

longitudinaliter oblique crassistriatis, duobus apicalibus brevibus, cæteris lente accrescentibus; apertura rotunda, peristomate albo, nitente, dentibus plicisve tribus instructo, plica parietali conspicua, acinaciformi, dente labiali prominente, plica columellari interna subtus marginem columellarem.

Long. 5, lat. 2 mm.

Hab. Grahamstown.

This is the largest species of the minute *Enneæ* described in this paper. We have seen four specimens, all precisely alike. The shell is of the *infans* type, and is conspicuous for its rounded aperture, the lip bearing a very prominent parietal plait; only one external tooth (the labial), while a deep-seated internal plait below the columellar margin is the third and only other process observable.

EXPLANATION OF PLATE XVIII.

- Fig.* 1. *Ennea Margarettae*.
Fig. 2. — *cimolia*.
Figs. 3-5. — *Farquhari*.
Fig. 6. — *Wottoni*.
Figs. 7, 8. — *labyrinthea*.

LXVI.—Description of a new Characinoid Fish of the Genus *Parodon*. By G. A. BOULENGER, F.R.S.

Parodon caliensis.

Dentition as in *P. suborbitalis*, C. & V., $\frac{2-8-2}{3-3}$; præmaxillary teeth fringed. Depth of body $3\frac{1}{3}$ to $3\frac{1}{2}$ in total length, length of head 4 to $4\frac{1}{4}$ times. Snout prominent; diameter of eye equal to length of snout, $3\frac{1}{2}$ to $3\frac{2}{3}$ times in length of head, interorbital width 3 times. Dorsal 12, originating a little nearer end of snout than base of caudal, the last rays above base of ventrals, longest rays $\frac{3}{4}$ length of head. Anal 8, longest rays $\frac{3}{5}$ length of head. Pectorals a little shorter than head. Ventrals not reaching vent. Caudal deeply forked. Scales 39-40 $\frac{5}{7}$, 5 between lateral line and base of ventral. Silvery, olive-brown on the back; seven or eight dark vertical bars on each side.

Total length 75 millim.

Several specimens from the Cali River, near Cali, Colombia, 3200 feet, collected by Mr. W. F. H. Rosenberg.

LXVII.—*Descriptions of Two new Snakes of the Genus Calamaria.* By G. A. BOULENGER, F.R.S.*Calamaria brachyura.*

Rostral a little broader than deep, visible from above; frontal longer than broad, more than twice as broad as the supraocular, shorter than the parietals; one præ- and one postocular; diameter of the eye equal to its distance from the mouth; five upper labials, third and fourth entering the eye, fourth smallest; first lower labial in contact with its fellow behind the symphysial; two pairs of chin-shields in contact with each other. Scales in 13 rows. Ventrals 201; anal entire; subcaudals 9. Dark grey-brown above, with six black longitudinal lines, which disappear on the anterior half of the body; two outer rows of scales black and white; a narrow yellow cross-band on the nape; head black above, with a small yellow spot on each præfrontal and parietal shield; upper lip white; lower parts white, with a black spot at the outer end of each ventral shield; a black line along the middle of the tail.

Total length 275 millim.; tail 8.

A single specimen from Mount Kina Balu, N. Borneo, collected by Mr. A. Everett.

Calamaria mindorensis.

Rostral a little broader than deep, visible from above; frontal longer than broad, twice as broad as the supraocular, shorter than the parietals; a præ- and a postocular; diameter of the eye equal to its distance from the mouth; five upper labials, third and fourth entering the eye; symphysial in contact with the anterior chin-shields; two pairs of chin-shields in contact with each other. Scales in 13 rows. Ventrals 193; anal entire; subcaudals 15. Brown above, with longitudinal series of black dots; a yellow spot on each side of the neck; a white spot on each scale of the outer row; upper lip and lower parts yellowish; a black spot at the outer end of each ventral; a black line along the middle of the tail.

Total length 240 millim.; tail 13.

A single specimen from Mindoro, Philippine Islands, collected by Mr. A. Everett.

LXVIII.—*Australian Entomophytes, or Entomogenous Fungi, and some Account of their Insect-Hosts.* By ARTHUR SIDNEY OLLIFF, Government Entomologist New South Wales, Fellow Ent. Soc. London, Life-Member Ent. Soc. France *.

THE Entomophytes, or Entomogenous Fungi, a remarkable group of parasitic plants which live upon and at the expense of various insects, appear to attain their highest development in Australia, Tasmania, and New Zealand. They may be said to be more or less familiar objects to the tourist, to whom dried but seldom perfect specimens are offered for a few pence, and for whose benefit wonderful stories are related as to their origin. At many of the smaller hostelrys bundles of specimens may be seen ready for the curiosity-seeker; and others are commonly to be obtained from the guides, both white and Maori, in the holiday resorts, especially in the hot-lakes district of Rotorua. These travellers' tales, to some of which we have alluded in detail, have a curious interest of their own, and are by no means confined to the casual observer. They have received currency even at the hands of entomologists and botanists, from whom some hesitation might have been expected in accepting the wild statements made by persons entirely ignorant of the habits and structure of both insects and fungi. It is singular that certain obviously erroneous statements regarding the identity of the hosts upon which these parasitic fungi thrive (although long since corrected by competent observers resident in the countries where the Entomophytes occur) should recur again and again in books of travel and in the writings of systematic entomologists. The worse offenders in this respect, as an examination of the literature of the subject will show, are the lepidopterists, especially those who confine themselves, with a mere pretence of an examination of structural characters, to describing the wing-markings and colouring of such specimens as come before them, a class from which we, in Australia, are unhappily not entirely free. Strangely enough, when other workers holding different views as to the value of the so-called species, established by these describers by methods which can only be compared to those employed in matching pieces of floor-cloth, find it desirable to combine or to disregard these alleged species, it is this very class of lepidopterists who

* From a separate pamphlet issued by the Department of Agriculture, New South Wales, for which we are indebted to the Author.

are loudest in their talk of the necessity for careful breeding of the insects and the observation of their habits and transformations, although wholly disregarding these points themselves. Truly where there is most noise there is least hurt, and it is not to this class of worker that we look for reliable information.

The first, and to this day (from the entomological point of view) the most complete, account of these insect-fungi was issued in 1858 by the late George Robert Gray, Assistant Keeper of the Zoological Department of the British Museum *. This memoir was privately printed, and bears only the writer's initials; but as it has had a tolerably wide circulation, and can be obtained from natural-history booksellers without much difficulty, it may be regarded, for all practical purposes, as having been duly published. It contains a very complete account of all the insects known to the author as being hosts of Entomophytes, or Entomogenous Fungi, and is the most important and original contribution on the subject that has yet appeared. The conspicuous and well-known group of fungi (*Cordyceps*) affecting the larvæ and pupæ of root-eating insects (the Australian species of which are the special subject of the present paper) are dealt with at considerable length; and the observations and conclusions regarding them, except in one particular to be noticed presently, may be accepted as accurate and reliable.

Thirty-four years later, in 1892, a more popular treatise on these parasitic fungi was published by Dr. M. C. Cooke †. In this handy and inexpensive volume, which is issued under the auspices of the Society for Promoting Christian Knowledge, will be found an excellent summary of all that was known of the Entomophytes, and it has a special value as coming from a recognized authority on the larger fungi. For the ludicrous title of the book we believe Dr. Cooke is not responsible. Presumably it is an inspiration of some luminary in the editorial office of the Society for Promoting Christian Knowledge, who, in striving after a popular designation, has succeeded in wholly hiding the subject of the book. It is almost needless to say that none of these fungi, or the insects upon which they live, have any connexion with worms; and

* 'Notices of Insects that are known to form the bases of Fungoid Parasites,' by G. R. G.: pp. 22, with 5 plates. 4to, London (privately printed), 1858.

† 'Vegetable Wasps and Plant-Worms—a popular history of Entomogenous Fungi, or Fungi parasitic upon Insects,' by M. C. Cooke: pp. 354, with four plates and woodcuts. London, 1892. Here quoted as Hist. Ent. Fungi.

that if the term "plant-worm" has any meaning it should be applied to those minute eel-like worms, properly called Nematodes, which are the cause of numerous plant-diseases. In this work, as the author points out, a free use has been made of Gray's observations, and, indeed, as far as the larger species, which more particularly interest us, are concerned, Dr. Cooke's remarks are almost entirely based on the work of Gray. The whole subject, however, and the questions of the origin, habits, and mode of growth of these curious fungi, must obviously be investigated by the entomologist as well as the botanist before satisfactory conclusions can be arrived at; and it is from the botanist's point of view mainly that Dr. Cooke's observations have a special value. The classification put forward by him is here adopted, and the characters upon which the genus *Cordyceps* has been subdivided (the name given by Fries to the species which live as parasites on root-eating and truly subterranean insects) are taken from his work.

One of the fancy stories in regard to the origin of these fungi which has gained wide currency is that the seeds of the rata-tree (*Metrosideros robusta*) are swallowed by the caterpillar, that they then germinate, kill the caterpillar, and grow in the ordinary way. Some, indeed, are so firmly convinced that these vegetable caterpillars are the veritable roots of the trees, that instances have been known where they have been deliberately planted in the confident belief that a row of rata-trees would result. Another singular and equally erroneous belief is that the sweet-potato (*Convolvulus batatus*) may be grown in a similar way, a superstition which has probably arisen from the fact that the caterpillars of the large convolvulus hawk-moth (*Protoparce* or *Sphinx convolvuli*, Linn.) have, by many ill-informed writers, been supposed to be the hosts of these fungi. This supposition, as far as I have been able to ascertain, has not a particle of evidence to support it, although it has gained considerable credence, particularly from observers in the early part of the century.

According to Pereira * a Chinese species (*Cordyceps sinensis*, Berk.) is used for medicinal purposes. He states that it is "used only in the Emperor's palace, as a strengthening and renovating substance, and is supposed to possess properties similar to those ascribed to ginseng †. It is recommended in cases where the powers or the system have been reduced by over-exertion or sickness. A duck is stuffed with five drachms of the fungus, and the bird roasted by a slow fire.

* Quoted by Gray, 'Notices of Insects, &c.,' p. 12.

† Another Chinese medicine.

The virtue of the fungus is supposed to pass into the flesh of the bird, which is to be eaten twice daily for eight or ten days." Unless it is to be supposed that the virtue is confined to those found in Chinese soil, here is a hint for the numerous Mongols in our midst.

Having referred to the old error that the hosts of the various species of *Cordyceps* are the caterpillars of hawk-moths of the family Sphingidæ, we have to notice another and more widely spread delusion with regard to the identity of their hosts which is equally erroneous. This is that the hosts are the larvæ of the large lignivorous Lepidoptera of the family Hepialidæ, known as *Charagia* or *Ænetus*; and the larvæ of certain species of Cossidæ (*Endoxyla*, *Zeuzera*, &c.), which are also wood-eaters. The larvæ of these insects, like those of the gigantic ghost-moth or bent-wing moth (*Zelotypia Stacyi*, Sc.), are lignivorous, living within the stems and branches of the various native trees and shrubs; and it is obvious that it would be impossible for large and highly developed fungi, such as *Cordyceps*, which are sometimes of large dimensions and which are frequently found growing at right angles to the axis of the body of their host, to grow within the narrow limits of the burrows made by these larvæ within their food-plants. With whom the mistake of associating the hosts with *Charagia* originated I have not been able to ascertain; but the error is an old one, as it occurs in the late Dr. George Bennett's 'Gatherings of a Naturalist in Australasia' * and in Gray's 'Notices,' &c., where the male of *Charagia virescens*, Walk. † (said by him to be the perfect stage of the host of the New Zealand fungus *Cordyceps larvarum*, Westw.), is figured; and the error recurs, although long since corrected, in the writings of Butler, Buchanan White, Steele, and Tisdall. As long ago as 1864 the late Mr. A. W. Scott ‡ corrected the error into which Dr. Bennett had fallen, and indicated the true hosts of the *Cordyceps*; but his observations appear to have been overlooked by subsequent writers. In treating of the genus *Pielus* Mr. Scott says:—"We are induced, as being applicable to the matter now in hand, to offer a few observations respecting those Australasian Lepidopterous caterpillars afflicted by *Sphaeria* (*Cordyceps*) which have come under our notice, conceiving that this subject has hitherto been treated more in a botanical light than the one interesting to the entomologist; and to do so more effectually it is necessary to exhibit clear outlines of

* P. 288 (1860).

† *Charagia rubroviridens*, Walk., is the female of this moth.

‡ 'Australian Lepidoptera and their Transformations,' pp. 5 and 12.

some of the larvæ with which we are acquainted. By comparing these with the one similarly affected which we obtained here, and also with the delineation on the plate of the living larvæ, together with the appended observations of several writers, a fair conclusion can be arrived at respecting the genus of moth, which, in its two preparatory stages, is liable to the fatal attacks of this fungus. In order, therefore, to carry out the necessary comparison, we copy a lignified larva found at Barrabool Hills, Victoria, and the well-known New-Zealand species. To these we have added sketches of one obtained near Sydney by Mr. Shepherd, and another by ourselves at the Hunter River." Our author then proceeds to summarize the observations of Mr. W. H. Hawkes on *Cordyceps Hawkesii* found at Launceston, Tasmania; and the observations of Mr. John Allen and the Rev. R. Taylor on *Cordyceps Taylora* from Yass, New South Wales. In each case he concludes that the host is the caterpillar of a species of *Pielus*, and, after noting that in the case of the New Zealand form *Cordyceps larvarum*, the host has been incorrectly identified with the larvæ of *Charagia* by Hooker, Dieffenbach, Doubleday, and Taylor, he adds:—"We think it probable that the stems and trunks of the *Metrosideros* furnish sustenance for the larvæ of the *Charagia virescens*; but these live and undergo their metamorphoses *within* the wood, effectually protected against injury from this particular fungus; and it is equally probable that the *external* portions of the finer roots of the same or neighbouring plants afford nutriment to the larvæ of such genera as pass their lives wholly in the earth, a state of existence which would render them exposed to the attacks of the *Sphæria* (*Cordyceps*)."

In my opinion we have in these remarks the truth of the matter, and I am inclined to go even further, and to assert that all the larger fungi of the genus *Cordyceps* live upon and at the expense of subterranean larvæ and pupæ. In support of this assertion I would point to the fact that all the bulky species of which the hosts are definitely known have been found on root-feeding insects. As instances I need only cite the Dynastidæ, Melolonthidæ, Elateridæ, and Lucanidæ amongst the beetles, *Cicada* amongst the Homoptera, and *Pielus* and *Trictena* amongst the moths. In all these cases the hosts are subterranean, and it follows that it is idle to speak of any connection between these parasitic fungi and the larvæ of wood-boring or foliage-eating and free-living insects. The best-known and the most abundant species are found on the early stages—larvæ and pupæ—of *Lepidoderma*, *Lepidiota*,



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