bad seasons, but possibly their worst enemy may be sandflies which swarm around drinking places after rain, stinging the eyes and often causing blindness.

The value of kangaroo leather was responsible for past destruction of vast numbers of kangaroos and this, associated with the sub-dividing and fencing of large holdings, undoubtedly threatens the ultimate survival of several fine species. Any reasonable nature-lover realizes that kangaroos cannot be allowed to inflict material losses on pastoralists, but the popular conception of enormous individual grass consumption has been grossly exaggerated. Kangaroos are often blamed for conditions that were caused by overstocking during poor seasons, and by tolerance of rabbit populations. Actually, the relatively moderate appetite of kangaroos in comparison with sheep, has been demonstrated by the large variety of kangaroos sustained in small paddocks such as at Koala Park and other limited sanctuaries.

The supposed " mystery " of marsupial birth, common not only to an opossum and kangaroo but to all pouched mammals, has frequently been covered in this MAGAZINE. However, in Australia endless controversy on the " pouch-birth " theory has centred around the largest kangaroos because of the amazing disproportion between the newly-born embryonic " joey " and its mother. The actual birth is a matter of anatomical fact, but the method of transference on to nipples within the pouch was unknown until a scientist in Philadelphia, in 1808, discovered that young of the American opossum, born in a sightless embryonic state, not only crawled unaided upwards into the pouch but that, as later confirmed by Professor Carl Harman in his book *Possums*, litters frequently outnumbered the teats for their reception.

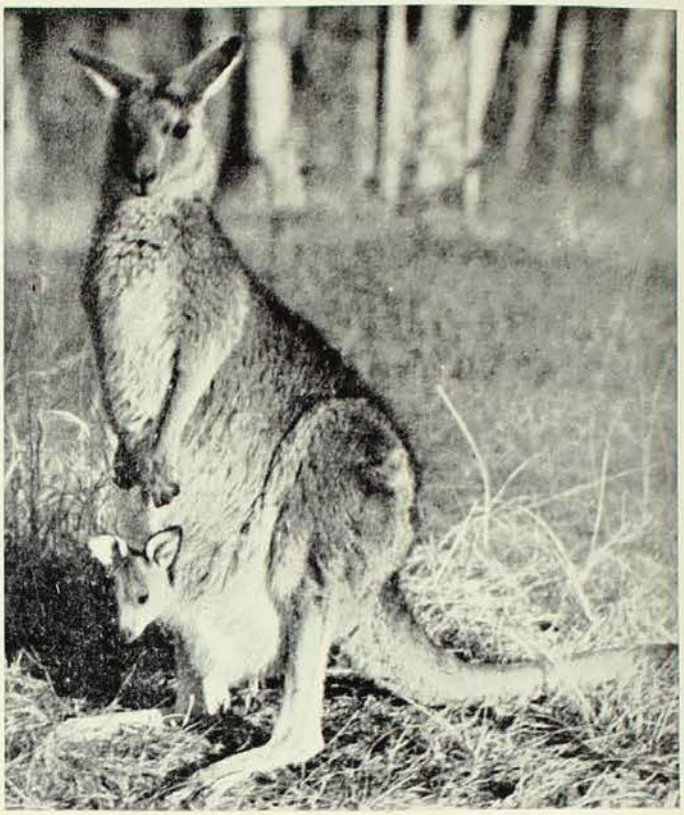
The first account of this unaided transference of an embryonic kangaroo was given in January, 1830, in a letter from Alexander Collie, surgeon aboard H.M. Sloop *Sulphur*, when the ship was anchored in Cockburn Sound, south Western Australia. His observations, published in the *Journal* of the Royal Zoological Society of London the same year, referred to the Tammar Wallaby taken from Garden Island off the port now known as Fremantle. After dissecting out embryos near the end of gestation, Collie described one as " about the size of the smallest young already mentioned as being in the abdominal sac ". He also quoted a fellow officer as describing the birth of an embryo which crept through the fur towards the pouch. Concerning the supposed inactivity of infant kangaroos, Collie described the gentle removal of a $1\frac{1}{4}$ in. long infant from a teat, which stretched for more than an inch and had an expanded nipple. Two hours after being left in the pouch the infant was reattached and suckling.

It is the preliminary swelling of the nipple, caused by the impending milk-flow, which gives a bush-observer the false impression that the embryonic kangaroo is formed on the teat " like a grain of tapioca ". Subsequently, if the teat or mouth is seen to bleed on forcible detachment of the infant, the pouch-birth theory

appears to be confirmed! But a casual observer overlooks the fact that he is not guided by continuous observation of an individual case, whereas there are numerous authentic reports from Australian and American zoological gardens of the embryonic birth of kangaroos, and unaided transference of young to the pouch. As an embryo of a Red or Grey kangaroo would rarely exceed an inch including the tail, the journey to the pouch provides an incredible example of instinctive energy, for which nature has allowed in the superior development of the forequarters of the "joey", so strikingly reversed in the adult adaptation for hopping.

Though rarely seen, there are a number of authentic records of twins, and the pouch of a Red Kangaroo with triplets attached is in the Australian Museum, presented by Dr. Arthur Chenery, from Wentworth, N.S.W. Observations in captivity have set the gestation period for kangaroos at an average of five weeks, but the specialized nature of the female reproductive system is responsible for remarkable irregularities and rarity of twins, although four teats are available for the young. Indicating this uneven rhythm of gestation, the late Professor Wood Jones recorded the birth of a Red Kangaroo 130 days after the death of the male parent, while in the Philadelphia Zoo a pouch-embryo was noticed seven weeks after the death of the male on 28th October, 1908. This young one suckled until 7th November, 1909, but meanwhile an apparently new-born embryo was noticed in the pouch after an interval only three days short of eleven months!

Estimation of the maximum age of kangaroos in the wild state is an impossibility but in captivity, according to the late A. S. Le Souef, when Curator of Taronga Park Zoo, young kangaroos have died of old age after ten years under conditions made as natural as possible; he believed the age-limit to be about fifteen years, but a wallaroo in Lone Pine Sanctuary near Brisbane is reported to have attained twenty-one years at least. In accordance with their chosen habitat, the large kangaroos are divisible into three distinctive groups: (a) the great-greys of the open forests and the black-faced variety of the mallee and denser scrub, and the Kangaroo Island and Tasmanian species; (b) the gracefully built long-limbed red kangaroo of the inland plains, with its blue-flyer mate; (c) the sturdy stout-limbed blackish wallaroo of the ranges of the eastern Divide, the roan Euro of South and central Australia, and the reddish wallaroo of the northern and western coastal region.



Great Grey Kangaroo (*Macropus major*).

Photo.—Noel Burnet.

THE GREAT-GREY OR FORESTER KANGAROOS

These rather woolly-coated kangaroos are readily distinguished from the red 'roo and wallaroos by the greyish-brown colour and entirely hairy muzzle-tip, and by the third upper incisor having two definite ridges down its front edge. The group now constitutes the genus *Macropus*, and the popular names show that the first settlers soon discovered that the grey kangaroo of the open forests inland from Port Jackson was a giant compared with wallabies around the settlement. World-wide interest at once centred on the Great-Grey on the mistaken assumption that Captain Cook first saw a Kangaroo at Botany Bay.

As shown in the preceding article,[1] however, the first " kangooroo " described by Cook and his naturalists at Cooktown was of wallaby proportions and had the muzzle-tip " naked between the nostrils and there . . . . . covered with very black rugose skin " like the muzzle of a dog. Apart from the doubt that the Great-Grey has ever entered the environs of Cooktown as explored by Cook's party, the fact that its muzzle is *completely haired between the nostrils*, eliminates the species absolutely from consideration as Cook's original kangaroo.

Subsequently, the appearance of kangaroos around the first settlement became of such interest that despite transport hazards of the day a living Great-Grey was sent to George III of England only three years after the arrival of the first fleet, and twenty-one years after Cook's discovery, at Cooktown in 1770, of a wallaby and what appears to have been the local kind of wallaroo.

Consignment of the kangaroo was reported in the following letter, according to the *Historical Records of New South Wales*:

Governor Phillip to Lord Grenville,
Sydney, November 22nd, 1791.

My Lord,

The Commander of the armed tender *Supply* has an animal in charge which is known in England by the name of kangaroo, and which I hope will live to be delivered to your Lordship for the purpose of being sent to his Majesty.

I have taken this liberty, as it is not known that any animal of the kind has hitherto been seen in England. I have &c.,

A. Phillip.

A letter followed on the same subject, dated 14th December:

I had the honour of informing your Lordship in my letter of the 22nd of last month that an animal known in England by the name of kangaroo had been put on board the *Supply*, as I presumed that so uncommon an animal might not be judged improper to be sent to his Majesty.

I have now the honour of informing your Lordship that another of those animals is put on board his Majesty's ship *Gorgon*, for the same purpose.

So great was the public interest aroused by these kangaroos, that live ones were frequently exhibited during the 1790's. An interesting old handbill amongst some news-cuttings of the period in the Mitchell Library describes the first public showing of a kangaroo in London. The florid style proves that even in those days the publicity man held sway, suggesting that a kangaroo proved a formidable rival to the " bearded lady " as a popular attraction of that time. The handbill reads:

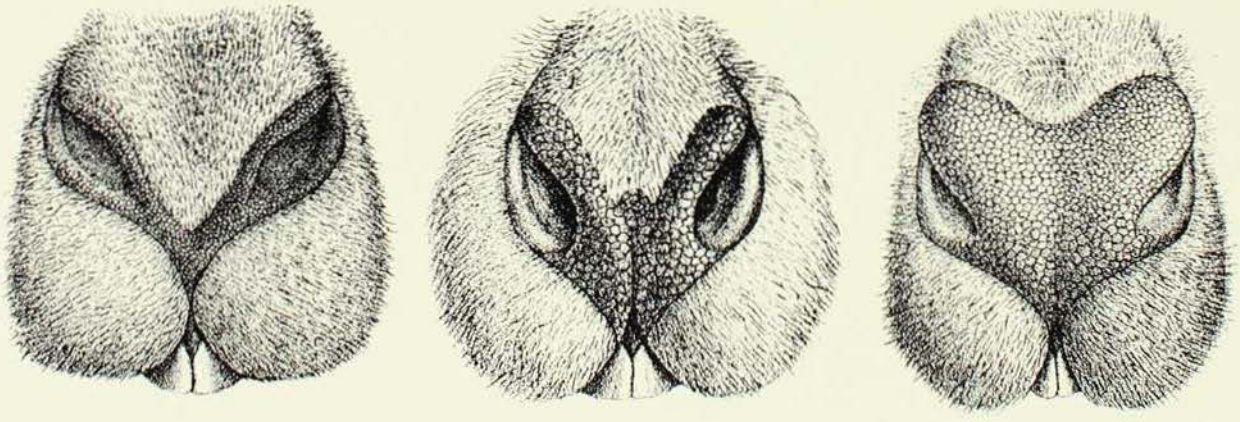
The wonderful
KANGUROO
from
Botany Bay

(The only One ever brought alive to Europe)

Removed from the Hay-market, and now exhibited at the Lyceum, in the Strand from 8 o'CLOCK in the Morning, till 8 in the Evening.

This amazing, beautiful, and tame Animal, is about 5 feet in Height, of a Fawn Colour, and distinguishes itself in Shape, Make, and true Symmetry of Parts, *different from all other* QUADRUPEDS. Its Swiftness, when pursued, is

[1]This MAGAZINE Vol. XII (6), p. 186.



Left: Muzzle of Great Grey Kangaroo; the hair of the nose extends below the level of the nostrils. *Centre:* Muzzle of Agile or Sandy Wallaby; an intermediate, partly-haired condition. *Right:* Muzzle of wallaroo; naked or dog-like in appearance.

From British Museum Catalogue of Marsupialia and Monotremata.

superior to the Greyhound; to enumerate its extraordinary Qualities would far exceed the common Limits of a Public Notice. Let it suffice to observe, that the Public in general are pleased, and bestow their Plaudits; the Ingenious are delighted; the Virtuoso and Connoisseur are taught to admire! impressing the beholder with Wonder and Astonishment, at the Sight of this unparalleled Animal from the Southern Hemisphere, that almost surpasses Belief; therefore Ocular Demonstration will exceed all that Words can describe, or Pencil delineate. Admittance, ONE SHILLING each.

In view of this extravagant tribute it seems a pity that reading could not have been included in the kangaroo's list of attractions since the poor exile would naturally fail to respond to the Plaudits of the Public, or appreciate being exhibited in continuous session like a modern motion picture. At the present time there is probably not one Australian traveller in whom the sight of a lonely exile in some foreign zoo does not awake sympathetic thoughts of home beneath the Southern Cross.

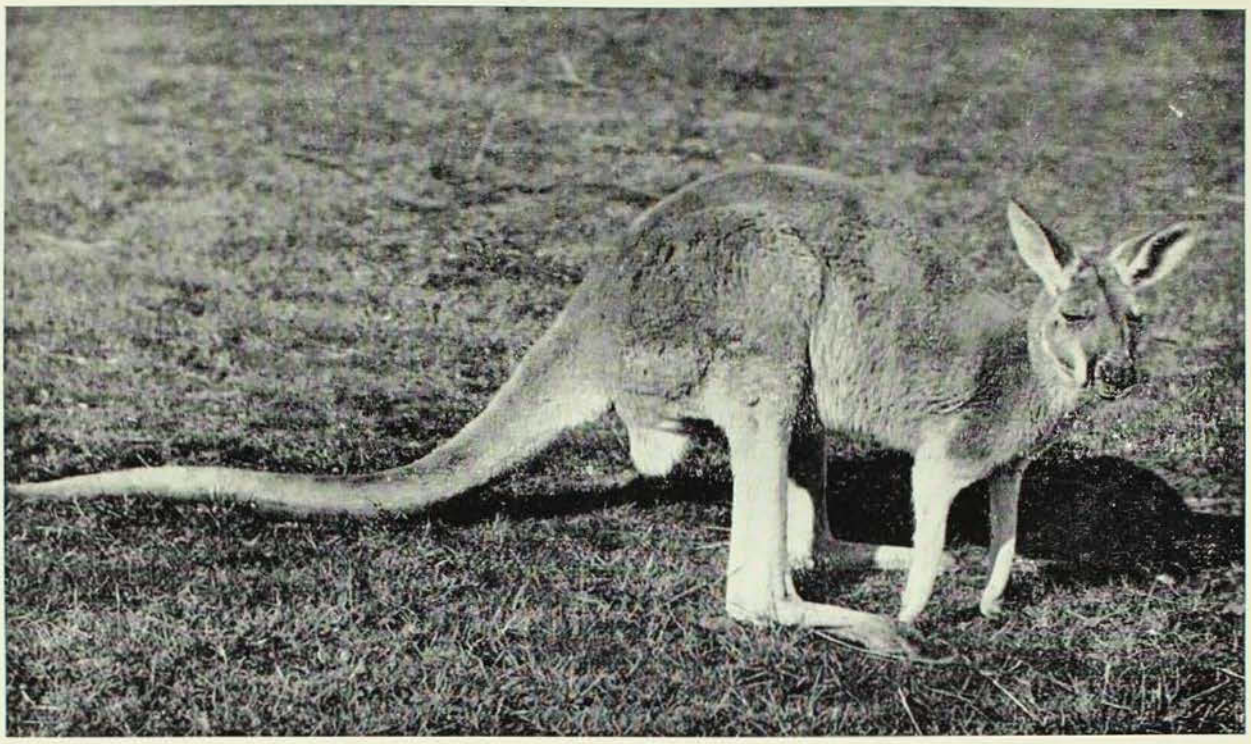
The eastern Great-Grey (*Macropus major*) ranges over the more coastal region from South Australia north to near Cooktown on the Peninsula. Specimens from the Bourke district (N.S.W.) in 1888, and more recently from Trangie and Hillston, seem farther west than usual. The Black-faced or Mallee Kangaroo (*melanops*) is somewhat smaller form of great-grey which favours the mallee scrub of this State and Victoria. The Western Australian Forester (*ocydromus*) is a more warmly reddish-toned kangaroo which became restricted to the region between Geraldton and Esperance long before white settlement. The heavily built dark brown Forester (*fuliginosus*) of Kangaroo Island was first reported by Matthew Flinders in 1802, and named in Paris in 1817 from specimens collected by the French naturalist Peron the same year. The Tasmanian Forester is distinguished by its heavy build and reddish-brown coarser coat, and the larger teeth. Owing to some confusion arising from early visits of the French to both islands the name of the Kangaroo Island species was misapplied to the Tasmanian Forester until 1923, when it was re-described as *tasmaniensis* by the late A. S. Le Souef.

THE RED KANGAROO

This magnificent richly-coloured kangaroo has the widest distribution throughout inland plains and the drier central region over to near the western coast from Geraldton north to about Port Hedland. The original specimen, evidently a male from the specific name *rufa*, collected beyond the Blue Mountains by Government Botanist Fraser, was given to Quoy and Gaimard, French naturalists, on their arrival in 1819 with Commander Freycinet in the vessel *Uranie*. The Red Kangaroo was greatly admired by John Gould, who provided exquisite pictures of it in his famous *Mammals of Australia*, and monograph of the kangaroo family. It was a striking tribute to the beauty of the illustrations that a German schoolmaster, Gistel, was moved to provide the generic name *Megaleia*, from the Greek for " stately " or " magnificent ", without having seen the kangaroo in its native state.

Fortunately, the Red is one of the best known kangaroos since no description could do justice to the wine-red coloration of the male or soft smoke-blue tones of his lightly built doe, whose colour and speediness suggested the name of " blue-flyer ". The long rather slender hindlimbs of the male give the red 'roo an appearance of greater height when " standing " erect, though it is doubtful if it would average more than an old great-grey " boomer " in actual bulk. The head of the red male is characterised by its strongly-bowed muzzle, the tip of which is not covered with hair as in the Great-Grey, or entirely naked as in wallaroos, but has hair extending down below the top level of the nostrils. Another facial feature is an oblique blackish whisker-mark extending backwards to the eye, and accentuated by a whitish line below. The skull is recognizable by the size of the long and wide nasal portion compared with the relatively small cranium. The third upper incisor is rather narrow, about as broad as long, instead of decidedly oblong as in wallaroos, and lacks the two outer ridges on the Great-Grey's third incisor.

In both sexes the young may have an unusual mixture of the red and bluish coloration which sometimes persists in adults,



The Red Kangaroo (*Megaleia rufa*).

Photo.—H. C. Barry.

notably in the Western Australian race, *M. rufa dissimulata*. A kangaroo named *hagenbecki* in 1907 by the Hon. Walter Rothschild is now regarded as a zoo hybrid of this race and the western red wallaroo. The Red 'roos usually move in small mobs, which may account for their rather sociable disposition in captivity, although the males are plucky animals ever ready to defend themselves at close quarters. But old captives sometimes develop a truculent familiarity which could become dangerous, although there does not seem to be the vicious instinct of old greys and wallaroos. The successful use of red males in boxing acts, in which their technique is grotesquely human, is suggestive of a more amiable disposition, until the tail is used as a prop while leading-off with both feet!

WALLAROOS OR ROCK-KANGAROOS

The wallaroos are really mountain kangaroos which inhabit the same great coastal ranges and rocky inland ridges as their small rock-wallaby relatives. They differ from the grey foresters and the plains-loving red 'roo in their stout build and stockier hind-limbs, adapted for leaping amongst rocks, the shorter more thickly-padded feet with roughened soles, and by having the muzzle entirely hairless between the nostrils. The generic name *Osphranter* from the Greek for " sharp-smelling " refers to the marked expansion of the nasal region of the skull. The third upper incisor is about twice as broad as long, with one slight central groove. The popular name was derived from the aboriginal " wolaru ", originally applying to all the larger kangaroos of eastern New South Wales. The name was limited by whites to the brownish-black wallaroo (*robustus*) of this State and south-eastern Queensland.

A rather solitary creature, the old males are usually alone and when viewed at a distance appear almost black, while the stooping carriage due to habitat, and the shaggy coat and drooping hairs of the face present a curiously uncouth appearance suggestive of an " abominable snow-man ". The full-grown does are smaller and somewhat slighter, but have the same suggestion of " dumpiness ", instead of the trimness of the females of other kangaroos. Old males are very dangerous to approach in the rough habitat because of their great muscular strength, and the way they may use the strong teeth as well as their nails. Their temper seems typical of the rugged

Wallaroo (*Osphranter robustus*). Male.

After Le Soeuf, Burrell and Troughton.

haunts, making them unsuitable family pets, but the *robustus* species is now almost entirely harmless to man's interests. Following the introduction of cheap rifles it was long ago hunted from the lowlands of the western divide where grazing or produce might be even slightly affected.

The more lightly built Euro or Roan Wallaroo (*erubescens*), once very plentiful in South Australia, extends south-west to Eucla, and far into the Northern Territory. It is often known as the " Roany " because of the reddish-grey colour, while " Euro " and " Yuro " are variations of the aboriginal name. The superb Antilopine Wallaroo (*antilopinus*) named for its more graceful build and bright reddish-brown coloration, inhabits the more coastal ranges of the Northern Territory. The original pair which Gould named in 1842 were collected at Port Essington, north of Darwin, by the naturalist Gilbert, afterwards killed by blacks on Leichhardt's overland journey from Brisbane to the same locality. Sub-species of the antilopine wallaroo extend the range west to the Kimberley region (*woodwardi*), and in the mid-west and south to Laverton and Kalgoorlie by the race *cervinus*.

Most interesting and least known is the dwarfed wallaroo of Barrow Island named *isabellinus* because of its drabby or " isabella " toned coloration. A skin was obtained in 1839 by Captain Stokes of the survey-vessel *Beagle*, which John Gould was able to name as a species of stunted wallaroo not previously sent to Europe. Unfortunately, the survival of this wallaroo has been endangered by atomic-blast experiments within the Montebello Group off Western Australia in 1952. Another little known species is the northern Black Wallaroo inhabiting the granite ranges about the head of the South Alligator River, south-east from Darwin. So perfectly is it adapted for its browsing rock-kangaroo existence that Lord Rothschild, in 1904, first considered it intermediate between a wallaby and tree-kangaroo, when naming it after Bernard Woodward, then Curator of Perth Museum.

Filled with admiration for the magnificent group of large kangaroos, and the Red Kangaroo in particular, the great naturalist Gould was shocked by the unrelenting way in which they were driven from their grassy haunts during early settlement of the inland. " Shortsighted indeed are the Anglo-Australians " he wrote " or they would long ere this have made laws for the preservation of their highly singular, and in many instances noble, indigenous animals ".

However, the principle of declaring restricted open seasons only where kangaroos or wallabies are *proved* guilty of economic damage, as now generally accepted under the fauna protection Acts of the various States, appears satisfactory to all concerned as curbing the appalling slaughter of the past when in one State, over a period of 25 years, more than seven million kangaroos and wallabies were killed for trade. Even so, it is urgently to be hoped that additional national reserves, similar to the great animal parks of South Africa and America, are soon to be established in which nature-lovers and tourists may see these beautiful marsupials grazing in safety, with the added pleasure of knowing that their survival is assured for all time.

A Simple Photographic Method of Copying a Drawing

By HOWARD HUGHES

AUTHORS of articles and scientific papers, lecturers and others, sometimes require copies of drawings and diagrams to be used as illustrations. If these are black line illustrations the easiest and quickest method of reproduction is to " contact print " them direct on to a sheet of photographic paper. Anyone with a little knowledge of photography can make such copies.

Provided the original drawing is on transparent or translucent paper the only equipment and conditions necessary are those used for photographic contact printing at home: A darkened room, various sized printing frames, some single weight (thin) photographic paper (one of the contrast grades), the proper chemicals, water, dishes, a white light and a safelight.

The drawing is used in place of a negative. The more transparent the paper on which the drawing is made and the more opaque the outlines of the drawing the easier it is to print the copies.

Often pencil lines will print through, but the best copies are produced from good quality India ink lines on good quality white tracing paper. If the drawing has been commenced on ordinary paper it is quite easy to make the inked copy on tracing paper placed over the pencilled outline. The better the inked drawing, the better the result obtained. It is advisable to ensure an even thickness and opacity of line by holding the tracing up to light occasionally while the inking-in is in progress.

The completed tracing can be treated in two ways. One is to make a paper negative from which " black on white " copies are possible and the other is to make direct " white on black " copies.

When a paper negative is to be made the drawing is placed in a printing frame with the inked surface in contact with the sensitized surface of a lightweight photographic paper and then exposed to the white light. If the drawing has been prepared as suggested the exposure will be fairly short. The photographic paper is

then developed, fixed and washed in the usual way. The paper negative will be " white on black " with the image in reverse. This paper negative can now be used in the same manner as any photographic negative to make as many " black on white " contact prints as required. (Fig. 1).

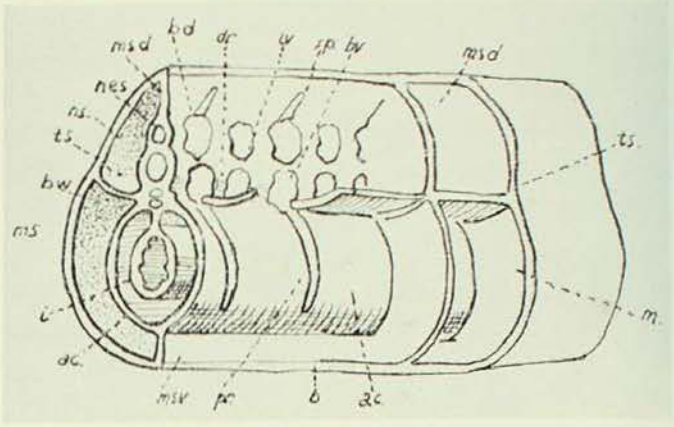
The " white on black " copies are made in the same way again except that the inked surface of the drawing is placed *away* from the sensitized surface of the photographic paper so that the *back* of the drawing is in contact with the paper. This method has the advantage of speed by doing away with the need for a separate negative. (Fig 2).

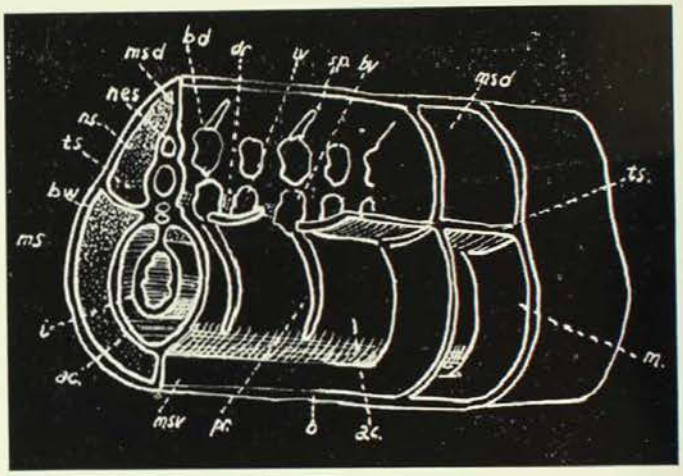
The only limitations on the size of the drawing to be copied are practical ones. If the original is too large for the printing frames available the drawing and the photographic paper can be sandwiched between a large sheet of glass and a perfectly flat surface. So as to avoid any soft outlines in the image, care must be taken to ensure that both surfaces of the papers are in as close contact as possible. For extra large copies the " sandwich " can be laid on the floor or work-table and the white room light turned on to make the necessary exposure.

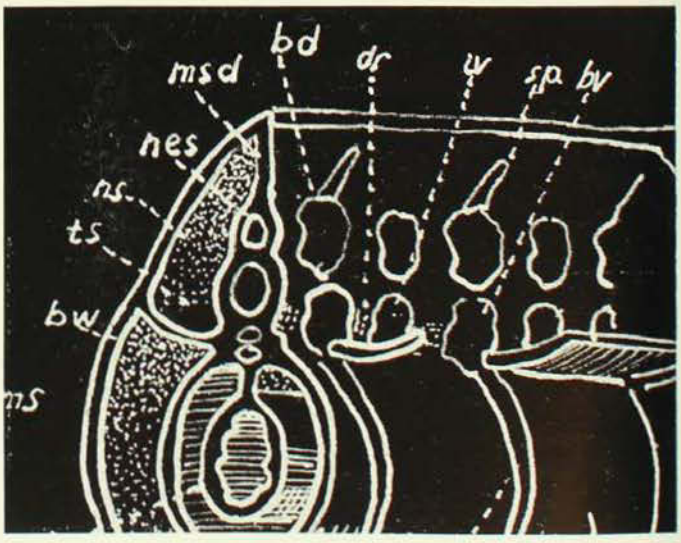
It is also possible to place a small drawing or portion of a drawing in the negative carrier of a photographic enlarger to produce an enlargement of convenient size. (Fig. 3).

The " white on black " contact print is adequate for normal purposes and, being unusual, attracts attention to the illustration.

Printers' blocks can be made from either the ink tracing or the contact prints.







ILLUSTRATIONS

Fig. 1. *Top:* Black-on-white copy produced from a paper negative.

Fig. 2. *Centre:* White-on-black copy made direct by contact.

Fig. 3. *Bottom:* Portion of the original tracing enlarged. Enlargement shows up small flaws but an enlarged print is an ideal basis for subsequent tracings.