

The
**AUSTRALIAN
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MAGAZINE**

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



- Butterflies and Ants** - *G. A. Waterhouse, D.Sc., B.E.*
Joadja Memories - - - - - *Keith C. McKeown*
The Teeth of Reptiles - - *C. Anderson, M.A., D.Sc.*
**Lake Burrill and How Our Coastal Lakes were
Formed** - - - - - *Frederick D. McCarthy*
Megascolides, the World's Biggest Earthworm - - -
Charles Barrett, C.M.Z.S.
The Stanthorpe Granite Belt - - - - *H. C. Barry*
The Corella - - - - - *A. W. Mullen*

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Caterpillars, tended by ants, feeding at night. (Flashlight photograph.)
[Photo.—A. J. Nicholson, D.Sc.]



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VOL. IV, No. 7.

JULY-SEPTEMBER, 1931

Butterflies and Ants

By G. A. WATERHOUSE, D.Sc., B.E., F.E.S.

ONE of the most fascinating studies in natural history is that of the complicated relationships of ants with other insects. In the nests of ants there are to be found as guests, intruders, hangers-on, or camp-followers, many other creatures than the ants themselves. The caterpillars of many butterflies seem to have solved the problem of gaining the protection of such fierce insects as ants, and it is such an association that will now be described.

Over a century ago, there was sent to England from Sydney a brilliant little butterfly, which on account of its vivid colours, especially on the underside, was named *ignita*. This small butterfly was doubtless caught close to the centre of Sydney, as at the present day it is still to be found on the North Shore, at Oatley and Como, and in the National Park.

The eggs are beautifully sculptured white objects and usually are laid by the female in clusters at the base of a small plant of one of our common wattles. After this has been done, if certain small black ants are not already there, they

quickly arrive and place a covering of *débris* over the eggs, thus forming an ant-byre, which is increased in size as required. In about ten days the baby caterpillars eat their way out of the eggs and begin to look for their food. I believe that at first these small caterpillars are carried by the ants to the tender young shoots of the wattle, or it may be possible that, when they are so small, the ants feed them. When older they certainly crawl to their food, being guided to the young leaves by the ants, and, when their meal is finished, led back home to the ant-byre at the base of the plant, as if they were cows taken out to, and driven back from pasture. They feed only at night, generally just after the sun has set. Should the caterpillars, when on their outward or homeward journey, go in the wrong direction, an ant will come and give the head of the caterpillar a push to turn it in the way it should go.

The ants tend these caterpillars with great care, and, in return for the attention and protection from their many enemies, the caterpillars make what no doubt the

ants consider an adequate return. These caterpillars are provided with glands on their backs from which from time to time exudes a honey-like fluid much prized by the ants, who eagerly consume it and may even by gentle stroking stimulate its flow. The caterpillars when feeding always have ants in attendance, and the



[Eggs of *Miletus ignita*. (Much enlarged.)
[Photo.—A. J. Nicholson, D.Sc.]

larger caterpillars usually have two or three of the small black ants on their backs, as is shown in the accompanying illustration. Another illustration shows the ant-byre broken open with several caterpillars and ants and also some of the other insect inhabitants of the byre.

If the number of caterpillars on the small tree is large, all the leaves are eaten and the plant may have the green bark

eaten away as well. After a few weeks of feeding the caterpillars retire as far as possible into the ant-byre, and if, as is often the case, the ants have excavated around the base of the plant, the caterpillars go underground. There they cast off their skins and turn to chrysalides. In this stage, which is a resting one, no food is taken, but a great internal change is going on in preparation for their future life as winged insects. After about two weeks as a chrysalis, one morning the back splits near the head, the front legs are withdrawn and the butterfly pulls itself out of the shell of the chrysalis. Its wings are soft and flabby, and, though it is really a perfect insect, for a short while it is scarcely recognizable as such. It crawls rapidly to the nearest opening in the ant-byre, being attracted by the light, and then out of the byre with the ants crawling around and over it without making any attempt to injure the defenceless creature. It then seeks a suitable position, hanging by its legs while its wings expand rapidly to their final mature shape somewhat after the manner of the little Japanese toys, which seem to be crumpled shavings and which, when thrown into water, swell into flowers and leaves. When the wings are fully expanded they harden and dry in a short time so that the insect can use them for flight.

In the case of a somewhat similar butterfly, also found near Sydney, the caterpillars feed together openly on the wattles and are attended by numbers of another kind of small black ant, which swarm all over them and so protect them.

Still a third butterfly, occurring near Sydney, has caterpillars which live in the nests of the large black and orange sugar-ant. These caterpillars have to travel some distance at night up the tree to their food, which is the mistletoe. As these are larger, it is easier to watch how the ants lead them and also how they take the drop of honey fluid as it exudes from the glands on the backs of the caterpillars.

I am convinced that in another case in eastern Australia the caterpillars are fed during their life by the ants, but I have never been able to get direct proof of this.

I have found eggs, caterpillars, and chrysalides at the same time in dead stumps in possession of ants with no likely food plant near. On bringing these caterpillars home I have been able to keep them alive by placing them on slices of

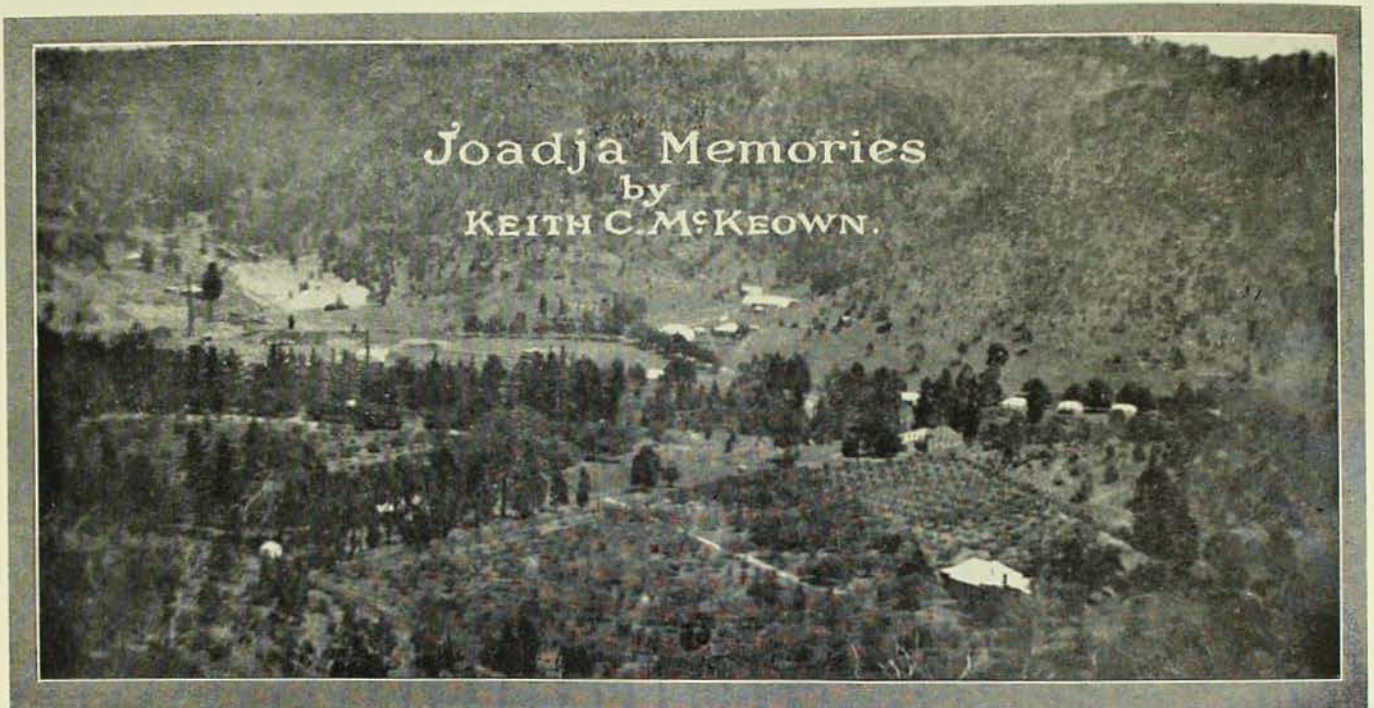
apple on which they fed and thus rear butterflies.

The illustrations are from photographs kindly given me by Dr. A. J. Nicholson, taken near the Cottage, Gundamaian, National Park.



Byre of ant, *Iridomyrmex* sp., opened, showing butterfly (*Miletus ignita*) larva, Mealy Bugs (*Dactylopius* sp.), and ants.

[Photo.—A. J. Nicholson, D.Sc.]



A general view of Joadja Valley. Orchards fill the foreground, while the old village lies to the right centre. [Photo.—K. C. McKeown.]

AMONG Australia's dormant sources of wealth is kerosene shale. In the past misfortune seems to have dogged its history, but, perhaps, the years to come may again bring prosperity to those districts where great deposits of kerosene shale lie practically untapped; then the future may see Joadja Valley once more a hive of activity, and its now silent depths resounding to the echoes of its reborn industry, and a prosperous community again occupying its deserted village.

Joadja Valley lies about twenty miles in a westerly direction from Mittagong, the road thither running through undulating country at first dotted with farms, but further out, where clearing has not yet marked the spread of settlement, heavily timbered and typical of the Hawkesbury Sandstone. There is little to note in this country until one reaches the valley, which spreads itself almost at one's feet with a suddenness which takes away one's breath, for there have been few indications to betray its

presence. In places sheer sandstone cliffs rise from the valley floor, banded here and there with black outcrops where the strata of kerosene shale are exposed; elsewhere the mountains sweep down in impressive lines. The green valley itself is usually dappled with the shadows of passing clouds. All this country is of the most rugged character, and in the early days, before much of the timber was cleared, it must have been almost impossible to find a way into its depths. The visitor is irresistibly reminded of the valley, so graphically described in Rolfe Boldrewood's justly popular book, *Robbery under Arms*, the stronghold of Captain Moonlight and his band of bushrangers.

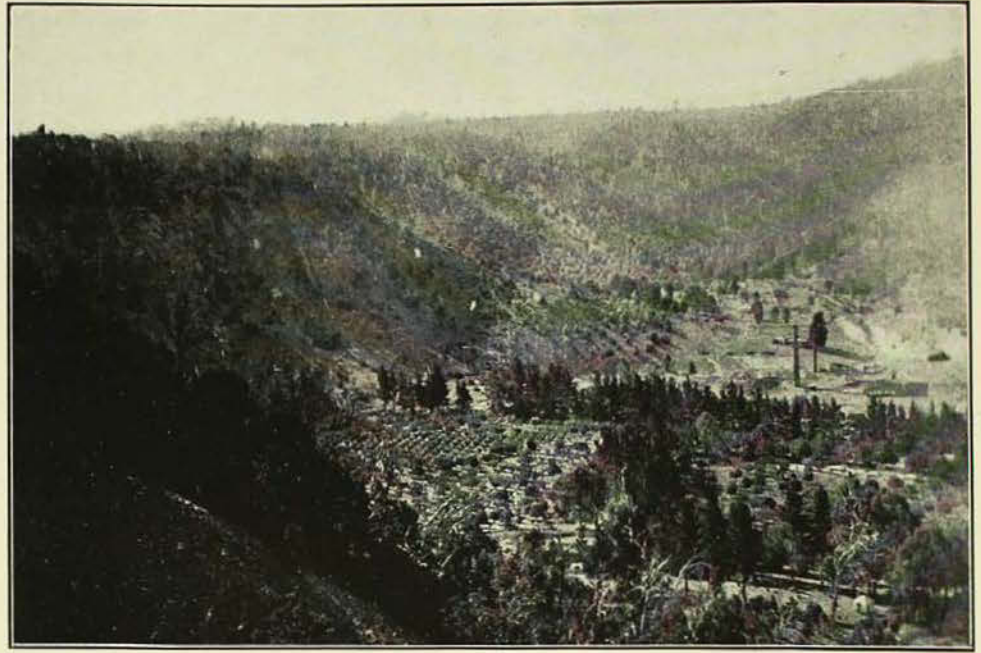
Joadja Valley has had a somewhat chequered history. Shale was worked there many years ago by the Australian Kerosene Oil Company, the "A.K.O.," but this company, being unable to compete with the cheap American oil, was eventually forced to abandon its operations. At the height of its prosperity the industry supported a population of over a thousand

souls in the valley itself. This community was practically self-contained, as the company conducted its own orchards, dairy farms, hotel, and stores in the valley—even its own theatre! At this time Joadja was connected to Mittagong by a light tramway, but this, together with most of the improvements on which money had been lavished, was dismantled on the abandonment of the work. Many thousands of pounds must have been expended while the industry thrived, for the valley is beautified by double avenues of oaks,

elms, sycamores, and other English trees, while windbreaks of pines sheltered the extensive orchards. In the village the cottages were of brick, while a distance away a fine sandstone school building still stands, which some years ago still contained all its fittings and equipment, giving the place an eerie air of mystery and folornness. The greater number of the buildings are in ruined condition and the whole valley wears an aspect of desolation. At night in the deserted village, with the moon lighting the fronts of the cottages, and their empty windows staring blindly into the street, it is easy to imagine that they are still tenanted by the ghosts of those long gone—truly a haunted village.

Several creeks flow through the valley, which resounds to the music of running water. Chief of these is Joadja Creek, from which the valley derives its name; this, together with numerous tributaries, flows into the Wollondilly River, which runs through the lower reaches of the gorge.

Two or rather three ways of entering the valley exist; a narrow pack-horse track down the mountain side, so narrow in places as to permit the bare passage of loaded horses in single file. It was by this route that the shale was first removed



The Valley. The pine trees (*Pinus insignis*) are the windbreaks surrounding the orchards, while the ruins of the works, and Russell's Gully lie beyond.

[Photo.—M. R. McKeown.]

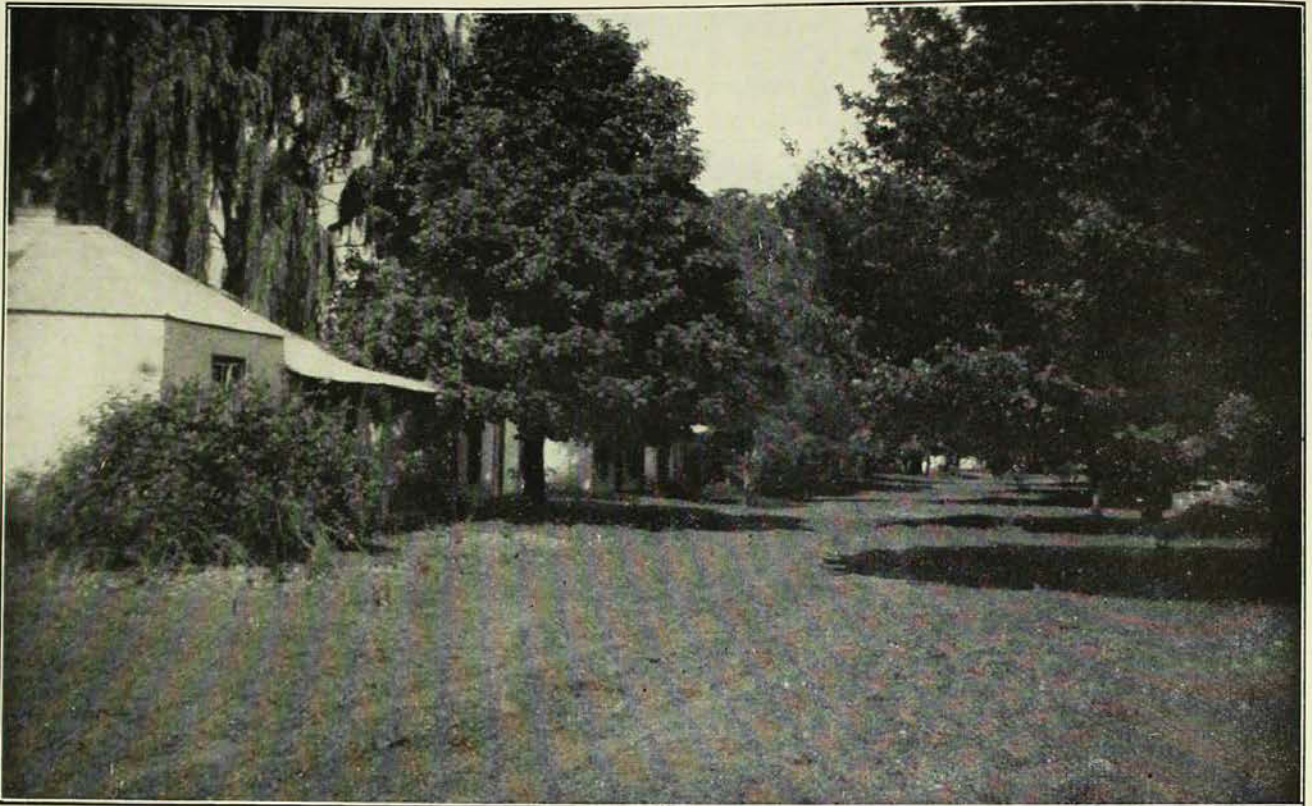
from the valley; at a later date a cable-hauled tramway up the face of the mountain offered thrills to those who ventured the passage, as the effect was that of a fly climbing a wall. The third means of access is by means of a long winding road through the lower end from the Burraborang Valley.

Joadja is dotted with the ruins of those buildings which constituted the refineries and general works, while the mountain sides are honeycombed with the disused mine galleries, the caving in of which produce many weird sounds at night during the winter rains—sounds quite in keeping with the general atmosphere of the valley.

WILD LIFE.

Joadja is a most fascinating spot for the naturalist, for it abounds with wild life of all kinds; wallabies frequent the sapling-covered hill slopes, and wombats tunnel among the fallen sandstone blocks at the cliff foot. The mythical bunyip is reputed to inhabit the swamps near the Wollondilly River, but these reports must be attributed to the booming of the Bittern (*Botaurus australis*) among the reed beds.

Black and Brown snakes (*Pseudechis porphyriacus* and *Demansia textilis*) abound among the *débris* of the ruined buildings.



The Deserted Village, where the empty windows of the houses stare blankly at the passer-by.

[Photo.—K. C. McKeown.]

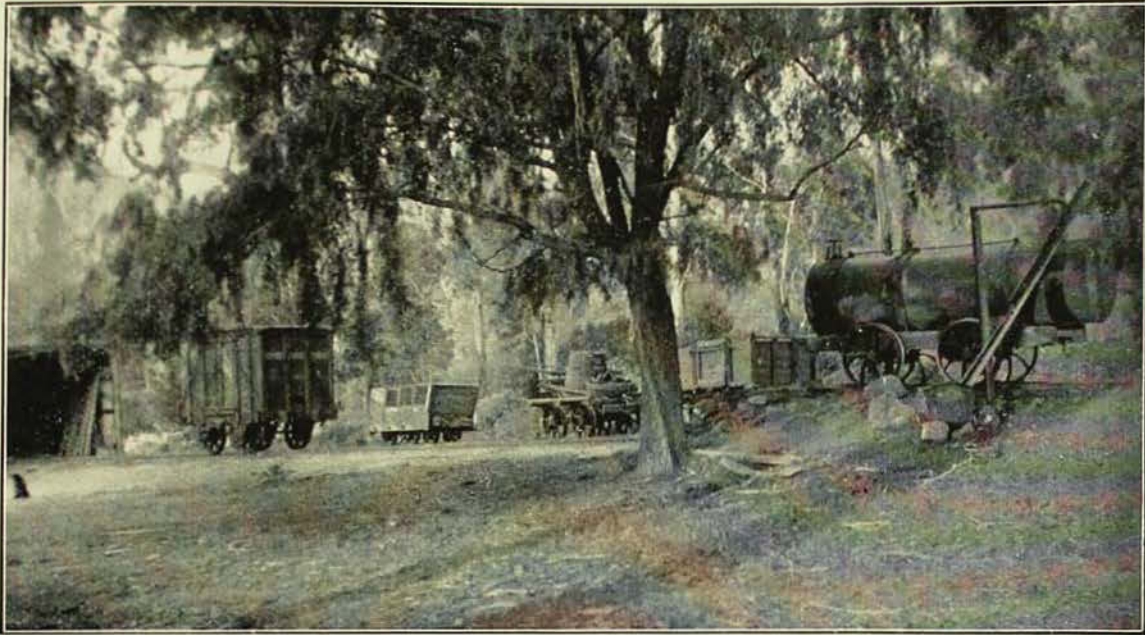
The Lace Lizard or goanna (*Varanus varius*) is numerous among the timber. I have found their nests on a number of occasions, each containing a variable number of large blotched eggs, safely bedded down in the centre of a white ant's or termite's nest, where the eggs are, no doubt, incubated by the heat generated by the termite colony and where, immediately upon hatching and until they leave the nest and face the world outside and fend for themselves, the young lizards are surrounded by unlimited food in the form of white ants. It is a curious fact that goanna eggs in the termite nests are never attacked by the insects; either the leathery "shell" is too tough for their jaws, or it is impregnated with a flavour distasteful to them.

In the sheltered gullies Lyre Birds (*Menura nova-hollandia*) are often to be seen, and still more frequently their loud ringing notes or unsurpassed mimicry of the bush sounds are to be heard. Here, too, parties of Black Bell Magpies (*Strepera graculina*) frequent the tree tops, while the Grey Bell Magpies (*Strepera versicolor*) are usually to be found either as solitary birds or in pairs in similar localities.

The Grey Bell Magpie or Currawong is locally known as the "Donkey Bird," and its loud call when echoed from the surrounding rock walls certainly bears a resemblance to the bray of a donkey.

In the old village, swallows (*Hirundo neoxena*) build their nests under the eaves, and the little brown Rock Warblers (*Origma rubricata*) hang their nests from the ceilings of the empty rooms, finding access by means of a broken windowpane. They appear to have thoroughly adapted themselves to these new conditions and to find them equally as suitable as their usual haunts in the rock caves; they are also to be found nesting in the disused retorts in Russell's Gully. They are thoroughly indifferent to the presence of human beings.

The old orchards provide Leatherheads (*Philemon corniculatus*), Silver Eyes (*Zosterops carulescens*), and parrots of several species with a banquet of fruit, while the Satin Bower Birds (*Ptilonorhynchus violaceus*) strip the grapes from the vines growing among the houses, and make the early morning hours ring with their rich flute-like notes. Their



Abandoned rolling stock at the foot of the tramway.

[Photo.—M. R. McKeown.]

bowers may be found in the more secluded localities.

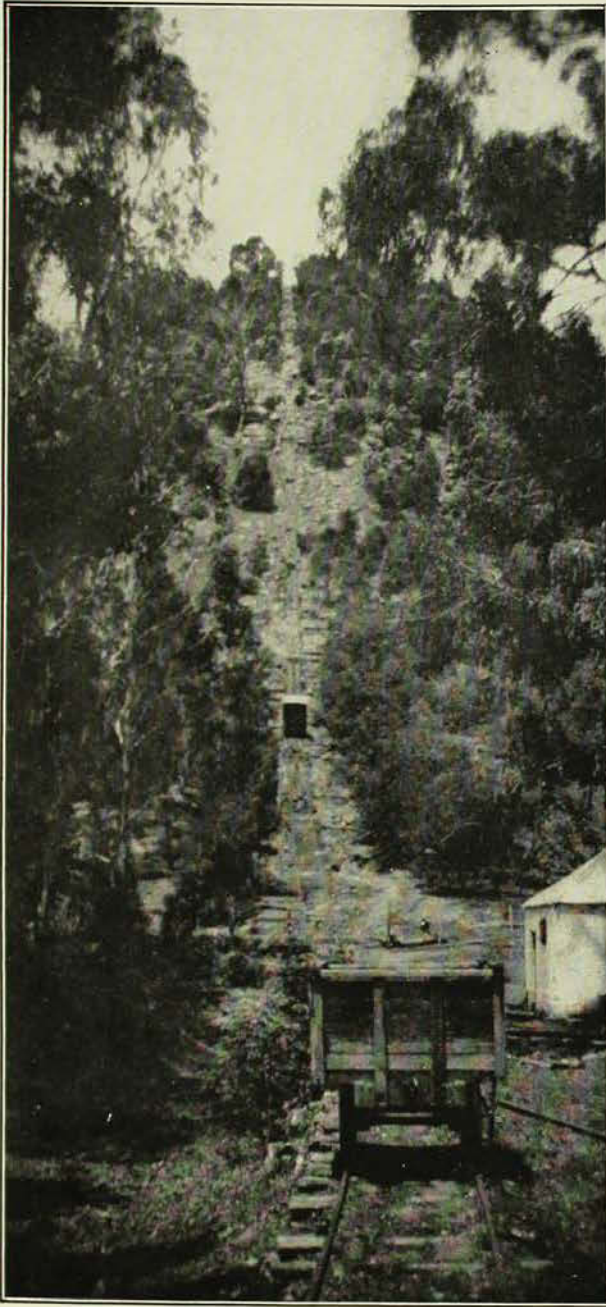
When night falls on the valley the call of the Boobook Owl (*Ninox boobook*) is heard, and the mountain sides are filled with the curious call of the little Swamp

Quail (*Synoicus australis*). This call has remarkable ventriloquial qualities, and it is almost impossible to locate the caller, the air seeming to be full of sound coming from all directions. The note may, perhaps, be best described by comparison with the



The Burragorang Valley with the winding road which leads into the lower end of the Joadja Valley.

[Photo.—K. C. McKeown.]



The old cable tramway up the mountain side, showing a truck, like a fly on a wall, nearing the valley floor.

[Photo.—K. C. McKeown.]

sound of a stream of bubbles being forced through water under high pressure.

The valley is a veritable paradise for insect life; a few species only can, however, be mentioned here. White ant or termite nests have already come under notice in connection with the habits of the

goanna. This termite is the common coastal species, *Termes lacteus*. The beautiful Carpenter Bee of the grass-trees is very plentiful, and the flower stalk of almost every grass-tree is pierced with the circular opening of their tunnels, where they have excavated the pith, and constructed a single row of cells one upon the other, each separated by a wad of triturated pith. The female bee is of a beautiful metallic blue colour, while the male is a wonderful shining green with the thorax covered with a coat of golden hair.

During the summer months the so-called "Gold Beetles" (*Lamprima latreillei*) and the familiar "King Beetle" (*Anoplognathus viridæneus*) assemble in their thousands around the blossom and young growth of the eucalypts in a glittering, whirling swarm. Diamond beetles (*Chrysolophus spectabilis*) cling to every wattle tree upon the wooded slopes, together with hundreds of slender *Belus* weevils of several species. Throughout the valley the cicadas force themselves upon one's notice by their insistent screeching, which fills the air until one's head throbs with the vibration. The commonest species is the Yellow Monday (*Cyclochila australasiæ*), with a small black and red species belonging to the genus *Melampsalta* not far short of it in point of numbers. Toward dusk the nymphs of the Green Monday may be seen leaving their holes in the ground and crawling laboriously up the tree trunks prior to splitting their skins and emerging as adult insects to add their voices to the chorus the following day.

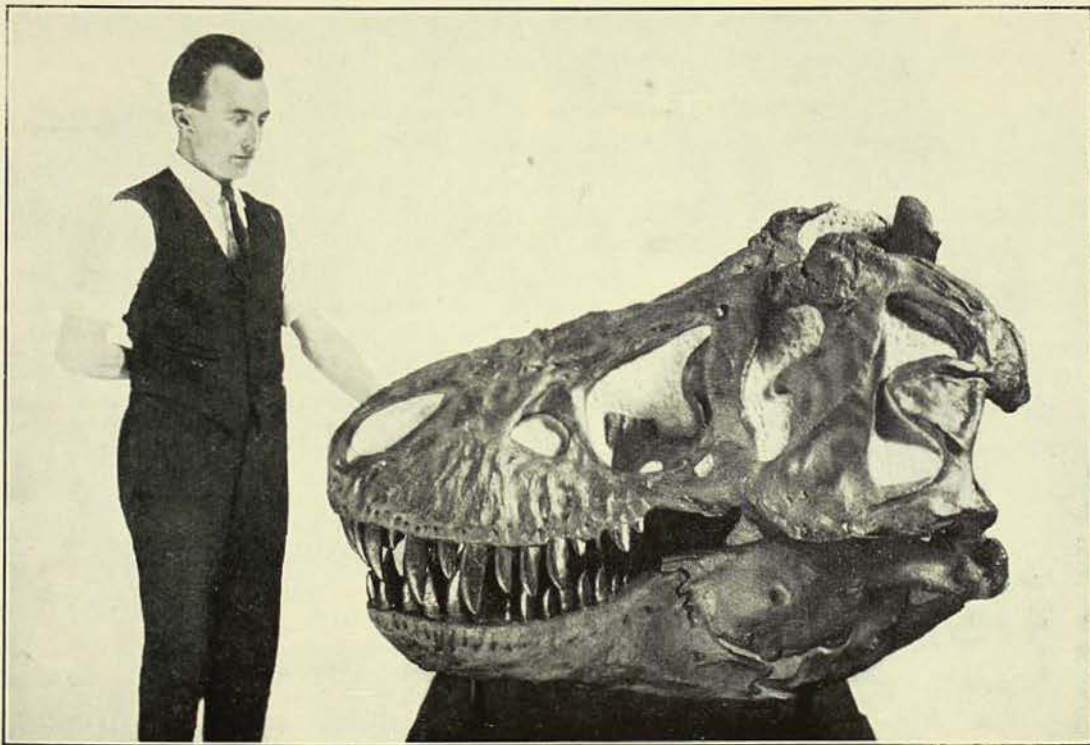
It is now some years since I last visited Joadja, and it is possible that these years have brought some changes, but these must be comparatively slight, for the valley still sleeps and its wild life is practically undisturbed. Memories of Joadja will always remain green, for it is one of the most fascinating localities in New South Wales for the naturalist and nature lover.

The Teeth of Reptiles

By C. ANDERSON, M.A., D.Sc.

EXISTING reptiles are divided into five orders, namely, Lacertilia (lizards), Ophidia (snakes), Chelonia (turtles and tortoises), Crocodilia (crocodiles, alligators, and caimans), and Rhynchocephalia (the tuatera of New Zealand); some zoologists recognize a sixth order, Rhiptoglossa, containing only the

play but a small part in mastication, except in a few forms which are habitually herbivorous; the majority, however, are insectivorous or carnivorous, and consequently their teeth are adapted for catching their prey and tearing it to pieces, although frequently it is swallowed whole.



Skull of *Tyrannus rex*, a large carnivorous dinosaur with long sharp teeth.

[From a cast in the Australian Museum.

[Photo.—G. C. Clutton.

chamæleon. But the living orders of reptiles are the survivors of a much larger assemblage that existed in the geologic past, and, moreover, the reptiles of today are relatively "feeble folk" when compared with such gigantic extinct forms as *Diplodocus*, which was over seventy feet long, and *Tyrannosaurus*, which was forty-seven feet in length and stood about thirty feet high when fully erect.

The teeth of reptiles are primarily associated with the procuring of food, but also with attack and defence. They

Not all reptiles have teeth; turtles and tortoises have horny beaks, although they are descended from toothed ancestors. Some extinct forms, too, were toothless, notably the giant flying reptile *Pteranodon*, one species of which had a wing-spread of twenty-three feet and a skull over three feet in length. It is supposed that *Pteranodon* was a fish-eater like the modern cormorant, and that, like the latter, it swallowed its catch whole.

There is considerable diversity both of form and mode of attachment in the teeth of reptiles, though generally speaking

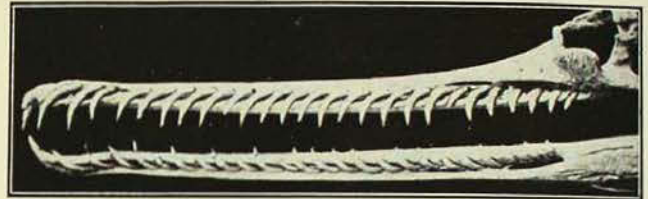
they do not exhibit the complicated structure and differentiation exemplified in the teeth of mammals.¹ The simplest form of reptilian tooth is a cone with only one root, but there are various modifications of this type. The teeth are usually pointed, erect, or recurved, but there are many varieties, depressed, hemispherical, or pavement-like; some are compressed or blade-like, with sharp serrated edges, others are chisel-shaped, or spade-like, and a few have several cusps. A highly specialized form is the poison fang of the venomous snakes. The crown of a reptilian tooth consists mainly of dentine capped with enamel; cement plays but a small part in its composition.

The mode of attachment of reptilian teeth is also diverse. In the extinct ichthyosaurs, or fish lizards, the teeth occupied a continuous groove; when this groove is crossed by bars of bone, forming partitions between adjacent teeth, we get the condition exhibited by the Crocodilia, in which each tooth is implanted in a pit and the dentition is said to be *thecodont*. When the teeth are cemented to the top of the jawbones, they are said to be *acrodont*; *pleurodont* teeth are attached by one side of their base to the flange-like inner rim of the jaw. It is not possible to associate these various modes of attachment with food habits, although it seems that thecodont and acrodont dentitions are mainly characteristic of carnivorous reptiles; both carnivorous and herbivorous forms are found amongst the pleurodents.

In mammals teeth are restricted to the jawbones proper, namely the maxilla and mandible, but in some reptiles teeth are also found on the bones forming the roof of the mouth. Reptiles also differ from mammals in tooth succession, for the latter are diphyodont, that is, have but two sets of teeth, while in reptiles, with few exceptions, the teeth are replaced irregularly and continuously, new ones growing up alongside or beneath the old ones, which are discarded when they become worn and useless.

THE CROCODILES.

The crocodiles and their allies are the largest existing reptiles, and, as they are rapacious animals, they are well armed with strong teeth, which are peg-like and deeply implanted in separate sockets; these sockets are formed before the teeth come up, whereas in mammals the teeth form their own sockets by breaking through the bone of the jaws.



Jaws of the gharial, an Indian crocodile with peg-like teeth, all similar. The bone has been removed to show the single fang.

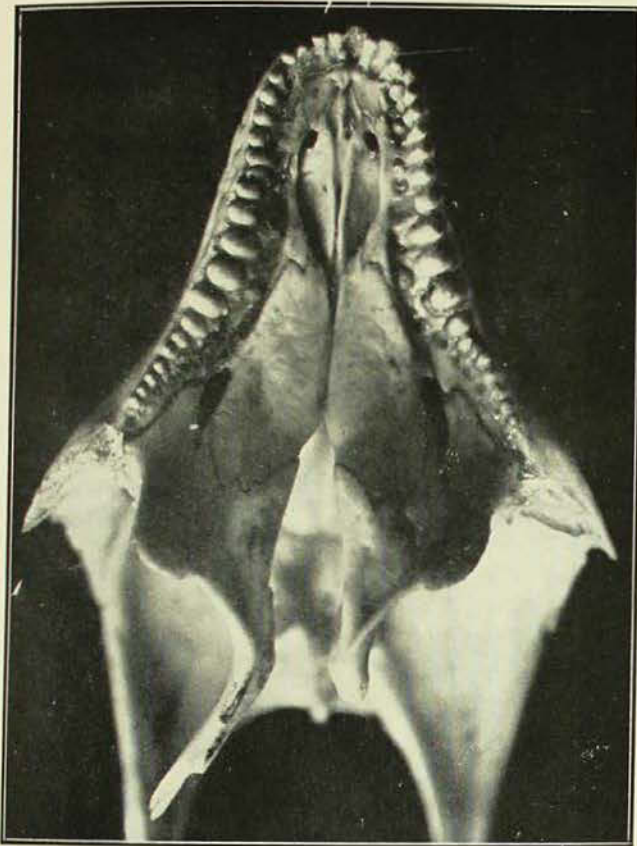
[From Lankester's *Extinct Animals*.

A large crocodile such as the Estuarine Crocodile (*Crocodylus porosus*), which is of common occurrence in northern Australia, can kill and devour animals of the size of a bullock, tearing the carcasses with its powerful, sharp-pointed teeth, which are all of the same type and differ only in size. The Gharial (*Gavialis gangeticus*), a genus of Indian crocodiles, which inhabits the basins of the Ganges, Brahmaputra, and Indus, has a long slender snout with about twenty-eight upper teeth and twenty-five lower teeth on each side, the teeth being slender and sharp. This crocodile lives exclusively on fish; indeed, its Hindustani name, *gharial*, means fish-eater.

TEETH OF LIZARDS.

The lizards constitute a varied assortment of reptiles and display considerable variety as regards their teeth; most are insectivorous or carnivorous, but some are wholly or partially herbivorous. The Australian Stump-tailed Lizard (*Trachysaurus rugosus*) lives on a mixed diet, and the Blue-tongue, an Australian skink of the genus *Tiliqua*, is partly herbivorous, as evidenced by its blunt, rounded teeth, though it seems to be mainly insectivorous. The goannas, however, which belong to the genus *Varanus*, are carnivorous and egg-eating, and their teeth are compressed

¹ Anderson: THE AUSTRALIAN MUSEUM MAGAZINE, III, 1929, p. 389.



Palate of the Blue-tongued Lizard, *Tiliqua scincoides*, in which the blunt teeth are fixed on the inside of a bony flange (pleurodont).

[From Australian Museum specimen.
[Photo.—G. C. Clutton.]

and slightly recurved, sharply pointed and with serrated edges. The largest living member of this family is the so-called Komodo dragon (*Varanus komodoensis*) of the East Indies, which grows to a length of about ten feet and lives partly



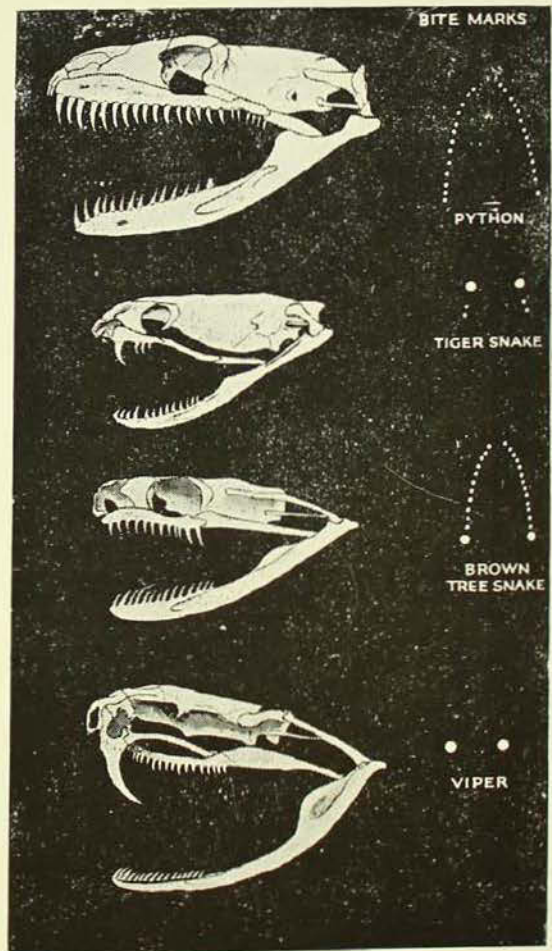
Skull of the Australian Frilled Lizard, *Chlamydosaurus kingii*. The teeth are cemented to the top of the jawbone (acrodont), and in front are a number exceeding the others in length.

[From Australian Museum specimen.
[Photo.—G. C. Clutton.]

on wild pigs and small deer, which it tears to pieces with its formidable blade-like teeth. A still larger species, growing to a length of seventeen or eighteen feet, formerly lived in Australia.² In devouring an egg the goanna holds its head high, cracks the shell, and allows the contents to flow down its gullet. The Sea-iguana of the Galapagos Islands, which lives on seaweed, has its teeth adapted for mastication, and, consequently, they become worn with use.

SNAKES.

The teeth of snakes are always sharp and recurved, and in most cases occur not only on the jawbones, but also on the palatine and pterygoid bones in the roof of the mouth. In poisonous snakes a pair of teeth

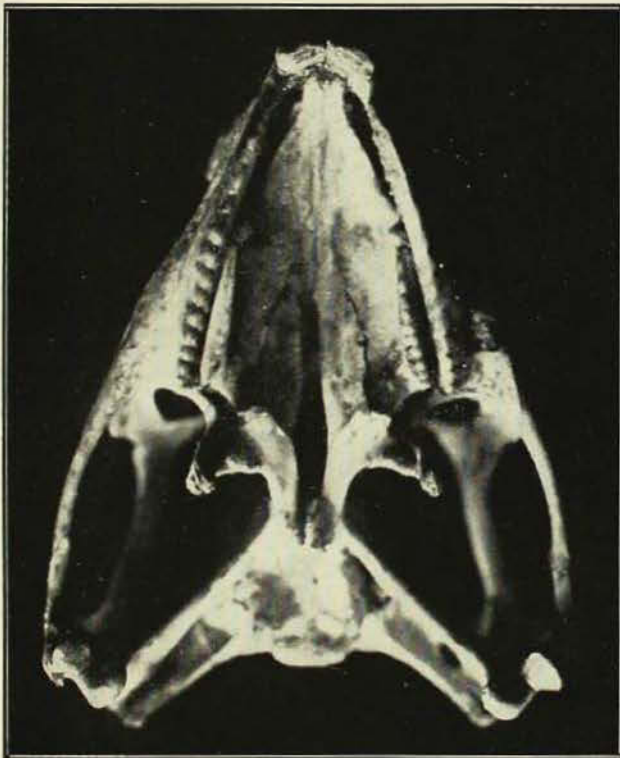


Skulls of snakes showing bite marks. At the top is a Python skull (such as Carpet or Diamond Snake, which are non-venomous, all the teeth being solid). Next is a Tiger or Black Snake, and at the bottom a Viper, all of which are venomous. The Brown Tree Snake with fangs at the rear of the jaw is only slightly venomous.

[J. R. Kinghorn, del.]

² Anderson: THE AUSTRALIAN MUSEUM MAGAZINE, III, 1927, p. 132; IV, 1931, p. 147.

are enlarged and have a groove on the anterior surface, or the groove may be converted into a canal. These poison fangs are connected at the base with poison glands, the venom being squeezed along the groove or canal into the wound inflicted when the snake bites. The venom-teeth may be either near the front of the mouth, when the snakes are said to be front-fanged, or towards the back of the mouth in the back-fanged snakes, which are much less deadly.



The palate of the tuatera, *Sphenodon punctatus*, of New Zealand, a very ancient form in which the upper teeth are arranged in two rows.

[Australian Museum specimen.
[Photo.—G. C. Clutton.]

In Australian venomous snakes³ the poison fangs are permanently erect. In the case, however, of vipers and rattle-snakes, the fangs are very large and are capable of erection and depression. Normally the fangs are bent back, but with the opening of the mouth they automatically assume the erect position. When the snake strikes, the muscles compress the venom-glands as a syringe is squeezed by a surgeon, and the venom is conveyed deep into the wound.

In non-venomous snakes, such as the boas (including Australian pythons and

rock-snakes), all the teeth are solid, and there are usually two rows in the upper jawbone or maxilla. These teeth are capable of inflicting a severe bite, but the larger prey of these snakes is killed by crushing, the snake enfolding the animal with coils of its body and squeezing it into a sausage shape before it starts its meal.

The egg-eating snake of Africa (*Dasypeltis scabra*) has a curious adaptation. It is a comparatively small snake, not over three feet in length, but it is able to swallow eggs as large as those of a fowl. The lower spines of some of the anterior joints of its backbone are long and have button-like extremities, which are capped with enamel, so that structurally they resemble teeth. These spines pierce the upper side of the gullet, and, as the egg, which is swallowed with difficulty, passes downwards, these projections break the shell, which is afterwards disgorged.

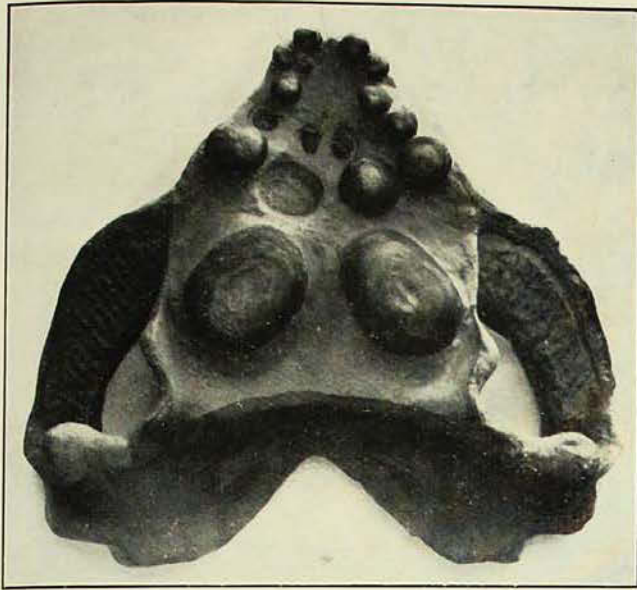
THE TEETH OF THE TUATERA.

This curious little reptile, which is now confined to some islands of New Zealand, is frequently spoken of as a lizard, but it is really a survival from long past geological ages, and has no living relatives. It has many structural peculiarities not shared by other living reptiles, and its dentition, too, is of an unusual type. The teeth are acrodont, and both above and below the jaws carry a pair of chisel-like teeth in front. The edge of the lower jaw is furnished with a single row of closely crowded teeth, but towards the back of the upper jaw there are two rows of teeth separated by a groove into which the lower teeth bite. There seems to be but slight replacement of teeth in this reptile, and, when they become worn, the edge of the upper jaw becomes ground down and converted into a cutting instrument. It lives on animal food of various kinds, such as insects, worms, and crustaceans, but it is likely that vegetable substances also form part of its diet.

BEAN-TOOTHED REPTILES.

The reptiles belonging to the extinct order Placodontia had very remarkable teeth, unparalleled among reptiles. They

³ Kinghorn: THE AUSTRALIAN MUSEUM MAGAZINE, 1, 1921, p. 22, and "Snakes of Australia," 1929.



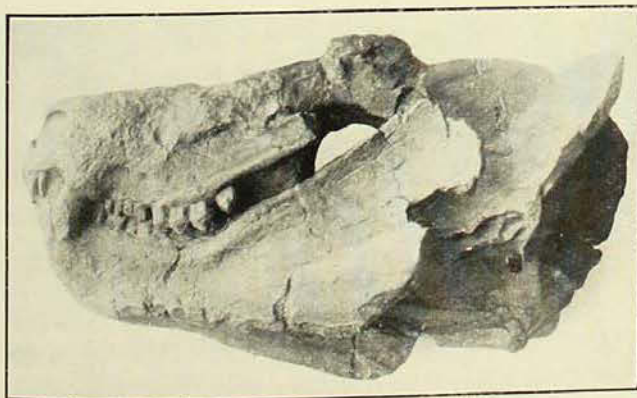
The pavement-like teeth of an extinct reptile, *Placodus laticeps*, which has large rounded teeth studding the palate and jaws.
[From a cast in the Australian Museum.
[Photo.—G. C. Clutton.

assemblage of animals which are known as dinosaurs dominated the earth, and by adaptive radiation played the rôles which are now largely the province of the mammals. Some were exclusively vegetarian, others strictly carnivorous, and their teeth were, of course, modified to suit their needs. Some had comparatively few teeth, but were equipped with bony beaks resembling those of the turtles; others had a dentition adapted for mastication of vegetable food; still others had long, sharp, serrated teeth, and preyed on their weaker relatives and other creatures that lived in these long past days. Of these reptiles the most formidable was *Tyrannosaurus*, a huge reptile with sabre-like teeth up to six inches in length, the largest terrestrial flesh-eater that ever lived.

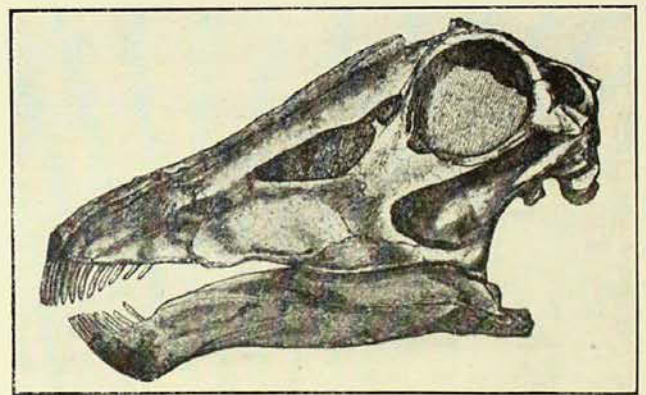
had a comparatively small number of round, flattened teeth covering most of the palate, but in front the teeth were chisel-shaped. In the genus *Cyamodus*, the palate of which is here illustrated, the teeth were not unlike the large Queensland beans which are sometimes fashioned into match-boxes and small ornaments. It is obvious that these teeth were used for crushing hard substances, and no doubt these reptiles haunted the shore and lived on crustaceans and molluscs.

DINOSAURS.

During the so-called Age of Reptiles, millions of years ago, the large and varied



The skull of *Cynognathus crateroides*, an extinct mammal-like reptile, in which the teeth are differentiated into incisors, canines, and molars as in mammals.
[From a cast in the Australian Museum.
[Photo.—G. C. Clutton.



Skull of *Diplodocus*, a herbivorous dinosaur, in which the teeth are slender, pencil-like, and confined to the front of the jaws.
[From Eastman-Zittel's *Text-book of Paleontology* (after Marsh).

Another group of dinosaurs, of which *Diplodocus* is a type, had a dentition of quite a different kind. These were possibly amphibious, spending much of their time in rivers and lakes and feeding on succulent vegetation, for their teeth were poorly developed, somewhat resembling an ordinary lead pencil. Yet it is apparent that the teeth of these sauropodous dinosaurs are derived from those of carnivores and have lost their sharp points and serrated edges. It has been suggested that *Diplodocus* and its relatives had a body cavity too small to accommodate a supply of vegetable food sufficient for such large animals, and that their diet was of a more concentrated nature such as fish, their long mobile necks enabling them to

dart on their slippery prey, which was swallowed without mastication.

THE MAMMAL-LIKE REPTILES.

Another group of extinct reptiles is of special interest because it is believed that from them the mammals originated. These cynodont (dog-toothed) reptiles, as they are called, have been found chiefly in

South Africa, and their dentition is remarkable in that the teeth, unlike those of other reptiles, are heterodont, that is, they are not all of one general shape but are, like mammalian teeth, differentiated into incisors, canines, and molars, and in some cases the succession of teeth is partly according to the mammalian plan, namely diphyodont.

Obituary

DR. ALFRED ELAND SHAW.

By the death of Dr. Eland Shaw at Sydney, New South Wales, on June 16, 1931, the science of entomology loses one of its most capable and enthusiastic devotees. He was born at Carlow, Ireland, in 1861, and was educated at Rathmines School, Dublin. Before he graduated in medicine (M.R.C.S., 1892; L.R.C.P., Lond., 1892) at St. Mary's Hospital, London, he worked for some years at the British Museum. In 1910 he arrived in Australia and commenced practice at Healesville, Victoria. Later he went to New Guinea, and subsequently set up practice in Wynnum, Queensland. On account of ill-health, about 1925, he came to New South Wales, and served as ship's surgeon in the Australian-Oriental Line and on the Union Steamships Co.'s vessels *Niagara* and *Aorangi*. He was engaged also in relief medical work at Waterfall Sanatorium, near Sydney, and at Callan Park and Rydalmere Mental Hospitals.

His first papers on the Orthoptera were published in England, and were as follows: "Synopsis of the British Orthoptera," *Ent. Month. Mag.*, Vols. XXV-XXVI, 1889-1890; and "Orthoptera and Neuroptera in Lincolnshire and Nottinghamshire," *Ent. Month. Mag.*, Vol. XIV,

1903. During his residence in Australia, he published six contributions on the Blattidæ (Cockroaches), a group in which he specialized. These appeared in the *Victorian Naturalist*, 1914 and 1916; *The Memoirs of the Queensland Museum*, 1918; *Proceedings of the Linnean Society of New South Wales*, 1922 and 1925; and *Queensland Naturalist*, 1924. Prior to his departure from Queensland he had presented his collection of Blattidæ to the Queensland Museum, and shortly before his death he presented his Card Index to the Blattidæ and his library of scientific literature to the Australian Museum. He was a Fellow of the Entomological Society of London since July 4, 1883, and a member of the Linnean Society of New South Wales since 1922. He was a familiar figure in scientific circles and was ever ready to assist in determining unnamed material or in supplying unrepresented species.

We of the Australian Museum staff who were privileged to enjoy his friendship extend to his widow and two daughters, Mrs. B. M. E. Lindsaye and Miss G. H. E. Shaw, our deepest sympathy in the loss they have sustained.

A. M.

Lake Burrill and How Our Coastal Lakes Were Formed

By FREDERICK D. MCCARTHY.



Burrill Lakes. The conspicuous Pigeon-House Mountain, so named by Captain Cook, may be seen on the extreme left.

[Photo.—F. D. McCarthy.]

THE eastern coast of New South Wales is studded with numerous lakes and lagoons, some of them, such as Lakes Macquarie, Tuggerah, Wallis, and Myall, to mention some of the better known, being of considerable size. These indentations offer an extremely interesting field of study to the naturalist. He may study the origin of a lake, the reasons for its present condition, its fauna and flora, the freshwater life of the streams running into it, and in all a comprehensive survey can be made.

Nature is constantly lowering the highlands, using as its agents water, wind, and ice: the dissected nature of the country around Sydney, especially the Blue Mountains, is a very good example of the ability of streams and rivers to carry out the task set them. Such is in marked contrast to lakes, which receive the

sedimentary matter of the waterways which run into them. This waste matter is either deposited around the lake shores, or emptied into the sea.

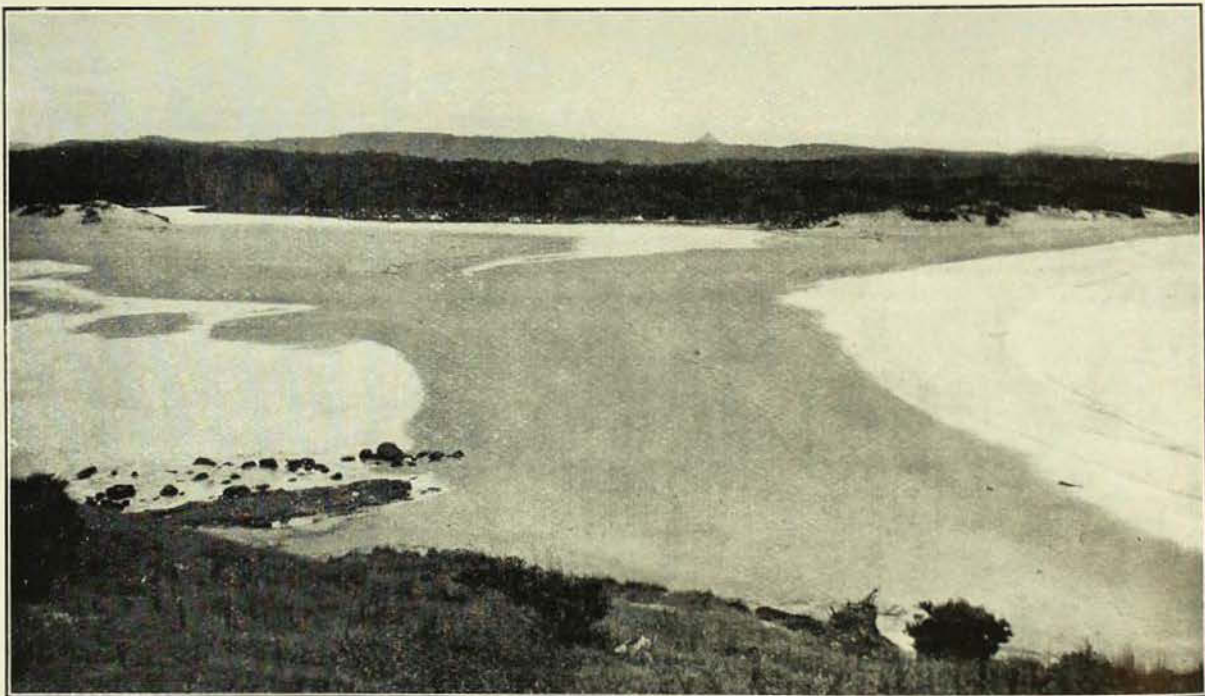
Most of our lakes and lagoons were formed by a change in the relative levels of the land and sea, either by subsidence of the land, or by a rise of the sea-level. Thus the water was able to fill the depressions and low valleys along the coast, and to transgress for considerable distances along the river courses and form what are known as drowned valleys, of which Broken Bay and Port Jackson are typical examples.

While on a trip to the south coast I was able to make some observations on the development of a good example of coastal lakes, Lake Burrill, which is situated about one hundred and sixty miles south of Sydney, and two and a half south of Ulladulla.

The surrounding country is hilly and rugged, and towards the upper end of the lake is very fertile. The Ulladulla Hills enclose the lake, the north arm of which extends for some miles into them, and is joined by Cabbage Tree Creek. The Pigeon-House Mountain, of which Captain Cook says in his diary: "Sunday, 22nd April, 1770—'A remarkable peak'd hill laying inland, the top of which looked like a Pigeon house, and occasioned my giving it that name.'" It forms a famous landmark, about fifteen miles to the west, and Mount Kingiman, a flat-topped precipitous mass, lies between. A ride to the Pigeon-House took us through typical

and Wallinga; Lake Conjola is to the north of this group. It was in this region that Captain Cook first saw our aborigines.

In the case of Tabouree there is an interesting development at its entrance. Crampton Island is situated about two hundred yards from the beach, directly opposite the mouth of the lake. A sand-spit has been built up, connecting the island to the shore and closing the lake, which is very shallow and not very large. It will probably be opened to the sea again by flood waters, in spite of the fact that the sand-spit is being continually added to. Dermal and Meroo are small lakes and very shallow.



Sand-spit at the mouth of Lake Tabouree, with the surf on each side. Pigeon-House Mountain is discernible near the centre of the horizon.

[Photo.—F. D. McCarthy.]

rain-forest country. The giant trees of various kinds are an inspiring sight in the deep valleys and on the sides of the ridges, where numerous birds could be heard calling and singing. The Clyde River rises on the south-western side of the mountain.

Lake Burrill is about seven miles long from its entrance to the head of the north arm, and about five miles up the south arm; it has approximately thirty miles of shoreline. It is one of a group of lakes along a curve of the coastline from Warden Head to Murramarang, the others being Lakes Tabouree, Dermal, Meroo,

The silting of lake and river entrances is governed by many conditions—tides, currents, waves, rate and volume of flow of the water to the sea, width of entrance, prevailing winds, and the contour of the land around the entrance. Floods are an exceptional condition, undoing the work and arresting its progress, while storms very often hasten the work, and a severe one may completely close an entrance. Flood tides set up strong currents, and may alter the mouth of a lake considerably.

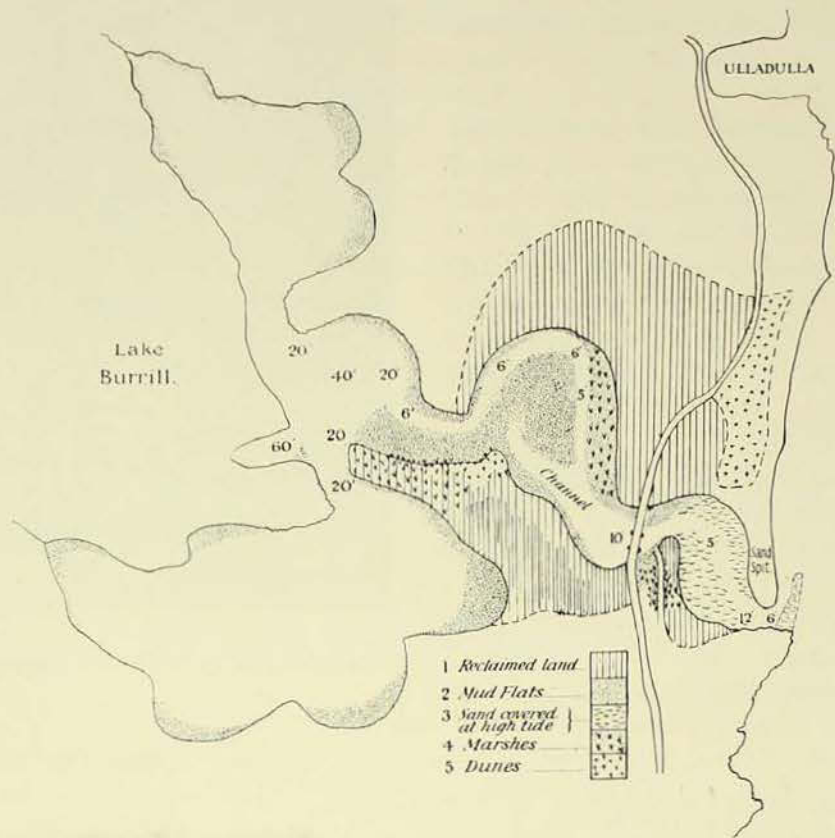
In the case of rivers which are used for navigation, the closing of the channel by sand is a serious matter. On the north

coast of New South Wales it has been found necessary to construct breakwaters across the sand-flats, and the channel has to be continually dredged to preserve it. Thus, if the continuous flow of rivers which are hundreds of miles long and drain enormous areas of rainy mountainous country cannot keep their entrances open and clear of sediment, it is quite easily understood why so many of the coastal lakes are closed up. The various factors have soon piled up a barricade of sand across the mouth, as for instance at Narrabeen Lakes. Here the current is not very strong, but the rivers have a much greater flow, consequently the process is slower.

DEVELOPMENT OF LAKE BURRILL.

When the valley which forms this lake was invaded by the sea it was very wide, extending from a headland on the north to a rocky peninsula of high land on the south, and it had an entrance about a mile wide. It was then a bay, much bigger than the present lake, and the contour of the surrounding country helped in no small degree to shape its future. The lake opens out into two arms, and the currents from these have converged, forming a stronger one which flows to the sea. From the entrance for about one mile inland, it is very shallow; the water is not more than six feet deep in the channel, except at the road-bridge, where the swirling current has deepened the narrowed channel. On the flats the depth is from one to three feet at high tide, but at low tide these areas are mostly uncovered. Above this the lake deepens suddenly.

Deposition has commenced by the beach being gradually extended from each side, in this case being built up mainly from the north, so narrowing and stabilizing the entrance against the rocky southern shore, and by sedimentation of the foreshores of the lake. On the north



side, as will be seen in the diagram, a ridge juts out for about one-quarter of a mile into the lake. This has caused the current to flow towards the south shore, leaving a great expanse of quiet water in its lee, where conditions were particularly favourable to sedimentation. Weeds (*Zostera*, *Posidonia*) flourished in the shallow water, and held the silt as it was deposited. These weeds, which are slender leaved, and flourish in shallow water, are common in the coastal rivers and inlets, fringing channels, and often covering extensive areas of sand and mud flats in the form of a zosteretum. Such is the home of innumerable invertebrates, while fish of many kinds find these areas rich feeding grounds when covered by water.

Silting has progressed comparatively rapidly in this area. Similarly on the south side the gently sloping land of the peninsula was also favourable to deposition, and a long narrow flat, Simmons's Flat, juts out into the lake. It is dry, being about a foot above water-level at its extremity, where it is covered with reeds and grass. Nearer the shore is a thick growth of trees.

As the water got shallower on these flats reeds took the place of the weed, and marshy conditions prevailed. The wind became the next factor in the reclamation. It carried sand back from the beach and deposited much of it over the swamps, thus building them up until they were dry. After a time vegetation was able to take root, and the land was then completely reclaimed.

The activity of the wind in such work will be realized if the reader is at all familiar with the beaches, and Cronulla is perhaps one of the best examples close to Sydney; it resembles the beach at Lake Burrill, but is much longer. Here, a line of sand dunes, up to thirty feet in height, extends along the whole length of the beach, for a distance of about half a mile back, covering the vegetation, and burying the trunks of the trees, so that often the crowns of branches and leaves only project. As the wind loses its carrying power, there is a thinning out of the sand farther back, and the size of the particles decreases, as the smallest grains are carried the greatest distance. Wind-blown sand grains are more rounded from friction than the beach sand.

There is a large area of sand-flat between the beach and the road-bridge at Burrill. This is due to the comparatively small quantity of water flowing to the sea being unable to cope with the amount of sediment that is brought down, and, therefore, this matter in suspension is deposited mainly on these flats, the balance being emptied into the sea. A sand-bank is being built up about fifty yards out from the beach. A portion also is added to the beach, and the remainder, consisting of very fine silt, is carried away by the ocean currents.

The choking of the entrance has caused a curious alteration of depth higher up the lake. As before mentioned, the shallow flats continue for about a mile inland from the entrance, but at this point there is a drop to forty feet and even greater depths.



Sand-dunes at Cronulla illustrating the covering of the vegetation.

[Photo.—J. S. Rolfe.]

Thus the sedimentation is gradually working back from the mouth, but its progress is blocked at the point where the currents from the two arms converge into a narrow channel. Along this line of demarcation there is a swirling, as the current from the south arm flows along the wall of sediment till it meets that from the north arm, and the even deposition of the silt is thus prevented. As a result all the bays along the sloping shores in the vicinity, and in the two arms of the lake, are being silted up, leaving deep channels in the middle. In some cases where deep gullies have been "drowned," their banks are formed of sandstone, sloping steeply; in one instance there is a perpendicular face of about eighty feet; there are great depths in the middle, reaching sixty feet. These will be the last to be filled up.

Unless the entrance is kept open, so allowing the inflow and outflow of a tidal current, the slow but sure building up of the shallow areas will continue until these also will become reedy swamps, later to be added to the already reclaimed portion, and the deep portion at the head of the lake will then be land-locked; floods may arrest this process, but would not prevent it. The water is now flowing out at the entrance through a narrow channel, of which the south bank is rocky, and the

north is the beach. From the deep water, the channel, running across the shallow flats, has gradually shifted its bed from the south to the north bank, cutting away the latter and building up the former into mud flats. Thus there is a series of steps by which the land is reclaimed : from the deep water to the shallow weed flats ; the marshes and swamps ; the low dry flat

on which trees are beginning to take root and on which clusters of reeds are growing ; and the thickly vegetated areas which were sand dunes.

The mud has destroyed much of the shell life. On the weed flats the cockles have been smothered by it, the dead shells forming thick layers, the weeds having in many cases taken root in them.

School and College Collections

FROM time to time the Museum supplies schools and colleges with collections of natural history specimens for educational purposes. That these are appreciated is evidenced by the following letter from the Redemptorist Fathers, Pennant Hills.

The Secretary,
Australian Museum,
Sydney.

18th June, 1931.

Dear Sir,

On Saturday the 13th inst. we received delivery of consignment of specimens forwarded by you. Everything was in perfect order and all in accordance with the lists.

On behalf of the Collegiate authorities I extend to you our most sincere thanks for this munificent gift. Though we expected much from your kindness, our expectations were more than fulfilled.

All who saw the collection could not sufficiently eulogize your generosity.

The chief purpose of a National Museum being to promote scientific interest, we were most gratified to see that our Australian Museum, at any rate, is true to its colours. For we believe, Sir, that your present was not a contribution to us personally, but rather a helping hand extended in the interests of science.

Mindful of this, the only suitable recompense we feel we can bestow on the pains you took to oblige us, is by treasuring and exhibiting to advantage the foundation collection with which you have presented us, by making our subsequent additions worthy of their beginning, and by placing ourselves at your disposal, should you feel that, at any time in the future, we might be of some service.

I remain, dear Sir,

Yours very sincerely,

J. P. HOGAN, C.S.S.R.

Lectures

Popular Science Lectures will be delivered in the Australian Museum Lecture Theatre on the following dates at 8 p.m. Admission is free. The Lectures are illustrated by cinema, lantern slides and exhibits.

July 30, "Antarctic Experiences," H. O. Fletcher ; Aug. 13, "Latest Deep-Sea Research," T. Iredale ; Aug. 27,

"Bats as Friends and Enemies of Man," E. Le G. Troughton ; Sept. 10, "Sharks," G. P. Whitley ; Sept. 24, "The Ascent of Man (Human *versus* Animal Characters)," Professor Harvey Sutton, O.B.E., M.D., B.Sc. ; Oct. 8, "Poisonous Animals," Professor W. J. Dakin, D.Sc. ; Oct. 29, "Scenic Wonderland of Australia," E. C. Andrews, B.A., F.G.S.

Mr. E. H. Rainford, of Bowen, Queensland, has recently presented some extremely interesting sea-stars to this Museum. Mr. Rainford has for many years studied the marine life of Port Denison, and from his activities on our behalf we are sure to receive many new and valuable specimens.

Special efforts will be made to secure for this Museum a representative series of all the known sea-stars from Port Denison, a locality that has never been

systematically studied from this angle since the days of the "Alert" Expedition. Careful search during the last few weeks has resulted in the discovery of some very rare species. These have been added to the Museum collection and will later form the basis of a scientific report. Knowing of Mr. Rainford's wide experience and the absorbing interest he takes in his work, we can look confidently forward to a repetition of his earlier successes.

Megascolides, the World's Biggest Earthworm

By CHARLES BARRETT, C.M.Z.S.

MEGASCOLIDES AUSTRALIS, largest of all the 1,800 known species of earthworms, has recently gained a further distinction; it is the first annelid to be "filmed." We made the picture at Loch, in the Bass River Valley, on a farm which appears to be Megascolides' headquarters, since everywhere on the flats and hill slopes one hears the weird groaning gurgle of the giant moving along its burrows. And almost any moist spot is worth prospecting by the collector, whether he seeks worms or their egg capsules, or both.

The giant earthworm of south Gippsland is becoming famous, oversea as well as in Australia. Specimens have been sent to

museums and other institutions, and many "commissions" are being received from Europe and the United States. We are not anxious to supply the world with examples of *Megascolides*, but special cases do receive attention. A fine specimen, properly preserved at full length extension, was forwarded to the Zoology School at the University of Edinburgh, where it is duly appreciated.

America desires proof that Australia is the home of the greatest living earthworm; a professor of zoology writes for two or three specimens, giving an assurance that all expenses will be met. My friend, the farmer whose property is rich in *Megascolides*, has received



Giant Earthworm partly out of its burrow. This specimen measures about six feet in length, not fully extended.

[Photo.—C. Barrett.]

numerous requests for specimens, photographs and notes on haunts and habits. But our keen interest in the giant earthworm, of course, is not even remotely commercial, and help in securing material is given only in the case of a museum or university zoology department.

Several years ago I became interested in *Megascolides*, when staying with Mr. L. C. Cook, of Holbrook, between Loch and Poowong. Both nature lover and farmer, Mr. Cook has lived all his life in south Gippsland, noting wild Nature's ways, and, in recent years,



"Persuading" a giant to leave its burrow.

[Photo.—C. Barrett.]

Living examples of *Megascolides* were a star attraction at the Wild Nature Show organized by the Field Naturalists' Club of Victoria, in connection with the club's jubilee celebrations in Melbourne last year. The novel exhibit was featured in the Press, and thousands of citizens came to gaze in wonder, maybe mingled with a feeling of disgust, at the giant annelid.

paying special attention to the giant worm. He has an unrivalled knowledge of the creature in its haunts, and, during several visits to Holbrook, I have qualified as his understudy.

One need not be an enthusiast in earthworm studies to delight in digging for *Megascolides*. Size is not its sole claim to a naturalist's notice; it is in

other respects a most remarkable annelid, and much remains to be learned concerning its life-history and habits. We are not certain, even, whether it forms castings, like the familiar garden earthworms.

Nor have we definite information as to size. On my latest visit to Loch, I heard of earthworms fifteen feet in length! My informant was a leading townsman, and his statement was supported by others. But the monsters dug up on "Jim's farm" were measured only by estimate, not a foot-rule or a tape. We cannot believe yet in fifteen-foot worms.

Mr. Cook considers twelve feet as about the limit; he has actually seen a specimen eleven feet in length—it was carefully measured. The largest one I have seen was eight feet long when extended.

Length varies greatly with contraction and extension. A four-foot worm will lengthen itself, if looped over a bough or a spade handle, to at least seven feet. If one which measures about three feet when removed from its burrow be held aloft, either head or tail downward, it will gradually double its length. Our measurements are based on natural extension, not on "drawing-out." By the unlawful method it *might* be possible to record a fifteen-foot specimen; but *Megascolides* is liable to break under such barbarous treatment, despite a generous allowance of rings and its surprising elasticity.

Not perhaps a fatal parting, for regeneration is a prerogative of earthworms. The tail, however, is more often reproduced than the head, and *Megascolides*, rudely handled, is prone to lose its head! Yet an earthworm has been known to reproduce its head five times. Another specimen was cut into nearly a dozen pieces, and each section developed into a complete worm. A tail has been produced between two heads, and a head at each end of a decapitated and de-tailed earthworm. Regeneration, you see, is wonderful and freakish.

In his great treatise on "The Oligochæta," Dr. J. Stephenson, of Edinburgh, describes *Megascolides australis* as the largest known species of earthworm; but his length figures are smaller than those we have



Three Giant Worms looped over a spade, extended until their heads and tails touched the ground.
[Photo.—C. Barrett.]

recently recorded at Loch. Specimens six feet or seven feet have been measured, Dr. Stephenson states, but such big ones apparently are not common. The average,

we agree, is 1,230 millimetres (a little over four feet), and specimens over six feet are not nearly so numerous as worms of lesser size. Still, an hour's digging at Holbrook, any day in the "season," may produce several six- or seven-foot worms.

over it, you hear the loud and curious gurgling sounds that always betray the giant worm's presence.

Moisture is essential to *Megascolides*, for comfort, for locomotion, for life itself. Death is the penalty of dryness. A giant worm left on the surface in the daytime



Making the first cinema film of *Megascolides*—and the first moving picture of an earthworm yet made in any country.

[Photo.—C. Barrett.]

Again, you may dig until your arm muscles ache without finding a "big one." Many yard-long worms or four-foot specimens, and some egg capsules, are sure to be revealed. I have seen more than a score of fair-sized worms unearthed from a bit of sloping ground above the creek—an area of only a few square yards. The ground, in many spots, is a maze of *Megascolides* burrows; walking

and unable to retreat into a burrow, soon dies, unless in the grass or moistened by rain. I have kept specimens alive for several days, in a kerosene tin half-filled with soaked clods of earth from its habitat. No sign of feeding was observed, and very little movement; my captives were content to remain loosely coiled among the clods. Their destiny was to become museum specimens.

Sloping creek and river banks, fertile flats, and green knolls with a southerly aspect, are favoured for their burrows by the giant worms. The rich dairy lands and potato fields of the lower Bass Valley are thickly populated by these great annelids. Thousands are turned up by the plough, and the best place to search for their eggs is a newly-ploughed field. What a feast for the birds! No; birds, with one exception, turn up their beaks at *Megascolides*. Even those kinds that eat little earthworms with evident relish cannot stomach pieces of the giant. Perhaps they are appalled by its proportions, or mistake it for a serpent.

The exception is the kookaburra. Mr. Cook, more than once, has seen a laughing jack engaged in a tug-o'-war with a giant worm. The bird uses strategy to gain its meal. Darting from its observation perch, it seizes the protruding head of a worm. The giant immediately contracts, having its tail end anchored, perhaps several feet down in the burrow. The kookaburra, without loosening the grip of his beak, yields a little length. A few moments' waiting, then the bird suddenly tugs again, his victim having lowered resistance. Another violent contraction follows, but the worm now has some inches more of its body in the open. Thus the tussle continues, until the luckless annelid breaks under the strain or is hauled clear from its burrow.

Some residents of Loch and neighbouring districts assured me that kookaburras do not prey upon the giant earthworm. But these men are not close observers of wild life, like my farmer friend of Holbrook. And he does not call the kookaburra a menace to *Megascolides*. He only records that which he has observed on rare occasions.

Parasites, disease, and the plough are the giant worm's chief enemies, the latter taking heaviest toll in many parts of the creature's limited range. *Megascolides australis* is confined to south Gippsland, and the capital of its territory is in the Bass River Valley. It is so abundant, that even intensive cultivation is unlikely to make it scarce. Indeed, a campaign of destruction would be futile and extremely foolish, too. Darwin has shown us the

value of earthworms, in sweetening and top-dressing the soil.

But does *Megascolides* do any top-dressing? It has not been observed depositing "digested" earth on the surface, and the large turrets of grey mud, with a hole going deep underground, though plentiful in its haunts, are surely the work of land-crabs. We know, however, that, sometimes at least, giant worms make use of these doorways to an underground world.

Megascolides, like other earthworms, as it burrows "eats the ground." And the soil it has swallowed, with nutrient particles extracted and absorbed, is ejected—whether in the form of surface castings, or disposed of in some other way, we have yet to learn.

Megascolides has been nicknamed the "barking worm," a title suggested by those of the "barking lizard" (an engaging little gecko) and the "barking spider" of Central Australia. The gurgling and sucking sounds are loud enough to startle anybody who hears them for the first time and is ignorant of their cause. A weird sort of groaning from the ground beneath one's feet might foster a belief in gnomes or some mysterious animal. Even when you are familiar with the giant worm's "voice," a louder gurgle than usual may make you step quickly aside.

The noises, of course, are produced by the worm's peculiar mode of progression through its burrow. One end, say the tail, is expanded and wedged against the walls, while the remainder of the body extends. Then the head is expanded, and the tail "anchor" deflated, allowing the stretched body to contract again. Thus, extending and contracting, the giant moves along. The walls of the burrow, which winds and falls and rises, are lubricated with cœlomic fluid, ejaculated by the worm from dorsal pores. Progress is swift and easy through such well-oiled tunnels of just the right size for their tenants and makers, whose bodies measure up to three-quarters of an inch in diameter.

This cœlomic fluid is not merely a burrow lubricant; it attacks bacteria on the worm's body, and also, perhaps, is a defence against parasites which endeavour

to bore their way into the giant's body. Luminosity in certain species of earthworms is, I believe, due to this fluid, which analysis has shown to contain nematode and protozoan parasites, as well as crystals.

When hurt or frightened—if an earthworm can feel pain or experience fear—the giant sprays coelomic fluid from its dorsal pores; the thin jets are milky coloured and visible if you have a close-up view. Commonly, on handling a specimen we have seen the fairy jets from its pores, a very curious sight.

Big earthworms, in some countries, are used as food. The Maori esteemed no fewer than eight species. The earth having been squeezed from them, worms for the feast were thrown into warm water in a vessel heated on hot stones. They dissolved in due time, and greenstuff being added to the mess in the pot, a dish "fit for the gods" was ready for hungry mouths. The late Sir Baldwin Spencer, whose monograph on the anatomy of *Megascolides australis* was published in 1888, notes a medicinal use for the giant earthworm. When decaying, the creature passes into an oily fluid. Professor Spencer was assured by two old blackfellows that this fluid was a very good remedy for rheumatism!

In China and Japan, a preparation of dried earthworms is used in cases of

fever; it possesses anti-pyretic properties. Ashes of earthworm are used in Burma as tooth powder.

As regards size, *Megascolides australis* has possible rivals in South America, among the dozen or more species of the genus *Rhinodrilus*, *R. fafner*, Dr. Stephenson states, when extended measures up to 2,100 millimetres (about seven feet), and is 24 millimetres (nearly one inch) in diameter. Larger specimens may exist, but, so far, none to equal our twelve-foot Gippslanders has been recorded. *Megascolex giganteus* grows to over four feet in length. This genus of six or seven species is represented in Victoria and New Zealand, also southern India. Tropical South America is the home of another genus of giants, *Glossoscolex*. There are some fourteen species, and one, *G. giganteus*, attains a length of over four feet.

Megascolides of Gippsland deposits its egg capsules from a few inches to several feet underground. Mostly they are found netted in grass rootlets. They are of a horn-brown colour, sometimes almost black, generally light and semi-translucent, and measure two to three inches in length. Specimens found in May and June contained worms over six inches in length, pale pinkish-purple in colour, and nearly the thickness of a lead pencil.

At the Microscopical Society's recent meetings the following lectures have been delivered: "The Embryology of the Oyster," by Mr. T. C. Roughley; "Pond Life," by Mr. A. Monkman; "Marine Borer Investigations in Port Jackson," by Messrs. F. A. McNeill and R. A. Johnson; "Discoloration of Paints with regard to Smuts and Molds, and Mealy Scale," by Dr. C. W. Ryder.

The meetings are held on the first Thursday in each month at 8 p.m. in the

Australian Museum Lecture Theatre. Those interested in Microscopy are cordially invited to attend.

* * * *

Messrs. Tom Iredale, Gilbert P. Whitley, and Melbourne Ward have recently returned from the Embury-Hayter Great Barrier Reef Expedition to North-West Islet, Queensland, where they made a large collection of marine animals and delivered series of lectures to members of the camping party.

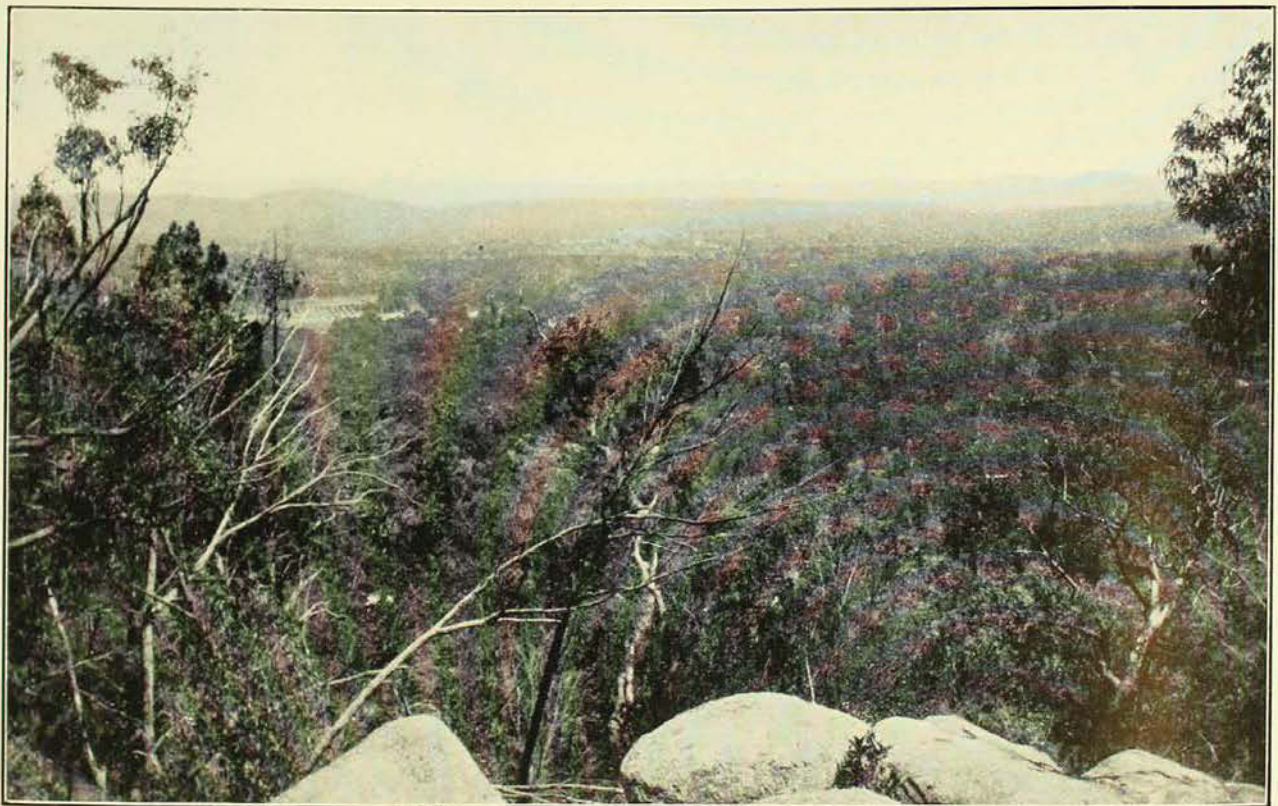
The Stanthorpe Granite Belt

By H. C. BARRY.

A TRAVELLER on the main Sydney to Brisbane railway on leaving the border at Wallangarra will notice a sudden change in the country he is passing through. In place of the flat pastoral lands around Tenterfield are now seen rugged hills covered with granite boulders of all sizes. Here and there, wherever a few clear acres can be obtained, orchards are scattered, for Stanthorpe,

Dalveen, forty miles from Wallangarra. Here the granite outcrop ends as abruptly as it began, and one enters the beautiful country of the Darling Downs.

Of recent years I have had the privilege of spending several vacations near Stanthorpe, and have been able to devote a considerable time to studying the bird and mammal life found there. The orchardist soon decides for himself which



View of granite belt country south of Stanthorpe.

[Photo.—H. C. Barry.]

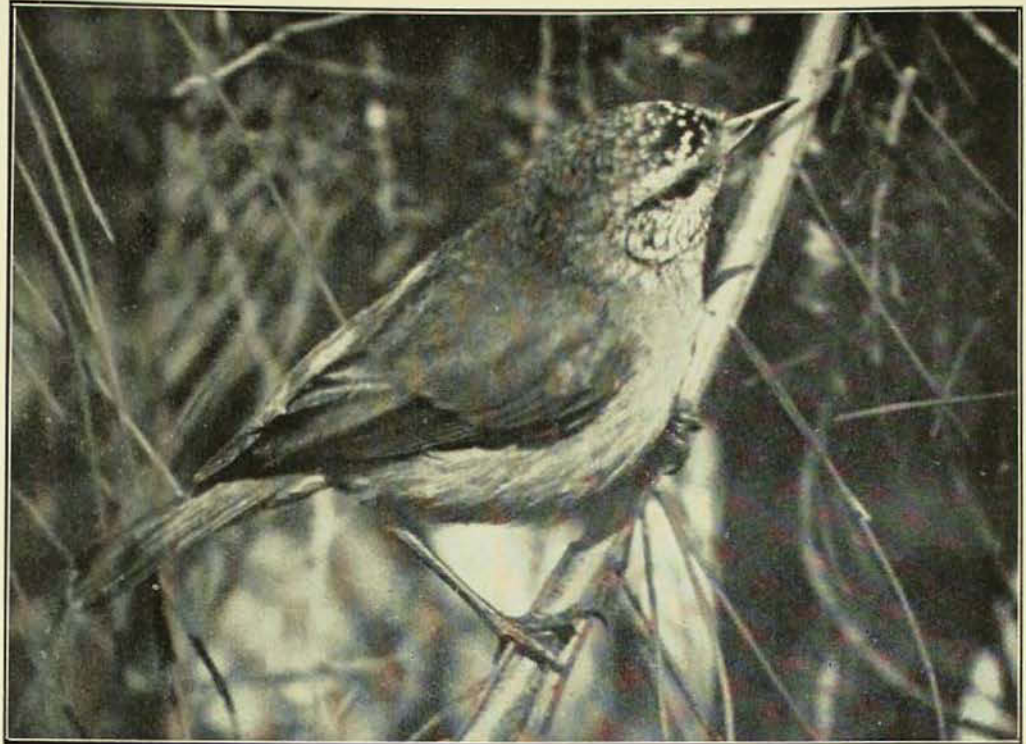
the main town, is the centre of a large and prosperous fruit-growing industry. Apples, grapes, peaches, and plums are the main crops, and some of the farmers have long and rough roads to traverse with their cartloads before reaching the various sidings scattered along the railway line. The Summit (3,030 feet) is reached seven miles past Stanthorpe, and from there a steady decline is maintained to

birds he likes to have around his trees, and those that he must wage perpetual war against when the fruit is ripe. Flocks of the Yellow-tailed Thornbill (*Acanthiza chrysorrhoa*) and the Spotted-sided and Banded Finches (*Zonaginthus guttatus* and *Steganopleura bichenovii*), commonly called Diamond Sparrows and Double Bars, were common in the orchard. Honeyeaters, particularly the Spinebill (*Acanthorhynchus*

tenuirostris) and the Yellow-faced (*Meliphaga chrysops*), were always in the trees, and nests were often found when picking. These birds were always welcome, but Friar Birds or Leatherheads (*Philemon corniculatus*), Wattle Birds (*Anthochaera carunculata*) and Rosellas (*Platycercus elegans*) found no peace, and small shotguns were used to keep them away. The Rosellas I think did little harm, and it was pitiful to see the way they were

being thinned out. Flocks of Lorikeets were flying past every day in search of flowering eucalypts. The "Green Leek" was the commonest, but was often in company with the Purple-crowned species. Now and again they would come down in flocks on the apple trees, and, although they are usually seen only when travelling at terrific speed, yet once they had started eating they could often be knocked over by sticks. At night when the bird war ceased, flocks of Flying Foxes (*Pteropus poliocephalus*) arrived, and provided further use for the shotguns. They soon, however, became extremely wary and used not to arrive till nearly midnight.

On the bush roads the typical birds of inland country towns were met with. Among these may be mentioned the Apostle Birds (*Struthidea cinera*), the Babblers (*Pomatostomus temporalis* and *superciliosus*), the Soldier Birds or Noisy Miners (*Myzantha melanocephala*), and White-winged Choughs or Black Magpies (*Corcorax melanorhamphus*). They are all well known to country folk by a variety of names. All are found in little flocks of from four to a dozen birds, and their nests together with those of magpies, butcher birds, and peewees are familiar



Yellow-tailed Thornbill approaching nest.

[Photo.—H. C. Barry.]

figures in a country landscape. The Apostle Bird's and peewee's mud nests are very much alike, whilst that of the White-winged Chough, also a mud builder, is a huge structure in keeping with the bird's size. The large domed nests of the Babblers are by far the most plentiful and are mainly unoccupied. The Blue-faced Honeyeater (*Entomyzon cyanotis*) was fairly plentiful, though I failed to find it nesting, and an occasional Storm Bird or Channel-billed Cuckoo (*Scythrops nova-hollandiae*) was sometimes seen.

Kestrels (*Falco cenchroides*) hovered over the orchard all day long; they were nesting freely in hollows of dead trees. Dollar Birds (*Eurystomus orientalis*) were also numerous and were also occupying vacant hollows in large trees right into February. The Red-tailed or Banksian Black Cockatoo (*Calyptorhynchus banksi*) was occasionally found quietly feeding or seen flying over. I always met with three at a time (probably parents and young bird), though I believe two is the usual clutch. In the more heavily timbered country one might hear the call "wee-la," of the larger Yellow-tailed Black Cockatoo (*Calyptorhynchus funereus*). They were usually busy tearing off strips from the

stringy bark trees in their search for borers and were quite unconcerned at my presence. At night the mournful notes of the Stone Curlew (*Burhinus magnirostris*) were heard. It is found in timbered country, but is very shy and is becoming very rare wherever the fox is plentiful.

A large dam provided a happy feeding ground for many waders. The alarm notes of the Spur-winged Plover (*Lobibyx novae-hollandiae*) would be heard long before I saw them, and soon a small flock of these birds would fly off, followed by numbers of the Straw-necked and White Ibis (*Threskiornis spinicollis* and *molucca*), and of the large Yellow-billed Spoonbill (*Platalea flavipes*). Cormorants or shags, and White-fronted Herons or Blue Cranes, were always about, and Tree Martins (*Hylochelidon nigricans*) nested in hundreds in the hollows of the dead trees around the dam. The Australian Darter or Snake Bird (*Anhinga novae-hollandiae*) was a visitor there, but could not always be seen. A few splashes would be all that remained of some water lizards which love to bask on a branch overhanging the water. Goannas (*Varanus*) soon scented an intruder and raced over the ground to some deserted rabbit burrows which served as a common retreat. The commonest reptiles were the Jew or Bearded Lizards, which were often seen basking in the sun. Immature "Jews" about six inches long were especially plentiful in the sandy soil on the orchard.

Coming home one full moonlight night I chased two Ring-tailed 'Possums (*Pseudochirus laniginosus*) among some dwarf eucalypts by the side of the dam. When they were separated, the larger, which I took to be the mother, called her young one to her by a persistent low squeak.

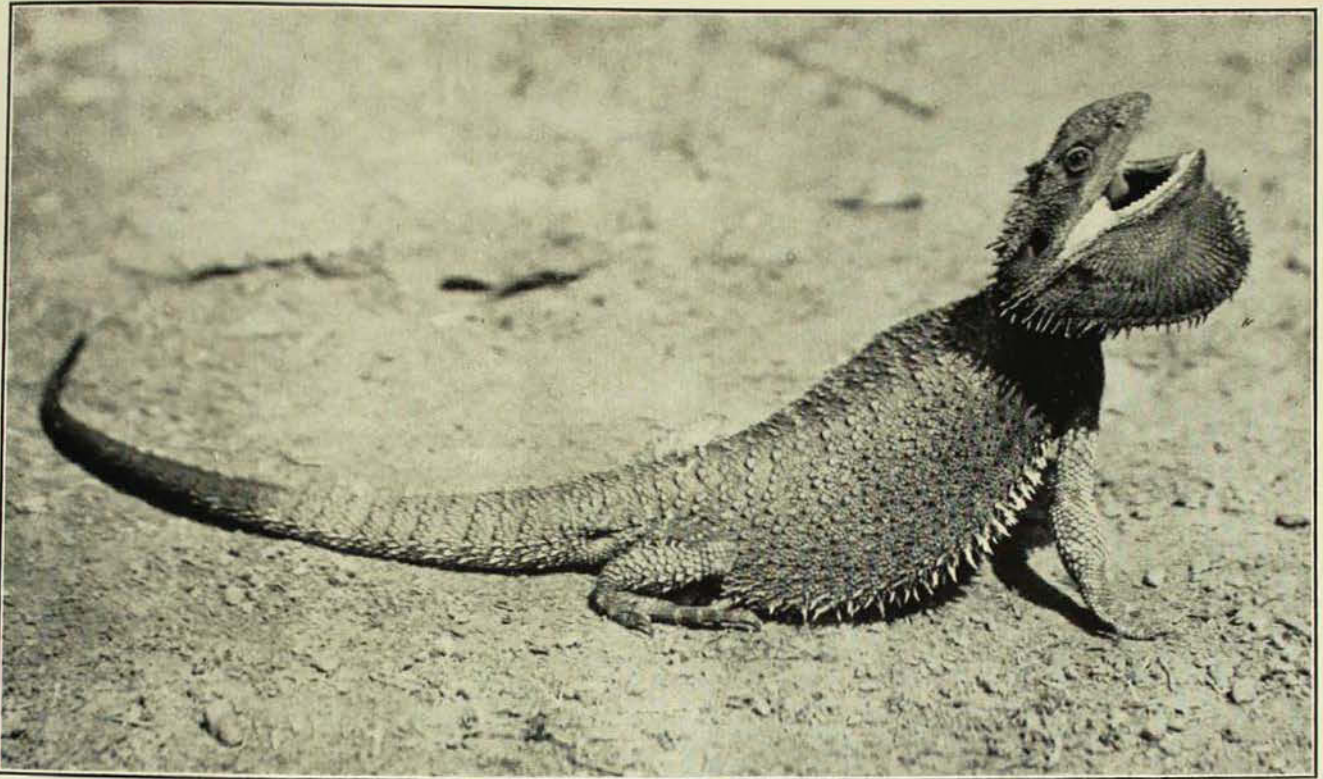
The smaller insectivorous birds were very numerous and cannot be mentioned here at length. One of the most interesting was the Speckled Warbler (*Chthonicola sagittata*), or Speckled Jack as it is



Mud nest and young of the Apostle Bird (*Struthidea cinerea*).
[Photo.—H. C. Barry.]

frequently called. I often found it in company with the little Yellow-tailed Thornbill quietly hopping over the ground. It builds a dome-shaped grass nest, usually placed right on the ground. The rough nests of the Yellow Tails were common objects, and I found nests occupied as late as February.

A visit was made one day to a 'possum farm owned by a returned soldier at Amiens, a few miles out of Stanthorpe. He had patented a fence and in a small enclosure had about fifty animals of the common Silver-grey type (*Trichosurus vulpecula*). In the daytime they were contained in a hutch consisting of many separate boxes. In the evening they were fed on fruit from the orchard as well as the eucalypts they got for themselves. The fence was about five feet high, overlapping at top and finished by hanging a vertical iron run of two feet from the overlap. A Tiger Cat (*Dasyurus maculatus*) was found in the enclosure one morning and the little Sugar Squirrel (*Petaurus sciureus*) sometimes got trapped. The small enclosure was only a preliminary breeding place to a large farm which the



Jew or Bearded Lizard (*Amphibolurus barbatus*).

[Photo.—H. C. Barry.]

owner had in view. The animals nearly all had young and seemed to thrive on their fruit diet.

While I was watching some of the 'possums I saw a White-eared Honeyeater (*Meliphaga leucotis*) flying round and pecking at a tree near by. On walking closer I saw it was chasing a little Pouched Mouse (*Phascogale flavipes*), which was on the tree trunk. My presence frightened the mouse into a small crevice and prevented the honeyeater from getting the desired fur for its nest. This same honeyeater has a habit of trying to get hair from human beings during the nesting time.

On various occasions I inquired from bush folk with regard to lyre birds in the district. I knew that the Prince Edward Lyre Bird was found in the granite belt, and also a wombat (*Phascolumys gillespiei*), both of which I was anxious to meet. I soon found out that they were confined to the country south of Stanthorpe. There the land is of a more rugged nature, covered with granite boulders of immense size, and consequently providing less room for settlement. Through the kindness of a friend I was

able to stay at his home set among hills with only an isolated orchard at intervals of a mile or two. On the afternoon I arrived I was walking through a flourishing vineyard in season when suddenly came the unmistakable notes of a lyre bird about a hundred yards away. A White-eared Honeyeater was calling on top of the hill, and the lyre bird was repeating his note every time. I climbed up the hillside quietly, but the bird ceased his song and I thought I had lost any chance of seeing him. Soon scratchings were heard on the opposite side of a large rock, and on creeping round I came face to face with a male bird. A sudden alarm note was given; he perched for a moment on a dead branch, and then made off up the hillside. From the homestead the birds could be heard calling every morning; each kept strictly to its own hillside. They appear to be holding their own very well in spite of the prevalence of foxes in the hills.

The Brush-tailed Rock Wallaby (*Petrogale penicillata*) is still found over a wide area, but sad to say it appears to be decreasing rapidly. The first orchards in the district have their fence posts pointed to prevent

the wallabies hopping over, but nowadays there is no such need. We made a trip to some hills where wombats were said to be found. Wallaby tracks were numerous, and a large Red-necked or Brush Wallaby (*Macropus ruficollis*) went hopping past. The wild rocky country should also suit the wallaroo, though I did not see it. Once among the large rocks one of the party found tracks and droppings of a wombat, and we continued to find their traces along a hillside for half a mile. Several burrows were found; all under huge granite boulders and impossible to excavate. There were many attempts

where the animals had met with granite and had to abandon the burrow, and their rootings were common in the grass near by. Unfortunately, I had not the time to set traps or camp on the spot, and so did not obtain a glimpse of the animal. Strangely enough, although it is generally known by people of the district that wombats are found in the hills, no one had ever seen one, or knew of one having been seen. Being of such a sturdy build, and having absolute protection afforded it by the everlasting granite, it should remain a curio for many years to come.

The H. M. Stephen Collection of May-flies

By ANTHONY MUSGRAVE.

THE insect collections of the Australian Museum have recently been enlarged through the kindness of Mr. H. M. Stephen, who has presented a splendid collection of over five hundred specimens of May-flies (Ephemeroptera) collected by him in Australia and Tasmania. May-flies have always been neglected by collectors, as their great fragility makes them extremely difficult to preserve, the bodies of some species almost "breaking down of their own weight," as it has been observed. They do not therefore make suitable gallery exhibits, the vibration from footfalls soon shivering them to pieces; for this reason the specimens presented will not be placed on view. Mr. Stephen, a disciple of Izaak Walton, made his collection from a desire to learn something of the group which forms the favourite food of trout. As he has visited places such as the Great Lakes, Tasmania, and Mount Kosciusko, where fly-fishing is the vogue, we find the collection rich in specimens collected in these parts. In Australia, Dr. R. J. Tillyard appears to be the only entomologist who has paid any attention to the group, but very little has been published on the Australian species apart from the information given by Dr. Tillyard in his *Insects of Australia and New Zealand*.

MAY-FLIES AND THEIR LIFE-HISTORY.

It is to the great Dutch naturalist, Swammerdam, that we owe our earliest complete knowledge of the May-fly, for in 1675 he published an account of its life-history, the species studied by him being now known under the name of *Palingenia longicauda*. We are told that, to make his dissections of the May-fly, Swammerdam used instruments so delicate that they required to be sharpened under a microscope. His great work "Biblia Naturæ" was posthumous, and included the life-histories of over a dozen insects. It is melancholy to reflect that so excellent a scientist should have died in abject poverty at the age of forty-three.

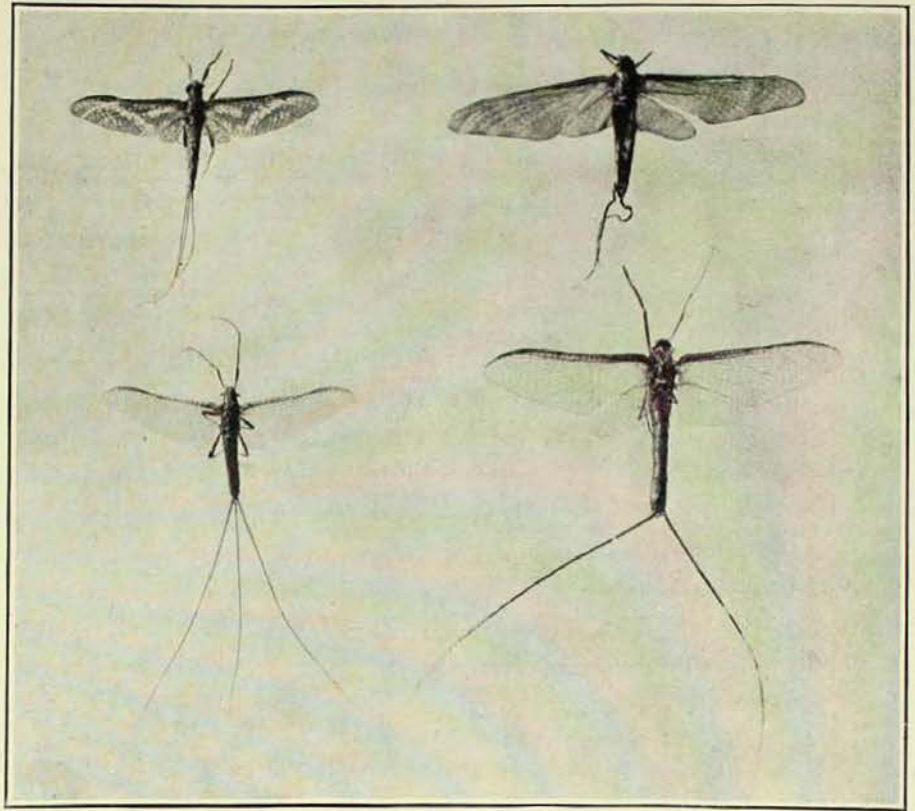
May-flies are delicate insects with fragile gauzy wings, short antennæ, vestigial mouth-parts, hind-wings small and reduced, and with usually three long tail filaments at the end of the body.

The winged forms make their appearance about dusk, and in a former article I have written in THE AUSTRALIAN MUSEUM MAGAZINE of a Museum party's encounter with them while camping on the banks of the Nepean River near Norton's Basin. May-flies are aquatic during their early stages. The larvæ on emerging from the eggs move about over the bottom of the stream, hide under rocks, or burrow in

the banks. Some forms are carnivorous, others vegetarian. They are elongate creatures with powerful legs, three tail filaments, and a system of paired gills arranged along the segments of the abdomen. When first hatched they have no gills, these appearing about the second moult or instar. The larvæ change their skins repeatedly as they develop, no less than twelve changes or instars taking place, the wing-buds appearing about the sixth moult and gradually increasing as the larva develops in size. A larva when full-grown climbs up a rock, or swims to the surface of the water, and there the skin splits and the insect flies forth to rest

on some neighbouring rock or bush. This first winged stage is called the *pseudo-imago* or *sub-imago*. This stage is one of the most remarkable features of the group. The whole of the body and wings are invested in a delicate skin which, according to Dr. Tillyard, is shed in from three to four days or only a few minutes in the highest types. Then they dance over the water seeking their mates. The wings of the *sub-imago* are clouded, those of the *imago* or adult being clear and transparent.

The classification of the order Ephemeroptera or Plectoptera is given by Dr. Tillyard in his work on Australian insects, and he records four families for Australia. The first two families have the hind-wings well developed, from one-half to one-third as long as the



Examples from the H. M. Stephen Collection of May-flies. These illustrate the extreme fragility of these insects and their delicate wing structure.

[Photo.—G. C. Clutton.]

fore-wings. These families are the Ephemeridæ (including one species known only from the larva) and the Siphonuridæ (including four Australian species). In the last two families the "hind-wings are very small or absent, at most less than one-fourth as long as fore-wings." These families are the Leptophlebiidæ (including twelve Australian species) and Bætidæ (three Australian species). The characters which subdivide these families are based on the venation of the wings, which is given in Dr. Tillyard's book, but being of a complicated and technical nature, it need not be dealt with here. It is interesting to note that the May-fly fauna of Australia and New Zealand is not adapted to hold its own against the introduced Brown and Rainbow Trout.

The Corella

By A. W. MULLEN.

Commissioner of Western Land Board.

THE Corella (*Kakatoe sanguinolenta*) is a Central Australian bird; it is also found in the north-western corner of the State, but it seldom comes east of the stony timberless hills beyond the Bulloo Overflow claypans in New South Wales.

It is a white parrot with a faint tinge of yellow in the under wing and tail feathers, its short crest when raised discloses delicate pink feathers and there is bare blue skin, about half an inch in diameter round its dark brown eyes, hence the name the Blue-eyed Parrot by which it is known amongst the inhabitants of the "Back o' Beyond." Its bill and crest are shaped like those of the Galah, than which bird it is somewhat larger.

The subject of this narrative was secured by a black boy in 1904 in the hollow of a gum tree on the edge of the waterhole in Sturt's historic Depot Glen on Mount Poole Station near Milparinka, New South Wales. Close to this Glen, Sturt's assistant, John Poole, was buried, under a beefwood (*Grevillea*) tree on which is cut ^{JP}45, and an obelisk of sandstone suitably inscribed now marks the spot where he has slept since July 17, 1845. From Poole's grave can be seen the cairn that Sturt caused to be erected on top of "Red Hill" or Mount Poole. This cairn now forms the southern corner of two counties, Poole and Tongowoko, and from its summit long lines of fence stretch as far as the eye can see true north, south, east and west on lines laid out by pioneer surveyors.

Such were the surroundings of the birth-place of our Corella now in his twenty-sixth year.

I brought him into Bourke, about 300 miles, in the days of horse-drawn vehicles, and was obliged to hand-feed him all the way as he was only a fledgeling.

Once home he became the property of my four children and immediately endeared himself to the whole family.

He soon learned to talk and would call the children by name and mimic the dog and fowls, and could also sneeze and cough in an almost human fashion.

The children one night were firing off crackers close to his cage when he became frightened, and seizing his loose drinking tin (a shallow preserved-meat tin) in one claw he placed it over his head to hide what was to him a terrifying scene. Ever since then, for twenty-five years, he has worn a tin pot on his head all night. When we found he used the loose tin for a plaything we gave him another tin for water. He places the tin on his head before falling asleep and keeps it on like a night-cap until the first streak of dawn wakens him.

During the years he has worn the tin hat he has worn out at least four tins. One got so damaged from constant use that it gave him the appearance of a school-boy in a broken-crowned straw hat, the bird's crest feathers sticking out through the rent. When matters reached this stage, my youngest boy went to a lot of trouble to make a new hat for "Cockie" and threw the old one away. But "Cockie" had no use for the new tin. He pined for the old one and kept all our neighbours and ourselves awake at night trying to explain by shrill screeches what a loss he had sustained. This went on for three weeks and the old tin could not be found, but one day he was placed on the lawn in his cage and a sudden thunder-storm drenched him; in desperation, he jammed the new tin on his head and has been happy ever since. Now if a new hat is required the old one is removed when he is asleep and the new one substituted. He knows there is a difference, but has grown wise with age and he adopts the new hat without protest.

When I left Bourke in 1912 with my wife and family, "Cockie" also was a train passenger, in his cage, which was placed on a shelf in the guard's van. As soon as the train started, the tin hat was put on to shut out such unaccountable sights and sounds. The guard had a sense of humour and "Cockie" held an unconscious levee at every stopping-place on the journey, during which he did not once remove his helmet to inspect the curious acquaintances of the guard.

When we reached Sydney the guard allowed me to take delivery of the bird at the van, but on the way to a vehicle the hooded bird attracted great attention and a crowd followed me until we were all whisked away in cabs. My wife and I now reside in one of the beautiful North Sydney suburbs, and "Cockie" spends his days in a pepper tree from which his cage is suspended. He most assiduously employs his waking hours wet or dry in barking the limbs of this tree. Between

meals and when night approaches or he hears me coming home from town, he enters his cage and gives his native call to attract our attention. We then remove his cage to a hook on the back verandah, and he puts his hat on and settles down for a well-earned night's sleep. He has forgotten how to fly, but climbs every day from his open cage to the pepper tree and so lives very close to nature.

Our household is now limited to ourselves and youngest son, for whom he will go through all his tricks, dance, jump, whistle, cough, sneeze or kiss. The other members of the family are scattered far and wide, yet, despite the fact that they have attained man and womanhood, he knows them all, and greets them by some mannerism when they visit us.

His plumage is as white as snow and as perfect as that of a young bird. He really is only a youth in the parrot world, for, it is said, these birds live to a century, and he is only in his late twenties.

A cast of the brain case of Peking Man (*Sinanthropus pekinensis*) has been added to the collection and placed on exhibition. This interesting and important specimen was found in a cave at Chou Kou Tieu, near Peking, in December, 1929, by Mr. W. C. Pei, a young Chinese geologist. It combines features exhibited by the Ape-Man of Trinil, Java (*Pithecanthropus erectus*) and the Piltdown Man of England (*Eoanthropus dawsoni*), but shows that Peking Man was generically distinct from both and also from modern man (*Homo sapiens*). In skull and brain characters Peking Man links together these two primitive hominid types and enables anthropologists to form some idea of the structure and organization of their common ancestor, the hypothetical Tertiary Man.

* * * *

Mr. G. A. V. Stanley, B.Sc., who has recently returned from New Guinea, has presented to the Museum a fine collection of over one hundred stone axes from the Mandated Territory.

Mr. Charles McAndrew, of Shellharbour, New South Wales, recently presented twelve aboriginal stone axes obtained in that district.

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In connection with the opening of Science House, a number of exhibits, zoological, ethnological and geological, were put on view there from May 7 to 9.

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Three fine examples of trees carved by the aborigines were obtained in the Mungle Scrub, near Boggabilla, Moree District, New South Wales, and presented to the Museum by Mr. H. K. Nicholson, of "Glenesk," Moree, on whose property the trees were standing. We are indebted to Mr. V. H. Mahoney, of the Railway Department, for bringing these trees under our notice, and to Mr. L. W. Gill, Resident Engineer, Camurra to Boggabilla railway, for his kind offices in securing the specimens and having them conveyed to the Museum.

Book Review

AN ANTHOGRAPHY OF THE EUCALYPTS.
By Russell Grimwade, B.Sc. (Melb.).
(Angus and Robertson, Limited,
Sydney.) 1930. Price: 42s.

In 1920 Russell Grimwade delighted us with his *Anthography of the Eucalypts*, a work charmingly illustrated in monochrome. Now we have the second edition which surpasses its predecessor. There are more illustrations, which are admirably reproduced.

The aim of the book is to stimulate an interest in things pertaining to our eucalypts, to promote their cultivation and to direct consideration to the economic value of our forests, all worthy objects. Mr. Grimwade has dipped into history and begins his *Anthography* with a reference to Anderson and Nelson, the naturalists on board the *Resolution* and *Discovery*. He credits these with having introduced the eucalypts to the civilized world. William Anderson used the name *Aromadendron* to distinguish them, but a few years later, 1788, L'Herétier gave the genus the name we know so well.

The eucalypts are confined practically to Australia, though the genus extends to Papua and the Austral-Malayan region. In Australia the author estimates that the genus forms three-quarters of our natural forest. *Eucalyptus* ranges over the whole continent "from tropic to sub-temperate zones, from sea-level to an altitude of 5,000 feet, with ten inches or less to

ten feet or more of annual rainfall, from clefts in rocky sandstone to luscious loam—everywhere, certain members of the genus persist." Indeed it has been acclimatized in many parts of the world, California, the Mediterranean, North and South Africa boasting groves and avenues. In size the eucalypt is from a few feet to upwards of three hundred. It provides us with many things, some species timber of beauty and value, others merely firewood, some yield honey, others essential oils so useful in perfumery, but, perhaps, most of all useful is the oil justly famed for its medicinal properties. Are we not all familiar with the names of R. T. Baker and H. G. Smith, who so thoroughly investigated the essential oils and employed certain tree-products as a means of classification?

More than one hundred species are described. The descriptions are accompanied by plates beautifully printed in colour. It is evident that considerable trouble and great care have been taken in all details. The descriptions and information are well arranged and face the illustration of the species. The work contains a useful glossary and there are indexes to both scientific and popular names.

The publication must be of considerable satisfaction to both author and publisher, for it reflects great credit on all concerned in its production.

W. A. R.

Among those donors who, from time to time, enrich the collections of the Australian Museum, may be mentioned the name of Dr. K. K. Spence, for the Entomological Department owes a great deal to his generosity.

For some years he was established at Clermont, Queensland, a district better known to entomologists as "Peak Downs," and the type-locality of many Australian insects. For the past two years, however, he has practised in Sydney and, despite

the fact that this district has been well combed for insects, he has, nevertheless, brought to light many interesting forms. Apart from being a collector of all orders of insects, he is a keen student of the order Coleoptera (beetles). Many of his captures from Clermont and Sydney are in the cabinets of the Museum. In entomological literature his name is beginning to take its place among those collectors who are doing so much to advance Australian entomology.