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CONTENTS OF VOLUME I.

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PREFACE.

THE issue of the first volume of a new periodical publication seems to require a few words of introduction by way of apology. It may appear rash or even reckless to launch a new journal upon the already crowded sea of scientific literature and thereby increase, though to an infinitesimal extent, the confusion of mankind. The experiment has nevertheless been sanctioned by Government, and it must be left to the future to decide with regard to its success or failure. Its justification will depend upon its success, and the latter will be determined not so much by the number of local subscribers as by the length of years during which it may be continued.

It will be seen from the nature of the contents of the first volume that "Spolia Zeylanica" contains matter of interest and intelligence to residents in the Island who are willing to give and take information of the kind vouchsafed to them in these pages. In a progressive Colony like Ceylon, where the aspect of the country is undergoing rapid change, records of apparently trivial observations often acquire a cumulative importance in the course of years, and it should be considered an advantage to have the means of rendering permanent and available for future reference, notes on the habits of creatures which become more shy and difficult to procure as time goes on and the new order of things replaces the old.

This is especially the case with those unapproachable people, the Veddas of Ceylon, and it is greatly to be hoped that those who have the opportunity of holding intercourse with this folk will rescue their vanishing traits from oblivion. A subject of this kind can never be exhausted, and the theory that the study of the manners and beliefs of primitive races belongs to the "history of the folly of mankind" has long been exploded. The same principle applies to the Rodiyas and the Gypsies and to all who hold aloof from the great game of destiny.

In addition to its function of conveying intelligence of local significance, this first volume is fortunate in having secured original contributions which constitute a distinct increase in our knowledge of the forms with which they deal. Other papers of an expert nature are in hand and will appear in the second volume. Of course it cannot be pretended that these articles will appeal very strongly to the personal proclivities of every reader of this journal. In such cases it can only be suggested that subscribers should rest content with the assurance that they are receiving good measure for their money and be satisfied with the crumbs which fall from the specialist's table.

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ARTHUR WILLEY,

Director, Colombo Museum.

Colombo, January 2, 1904.

ERRATA.

Page 2.—Paragraph 2 : *for* "there is not even one peculiar Mammalian species" *read* "there are not more than two or three peculiar Mammalian species."

Page 8.—Footnote : *for* "Newton, A. A." *read* "Newton, A."

Page 18.—*For* "Mycalesis subdita" *read* "M. rama." *See* also page 71.

Page 65.—Line 2 : *for* "chafering" *read* "chaffering."

Page 78.—Paragraph 4 : *for* "Fregata aquila" *read* "F. ariel."

SPOLIA ZEYLANICA.

CONSTITUTION OF THE FAUNA OF CEYLON.

By A. WILLEY.

AMONG the introductory paragraphs of Sir J. Emerson Tennent's "Sketches of the Natural History of Ceylon" (1861), the following quotation reproduced from his classical "Account of the Island" (1859) contains a succinct statement of the principal literature written in the English language in which the Fauna of Ceylon had been dealt with in a more or less comprehensive or special manner before his time.

I will repeat in full the paragraph to which I am referring, because Sir Emerson Tennent's words will perhaps form a fitting prelude to the quarterly record of observations and experiences, of which this is the first number to issue from the Ceylon Government Press :—

> Regarding the Fauna of Ceylon, little has been published in any collective form, with the exception of a volume by Dr. Kelaart, entitled *Prodromus Faunæ Zeylanicæ* [1852] ; several valuable papers by Mr. Edgar L. Layard in the Annals and Magazine of Natural History for 1852 and 1853 ; and some very imperfect lists appended to Pridham's Compiled Account of the Island [1849]. Knox, in the charming narrative of his captivity, published in the reign of Charles II. [1681], has devoted a chapter to the animals of Ceylon, and Dr. Davy [1821] has described some of the reptiles ; but with these exceptions the subject is almost untouched in works relating to the Colony.* Yet a more than ordinary interest attaches to the inquiry, since Ceylon, instead of presenting, as is generally assumed, an identity between its fauna and that of Southern India, exhibits a remarkable diversity, taken in connection with the limited area over which the animals included in it are distributed. The Island, in fact, may be regarded as the centre of a geographical circle, possessing within itself forms whose allied species radiate far into the temperate regions of the north as well as into Africa, Australia, and the Isles of the Eastern Archipelago.

In the light of our present knowledge of zoogeography it is, no doubt, an exaggeration to claim Ceylon as an important centre of

* Of course this reproach no longer holds good since the issue, under the editorship of Dr. W. T. Blanford, F.R.S., of many volumes of "The Fauna of British India, including Ceylon and Burma," a monumental work which was commenced in 1888 under the authority of the Secretary of State for India in Council, and is still in course of publication, new volumes being added to the series periodically.

geographical distribution, since this would imply the existence in the insular fauna of more primitive components than is actually the case. Indeed, in its present position and configuration Ceylon can hardly be regarded, in any instance, as the feeder of the Indian Peninsula nor of any other zoological province.

Of the thirty-nine genera of indigenous Mammalia not one is peculiar to the Island ; there is not even one peculiar Mammalian species, although there may be some insular races of continental species. The tailless lemur, locally known as the Ceylon Sloth (*Loris gracilis*),* rarely seen on account of its nocturnal and arboreal habits, though living in the outskirts of Colombo, is confined to Ceylon and to the Carnatic Tract† of Southern India, this being the most restricted range of any Indo-Ceylonese Mammal.

All the other species of Mammals known to occur in Ceylon have a much more extended range, though some few are restricted to Ceylon and the Indian Peninsula, among the more notable examples of this kind being the Ceylon bear, which is co-specific with the Indian Sloth Bear (*Melursus ursinus*), the Scaly ant-eater or Indian pangolin (*Manis pentadactyla*),‡ and the mouse-deer or Indian chevrotain (*Tragulus meminna*).§

On the other hand, no fewer than fifteen genera of Mammals occur in the Indian Peninsula, which are not represented in Ceylon, the most prominent of these being four antelopes, namely, the Nilgai (*Boselaphus tragocamelus*), the four-horned antelope (*Tetraceros quadricornis*), the black buck (*Antilope cervicapra*), and the Indian gazelle (*Gazella bennetti*). The absence of antelopes from Ceylon may be looked upon as ranking among the "famous deficiencies" of the Island, analogous, for example, to the absence of snakes from Ireland, Iceland, and New Zealand. Other creatures whose presence in neighbouring countries renders their absence from Ceylon the more conspicuous are, for example, tigers, vultures, cranes, and hamadryads.‖

The range of the hamadryad is approximately co-extensive with that of the cobra di capello (*Naia tripudians*) upon which, to a certain extent, it feeds. [See article by Vety. Capt. G. H. Evans on "The King Cobra or Hamadryad" in J. Bombay Soc.,

* Unahapuluwá of the Singhalese.

† Blanford, W. T. The distribution of vertebrate animals in India, Ceylon, and Burma. *Phil. Trans.* (Series B), vol. 194, pp. 335–436, 1901.

‡ Kaballéwá, S.

§ Míminná, S.; sometimes called Wali-miya, S.

‖ The Hamadryad or king cobra is named *Naia bungarus* on grounds of priority [see Boulenger, G. A. Fauna Brit. Ind. Reptilia and Batrachia, p. 392, 1890]. It is also widely known as *Ophiophagus elaps*, its food consisting principally of other snakes.

FIG. 1.—GAUTAMA BUDDHA AND THE SERPENT MUCALINDA.

From a wooden effigy in the Colombo Museum. Height of original, 1 foot 2 inches.

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vol. XIV., pp. 409–418, 1902 ; also in the same Journal on p. 629, a note on the "Food of the King Cobra," by E. H. Aitken]. But whereas the cobra occurs in Ceylon, where the manifold symbolic uses to which it has been put have rendered it sacred and classical, the more dreaded hamadryad is not found here.

The shelter attributed to the Lord of Lanka beneath the mantling hood of the sacred Nága, cobra di capello, is a picturesque example of the ancient interpretation of divine influence in the East. The effigies which commemorate this miracle are executed in brass and wood (see Fig. 1), and are described as the "Serpent-canopied Buddha" [*cf.* Sir M. Monier-Williams, "Buddhism," London, 1889, p. 480, and frontispiece].

The examples of distribution selected from the Mammalian section of the fauna seem to indicate that Ceylon is an outlier of India rather than itself a centre of distribution, and that it bears the same relation to India that Tasmania does to the island continent of Australia or the British Isles to the continent of Europe. From this point of view the Fauna of Ceylon may be regarded as a Relict Fauna, the members of which have been separated from their continental allies by subsidence of land and encroachment of sea since the Tertiary Epoch.

Excluding the category of Oceanic Islands, it is a generally accepted axiom that the terrestrial fauna of any island has reached its destination by means of former land connections between the island and neighbouring continental areas. Thus it is calculated that at least ninety-five per cent. of the British species of animals have reached the British Isles by previous land-connections with Scandinavia and the Arctic Continent in the north and with France and Belgium to the south-east.*

Before proceeding further with our analytical sketch of the Fauna of Ceylon, it will be interesting to consider more closely (with the assistance of Dr. Blanford's Memoir to which I have referred above) the relation of Ceylon to the Indian Peninsula.

The Indian region is divided into two main sub-regions by the Indo-Gangetic Plain, which extends from the Arabian Sea to the Bay of Bengal and "forms a geological boundary of the highest importance."

The Transgangetic sub-region includes the Himalayas, Assam, Burma, &c. The Cisgangetic sub-region includes the Indian Peninsula proper and Ceylon.

The Indian Peninsula is again divided into two very unequal parts by the Western Ghats or Sahyádri mountains which separate

* Scharff, R. F. The History of the European Fauna. London, 1899. (Contemp. Sci. Ser.)

the Malabar Coast Tract from the Central Provinces and the Carnatic.

The investigation of the fauna of Ceylon may be approached from at least three standpoints (excluding, for the moment, the economic side of the question), namely, zoogeographical, faunistic, and local or insular. Moreover, from whatever point of view the subject be regarded, the fauna of Ceylon presents a dual character.

From its purely faunistic aspect the dual character of the fauna depends upon the fact that, in addition to the relict or continental types, to some of which allusion has already been made, Ceylon possesses an extensive series of endemic or peculiar types.

Considered zoogeographically, it has been shown by Captain Legge* and by Dr. Blanford that the Ceylon area comprises two tracts, namely, the Northern Ceylon Tract, including the Northern and Eastern Provinces, with an average rainfall of about 50 inches; and, secondly, the Hill Ceylon Tract, comprising the Central, Western, and Southern Provinces, with an average rainfall exceeding 100 inches. The Northern Tract is defined by Dr. Blanford as being "in fact a part of the Carnatic with higher rainfall and with much more forest," while the Hill Tract "must be regarded as a part of the Malabar Tract."

From the local or insular standpoint, the faunal elements are grouped under the two headings of low-country and up-country types. As might be expected, there is a great amount of overlapping in the local distribution of particular species, and the special characteristics of the fauna of the various Provinces of the Island have yet to be ascertained with such precision, for example, as that with which the birds of Sabaragamuwa have been dealt with by Mr. F. Lewis.† It may be hoped that, in course of time, we shall obtain further information on this matter of local distribution by means of a system of careful records of the occurrence of species in different localities and at different times and seasons.

Of the 360 species of birds which have been recorded from Ceylon, as many as forty-nine, or nearly one-seventh, are peculiar to the island. The number of genera in which the species are grouped is 240, of which, as noted by Dr. Blanford, eighty-two, or rather more than one-third, belong to one order, namely, the Passeres. Only six genera of birds are peculiar to the island, and five of these are passerine.

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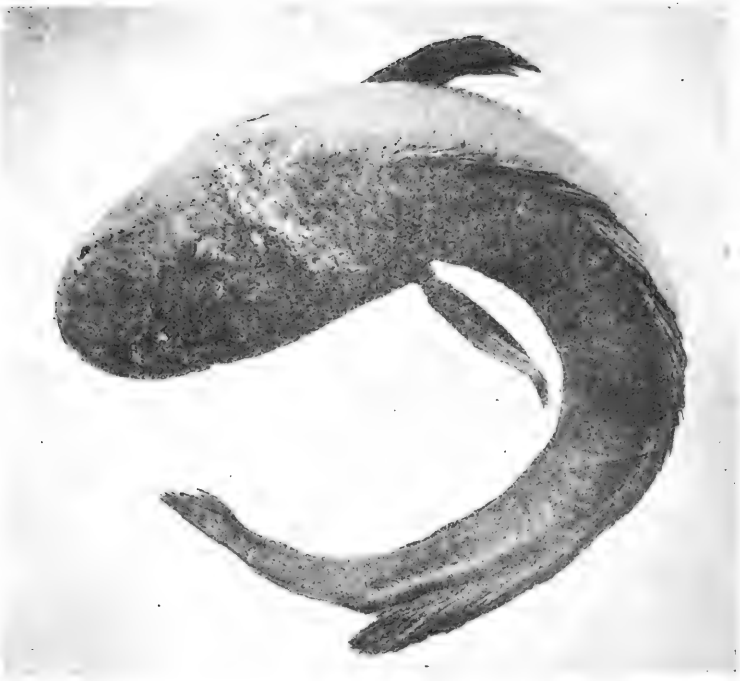
* Legge, W. V. A History of the Birds of Ceylon (*vide* Introduction, p. xiii. London, 1880.)

† Lewis, F. Field-notes on the Land Birds of the Province of Sabaragamuwa, *Ibis*, 1898, Part I., pp. 334–356; Part II., pp. 524–551



FIGS. 2 AND 3.—OPHIOCEPHALUS STRIATUS (FROM ABOVE AND FROM BELOW).

Photographed from a specimen in the Colombo Museum.

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Certain genera and species of birds, reptiles, and batrachians are restricted to Ceylon and the Malabar Tract. Again, the distribution of some animals points to the existence of a decided Himalayan affinity in the fauna of Ceylon, in so far that certain genera, which are represented by isolated species in Ceylon, only occur otherwise in Transgangetic countries, in some cases also in Malabar.

Thus, the chestnut and blue magpie of Ceylon (*Cissa ornata**) and the yellow-fronted barbet (*Cyanops flavifrons* †), inhabitants of the upland forests, are peculiar to the island, while their congeners are Transgangetic and Himalayan species (Oates and Blanford).

The remarkable legless Batrachian, *Ichthyophis glutinosus*, which is frequently dug out of its burrows in the plantations of Ceylon, and may be described as an eel-like, scale-bearing salamander, nearly black in colour with a bright yellow band running along each side of the body, occurs in the "Mountains of Ceylon, Malabar, Eastern Himalayas, Khasi Hills, Burma, Siam, Malay Peninsula, Sumatra, Borneo, Java" (Boulenger, Fauna Brit. Ind. Reptilia and Batrachia, p. 516).

The large tank fish "lula" (plural "lullu") of Ceylon (*Ophiocephalus striatus* ‡), which belongs to a distinctively Oriental family, the Ophiocephalidæ, occurs "throughout the plains of India, Ceylon, and Burma to China and the Philippines" (Day, Fishes of India, p. 366); but a nearly related fish (*Channa orientalis* §) of the same family, said to be common in the low-country paddy fields (Haly, M. S.), affords an excellent example of discontinuous distribution, occurring only in the fresh waters of Ceylon and China, being absent from the intervening countries (Day and Blanford).

Besides the Himalayan or Transgangetic element in the fauna of Ceylon, there are other foreign representatives which deserve special mention, namely, the Malay, Mascarene (Madagascar and neighbouring islands), and Australian elements.

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* This bird is called the Ceylonese Jay by Legge [Birds of Ceylon, p. 353], and the Ceylonese Magpie by Oates [Oates, E. W. Fauna Brit. Ind. Birds, vol. I., p. 29, 1889], the explanation being that the genus *Cissa* is as nearly related to *Pica*, the Magpie, as it is to *Garrulus*, the Jay, neither of which cross the Ganges. The Ceylonese Jay or Magpie is not to be confounded with the common black and white Magpie-robin (*Copsychus saularis*) of Colombo and the low-country, the "Polli-cha" of the Sinhalese. The Magpie-robin also occurs in the Kandy District and elsewhere.

† Described under the synonym of *Megalæma flavifrons* by Legge [Birds of Ceylon, p. 212].

‡ Known as the "Murrel" to Indian anglers (see Thomas, H. S. The Rod in India. Mangalore, 1873).

§ Kánaya, S. Common at Kesbewa and in the Wellawatte canal.

Many of the characteristic forms of the Malay Peninsula and the Sunda Islands are conspicuous by their absence from Ceylon, *e.g.*, the flying lemur (*Galeopithecus volans*) among Mammals, the flying lizard (*Draco maculatus*) among reptiles, the robber crab* (*Birgus latro*) among Crustacea, and the singular Prototracheate genus *Peripatus*. It is therefore remarkable to learn that it is none the less possible to recognize a special Malay affinity in the fauna of Ceylon, exemplified by certain rare denizens of the dense forests and luxuriant gorges of the interior. Captain Legge has drawn attention to this point in the case of two birds, namely, Bligh's whistling thrush (*Arrenga blighi*†) and the red-faced malkoha or ground cuckoo (*Phœnicophaës pyrrhocephalus*), both peculiar to Ceylon, but presenting near affinities to species from Java, Sumatra, and the Malay Peninsula.

Even the elephant, "the lord paramount of the Ceylon forests," has to be considered in this connection. Sir E. Tennent, who was one of the first to recognize a Malayan affinity in the fauna and flora of Ceylon, records the fact, established independently by the Dutch anatomists Temminck and Schlegel, that the Ceylon elephant is identical with the Sumatran elephant, which Temminck named *Elephas sumatranus*, and "differs as much from the elephant of India as "the latter from its African congener."‡ The specific distinction of the Sumatran from the Indian elephant is not commonly upheld now. The former is probably no more than an insular race of the Asiatic species, *E. indicus*.

Several reptilian genera which are represented in Ceylon and the Eastern Archipelago are wanting in the Indian Peninsula. An interesting example of this kind is furnished by a small burrowing snake, *Cylindrophis maculatus*, one of those to which the term "depatnaya" is applied. It is common in Colombo, Balangoda, and elsewhere, and may be easily recognized by its glistening skin adorned with a network of dense black markings. The broad meshes of the network are occupied by brown pigment above and brilliant white below. A small tract on the upper lip below the eye on each side of the head, a pair of oblique tracts behind the eyes and the areas immediately behind the large triangular black patch on the head, separated from one another by a narrow median black stripe, are also dense white in colour.

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* The robber crab is found locally all over the Eastern Archipelago from Christmas Island to the Loyalty Islands, but west of the Straits it only occurs on the South Sentinel, an islet of the Andaman Group less than one square mile in extent, and in the Nicobar Islands (see Alcock, A. A. Naturalist in Indian Seas. 1902, pp. 83 and 151).

† Syn. *Myiophoneus blighi* [Legge, Birds of Ceylon, p. 463].

‡ Tennent, *op. cit.*, pp. 64–68.

These points are not very well shown in Fig. 4. This earth-snake attains a length of about one foot with an even diameter of some five-sixteenths of an inch. As a species it is peculiar to Ceylon, but the genus is represented in the Malay Peninsula and Archipelago by a closely related species, *Cylindrophis rufus*.

Fig. 4. *Cylindrophis maculatus.*
From a specimen in the Colombo Museum, found in Colombo. About half natural size.

Perhaps even more remarkable than the evidence of Himalayan and Malay components of the Ceylon fauna is that which relates to the Mascarene element. Madagascar is well known as the headquarters of lemurs and of chameleons,* harbouring more species of these animals than occur in any other quarter of the Old World. Ceylon possesses a single species of lemur, the *Loris gracilis* referred to above, and a single species of chameleon (*Chamæleo calcaratus*). True chameleons are characterized by the great length of the tongue, by the mobility of the eyes (ensheathed within a circular eyelid which accompanies the eyeball in its rolling movements, each eyeball moving independently), and by the structure of the feet, which are specially adapted for climbing along the branches of the trees, having the toes closely webbed together into two groups. In the forefeet the two outer and the three inner toes are respectively united together, forming two divergent, opposable groups, while in the hind feet it is the three outer and the two inner toes which are thus united.

* During the last century, precisely between the years 1800 and 1900, eighty-two species of chameleons have been described. Of these, Madagascar possesses thirty-three species, thirty of which are peculiar. This is the highest percentage (91 per cent.) of endemicity in any zoological province in which chameleons occur. They are confined to the Old World, and the Indo-Ceylonese species marks the Eastern limit of the family (see Werner, F. Prodromus einer Monographie der Chamäleonten. Zool. Jahrb. Syst., XV., 1902, p. 332).

All chameleons possess the faculty of changing colour, but all lizards which change colour are not chameleons, those which are commonly seen along the roadside in Ceylon belonging to a genus of Oriental lizards named *Calotes* by Cuvier. The true chameleon seems to be rare in Ceylon, and I have not seen one in the jungle hitherto, though the Colombo Museum possesses four specimens from four different localities, namely, Mullaittivu (W. Ferguson), Chilaw (H. Nevill), Puttalam (F. A. Fairlie), and finally, one which is said to hail from Colombo (A. Haly, Report on Reptilia in Col. Mus., 1891).

The distribution of a genus of skinks (the family of lizards to which the Brahminy lizard, *Mabuia carinata*, belongs) named *Acontias*, also points to a marked Ethiopian (Mascarene and African) affinity in Ceylon. Four species of *Acontias* are endemic in Ceylon, "none in any other part of the Indo-Malay region, two or three have been brought from Madagascar, four from South Africa" (Blanford, *op. cit.*, 1901, p. 395).*

Among the birds, the Drongos or king crows (*Dicruridæ*) point in the same direction, the black drongo (*Dicrurus ater*), which may be met with in the wayside jungle between Chilaw and Puttalam, being regarded by Oates as synonymous with the *Edolius forficatus* of Madagascar, of which the term "Drongo" is the original native name.†

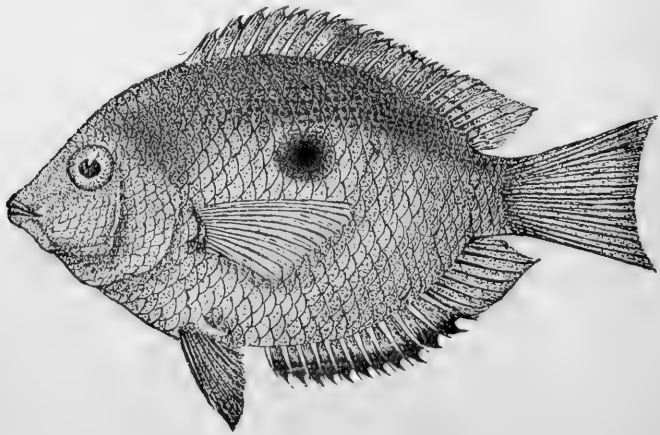

Fig. 5. *Etroplus maculatus.*
From the Colombo Lake.

A small fresh water fish which occurs in the Colombo lake, called "Rallia" in Sinhalese (*Etroplus maculatus*), belongs to a

* Dr. Alcock (A Naturalist in Indian Seas, 1902, see p. 140) mentions a small though gorgeously coloured Tree-gecko, *Phelsuma andamanense*, which is peculiar to the Andamanese jungles, while its congeners are confined to Madagascar and the neighbouring islands, the Comoros, Mauritius, and the Seychelles.

† Newton, A. A. Dictionary of Birds. London, 1893–1896.

strictly Indo-Ceylonese genus (*i.e.*, confined to Ceylon and the Indian Peninsula), whose nearest relative is the genus *Paretroplus* of Madagascar (Day, F., Fishes of India, 1878, p. 414).

The Land Mollusca of Ceylon are highly peculiar, and the largest of them are the species of the genus *Acavus*, which is confined to Ceylon, but exhibits close relationship with the genus *Helicophanta* of Madagascar.*

The earthworms† of Ceylon include no fewer than thirty endemic species, of which seventeen belong to the genus *Megascolex*, whose headquarters are in Australia, while eight other species of the same family (*Megascolecidæ*) belong to genera which, until recent years, had only been met with on the Australian Continent, namely, the two genera *Cryptodrilus* and *Megascolides*. One Ceylon species of *Megascolex* (*M. armatus*) occurs also in Madagascar, Zanzibar, and several other localities, though there is some doubt as to how far this species may have been accidentally conveyed from place to place by shipping.

The second family of Ceylon earthworms (*Moniligastridæ*) is represented by four species of *Moniligaster*, which is a dominant East Indian or Malayan genus.

The Ceylon earthworms therefore afford an indication of the existence of an Australian element in the fauna, which might be further illustrated by examples taken from other groups of terrestrial invertebrates. Thus, the snail *Acavus* appears, from the large size of the egg and of the embryonic shell which forms within it, to be as nearly related to the Australian genus *Panda* as to the Mascarene genus *Helicophanta* (Cooke, *op. cit.*).

The application of these facts to the theory of geographical distribution can only be indicated here in the briefest manner. The Island of Celebes is to the Oriental region what New Zealand is to the Australian region. The Fauna of Celebes is one of the most peculiar insular faunas in the world. Professor Semon has voiced a widely held opinion that Celebes has received the most characteristic members of its fauna, such forms as the monkey (*Cynopithecus*), the deer (*Anoa*), the pig (*Babirussa*), the lemur (*Tarsius*), &c., from the west, either from Asia or from a huge continent or archipelago which spread far to the West, of which Madagascar is perhaps the last remnant.‡ Of course Ceylon must also have formed part of this continent, the Lanka of the ancients,

* Cooke, A. H. Molluscs. Cambridge Nat. Hist., 1895, see pp. 303 and 355. The genus *Acavus* comprises the common Ceylon snails which are seen adhering to the trunks of trees and to fences in most parts of the Island.

† Michaelsen, W. Die Terricolenfauna Ceylons. Mt. Mus., Hamburg, XIV., 1897, 94 pp., 1 plate.

‡ Semon, R. In the Australian Bush. London, 1899.

and the hypothesis may serve as a provisional guide to the interpretation of the composite nature of the fauna of the Island.

The instances quoted above by no means exhaust the list of the heterochthonous* elements in the fauna of Ceylon, but they serve to illustrate the fact that the Island has special zoogeographical relationships indicative of former geological connections, either directly or indirectly, with the Malay Peninsula and Eastern Archipelago, with the Indian Peninsula, and with Madagascar.

Turning now to a brief consideration of that portion of the fauna which is peculiar to Ceylon, the great class of the Arthropoda, comprising the Millipedes and Centipedes, Insects, Crustaceans, and Spiders, naturally furnishes the most abundant, though perhaps not the most striking evidence of endemicity. In fact, with the exception of the highest and of the lowest classes of animals (Mammalia and Infusoria respectively), all the principal divisions of the animal kingdom are represented by various percentages of endemic types.

Besides those which have been incidentally referred to above, it is well known that the Ceylon jungle fowl (*Gallus stanleyi*), which is such a familiar feature of jungle life, is a peculiar species found only in Ceylon, while the equally familiar peafowl (*Pavo cristatus*) ranges over the whole of the Indian Peninsula, being replaced in Burma, Malacca, and Java by the Burmese or Javan peafowl (*Pavo muticus*).

Of all the vertebrates of Ceylon, it is the order of Reptilia which best illustrates, within a small compass, the distinguishing characteristics of the insular fauna. Although the degree of endemicity in the fauna of Ceylon does not extend beyond the possession of peculiar genera, yet there is a group of burrowing snakes, the *Uropeltidæ* (generally known as earth-snakes), which is restricted to Ceylon and the India Peninsula, and is therefore to be noted, in a special sense, as a peculiar Indo-Ceylonese family. These snakes are called "depatnaya"† in Siṅhalese, on account of the similar appearance of both extremities of the body, and of their faculty of gliding with equal facility forwards and backwards. Reverse locomotion is occasionally met with in other animals, and it always exercises a somewhat weird effect upon the imagination of the onlooker.

* Perhaps such archaic forms as *Channa orientalis* and *Ichthyophis glutinosus* are to be regarded as truly autochthonous species which have survived fluctuations of time, climate, and topography, having inhabited the regions in which they are now found from remote periods preceding the arrival of later immigrants.

† As mentioned above, the genus *Cylindrophis* is also called "depatnaya," but it belongs to a different family, the *Ilysiidæ*.

FIG. 6.—SCOLOPENDRA BICOLOR, HUMBERT.

A brilliant black and yellow centipede (the lighter portions are bright yellow, the head orange-coloured). Found in the sandy jungle bordering the sea from Puttalam to Trincomalee. It has a wide distribution in the East Indies.

[*To face p. 10*

FIG. 7.—CERATOPHORA STODDARTII (FROM NUWARA ELIYA).

Photographed from a living specimen at the Colombo Museum.

Some forty species of *Uropeltidæ* have been described, of which seven are known to be peculiar to Ceylon, but it is probable that more species remain to be recorded.

Three genera of lizards are peculiar to Ceylon, namely, *Ceratophora* with three species, the horned lizards of Nuwara Eliya, *Lyriocephalus*, the hump-nosed lizard of the Kandyan District, and *Chalcidoseps* a rare skink allied to *Acontias*, not represented in the Colombo Museum.

There are still two other categories of animals which play their part in the life of the island, and should therefore be mentioned before concluding this essay, namely, animals which have been introduced by human agency, and secondly, the domesticated animals.

Of the introduced animals the most important is the so-called hog-deer (*Cervus porcinus*), also known as the paddy-field deer (Wil-muwa in Siṇhalese), which is said to have been introduced by the Dutch into the Kalutara District of the Western Province, but I have not succeeded in finding any record of the date or motive of its acclimatization. It is normally an inhabitant of the Indo-Gangetic Plain, but not of the Indian Peninsula in the strict sense. Hence it is assumed by some authorities* that its presence in Ceylon is not an example of natural discontinuous distribution but of artificial introduction.

First in importance of the domesticated animals (apart from the elephant) are of course the draught-bulls which are of the three familiar kinds, the small Ceylon Bulls, the stately Brahminy Bulls which figure in procession with elephants, horses, and lions, upon the ancient moonstones of Anuradhapura, and lastly, the shaggy Indian Buffaloes, with which the wild buffaloes associate while grazing at the borders of the jungle.

The present position of Ceylon relatively to the Asiatic Continent and to the world in general has been roughly defined in the preceding lines in terms of its terrestrial fauna, and a brief reference has been made to a distribution of land and water in ancient geological times differing completely from that which we now know. On the first pages of Dr. Alcock's new and richly illustrated book† the same subject is touched upon from the marine side. After premising that the seas of India are three—to wit, the Arabian Sea, the Bay of Bengal, and the Andaman Sea—

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* *E.g.*, Mr. R. Lydekker and Dr. W. T. Blanford.

† Alcock, A. A Naturalist in Indian Seas; or, Four Years with the Royal Indian Marine Survey Ship "Investigator." London (John Murray), 1902. I am indebted to the courtesy of the Hon. Mr. John Ferguson for my first acquaintance with this charming narrative.

Dr. Alcock gives expression to the opinion that these seas were formerly part of a great inland ocean, "of which the present Mediterranean is the shrunken remains. Peninsular India and Ceylon then formed a great island-continent, connected by a chain of large islands—of some of which the Maldives and Chagos and Seychelles are the tombstones—with Madagascar and South Africa, and separated from the present heart of Asia by a deep channel—a channel perhaps traversed, much as now the West Indies traverse the Caribbean, by a series of islands, which may have been lowly precursors of the Himalayas; for these gigantic mountains are of quite recent origin."

The distribution of certain deep-sea fishes and other animals can (so far as our present knowledge of the abyssal regions of the ocean extends) only be rendered intelligible by some such inference as that just quoted. A fish belonging to the family of the Weevers or Trachinidæ was first discovered in Japanese waters and named *Bembrops caudimacula* by Professor Steindachner of Vienna in 1877. Three years later it was again discovered in the Gulf of Mexico, and several years afterwards it was found by the "Investigator" to belong also to the fauna of the 100-fathom line in the Bay of Bengal, having been trawled in 128 fathoms off the Coromandel Coast.*

From a depth exceeding 700 fathoms near the Laccadives a gigantic Crustacean named *Bathynomus giganteus*, belonging to the same order (Isopoda) as the common wood-louse, was brought to the surface by the "Investigator." It was first obtained about twenty years ago at a depth of 955 fathoms in the Gulf of Mexico to the north-east of Yucatan, and was described by the late Professor A. Milne-Edwards of Paris. A specimen of this wonderful abyssal Isopod, measuring 12 inches in length and 4 inches across, has been more recently dredged off the north-east coast of Ceylon in 594 fathoms.†

Many other examples of similar distribution of marine animals which live and feed on the sea-bottom are known. Of these, one of the most notable instances is afforded by the so-called King Crabs of the genus *Limulus*, which are found living in shallow water at certain localities on the Japanese, Moluccan, Malaccan, and Indian coasts, and also off the east coast of New England and in the West Indies.

The genus *Limulus*, of which a number of fossil species dating back to the Carboniferous and Jurassic formations have been

* Alcock, *op. cit.*, p. 120.

† Alcock, *op. cit.*, pp. 127 and 271. It is a matter for regret that the Colombo Museum does not profit by these new discoveries.

FIG. 8.—LIMULUS (FROM DUTCH BAY).

From a dried specimen in the Colombo Museum.

[*To face p.* 12

unearthed, while four species are still living, is one of those animal types which are of peculiar interest to the morphologist on account of their ancient lineage (a record of which has been preserved in the sedimentary rocks), their primitive or generalized organization, and their manifold affinities.

There is an imperfect specimen of *Limulus moluccanus** in the Colombo Museum, labelled "Dutch Bay," but no further information is available, and the fishermen of Karativu know nothing about the creature.

Colombo, February 5, 1903.

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* For the most recent account of the classification and distribution of the Limulidæ, see Pocock, R. I. The taxonomy of recent species of *Limulus*. Ann. Nat. Hist. (7th series), vol. IX., pp. 256–266, pl. V.–VI., 1902. For an account of the morphology and affinities of *Limulus*, Professor E. Ray Lankester's article "Arachnida" in the first of the new volumes of the Encyclopædia Britannica (1902) should be consulted.

VARIATION OF "CATOCHRYSOPS PANDAVA,"

Horsfield.

By N. MANDERS, Major, R.A.M.C.

A SERIES of five males and ten females of this Lycænid Butterfly, reared by Dr. Willey, and submitted to me with the remark that they were hatched on July 4, 1902, from larvæ collected from a species of *Cycas* in the Museum grounds, show an aberration which is especially noticeable in the females, and is worthy of record as an example of non-seasonal variation.

The five males are of the ordinary rain season form, and do not vary on the upper side of the wings beyond an intensification of the dark pigment inside the posterior border in three of them, giving rise to dark lens-shaped spots, which are not conspicuous in the other two specimens.

Figs. 9 and 10. *Catochrysops pandava*, ♀, showing extremes of variation in thesubmarginal pigment spots of the hind wing.

The females are also of the rain season form, and present an interesting series showing gradual diminution of pigment in the posterior margin of the hind wing. Two of them may be regarded as typical examples of the species *C. pandava;* four of the others show a whitish suffusion of the posterior margin on the upper surface between the veins and above the black lunules, but separated from them by some blackish scales.

In the remaining four females the black lunules are entirely replaced by white, the veins however remaining black; the whitish suffusion above the lunules has become concentrated into definite white lunules, though not of so clear a white as the marginal lunules; the blackish line between the series of outer and inner lunules still persists. In all these specimens the black lunule or ocellus external to the tail-like appendage of the

hind wing persists as a much reduced black spot almost circular, crowned internally with a few orange scales; in two individuals a few black scales represent the lunules internal to the tail.

On the under surface in both sexes the changes, as regards the presence or absence of the marginal spots, are the same, except that the ocellus and anal spots persist more conspicuously.*

Colombo, December 17, 1902.

* For an account of the seasonal variations of *Catochrysops pandava* see Marshall and De Nicéville, "The Butterflies of India, Burma, and Ceylon," Vol. III., Calcutta, 1890, p. 183, pl. XXVII., figs. 187 and 188.

"NYCTALEMON PATROCLUS" IN KANDY.

By F. M. Mackwood.

NYCTALEMON PATROCLUS is a moth of large size belonging to the family Uraniidæ. The colour of the wings is a varying shade of smoky brown or sepia, speckled with black and with a straight whitish band across the middle.

The species has been recorded from China, Sylhet, Burma, Andamans, Malacca, Philippines, and Papuan sub-region.*

Last December (1902) a specimen was caught in Lady Horton's walk, Kandy, this being its first record for Ceylon. Since then another example has been caught on the bank of the river near Kandy, and was purchased by a tourist.

The span of the wings (*i.e.*, from tip to tip of the fore wings) is $5\frac{1}{4}$ inches, and the distance from the tip of the fore wing to the tail of the hind wing is also $5\frac{1}{4}$ inches in the expanded condition.

[It is somewhat remarkable that such a large species should have escaped notice for so long, especially when we take into consideration the number of collectors who have worked in the Kandy District. Fresh records of its occurrence will be awaited with interest, and it must be left to the future to decide whether it is an accidental immigrant or a normal incoline.—Ed.]

* Sir G. F. Hampson, "Fauna of British India : Moths," Vol. III., 1895, pp. 111–112, fig. 57.

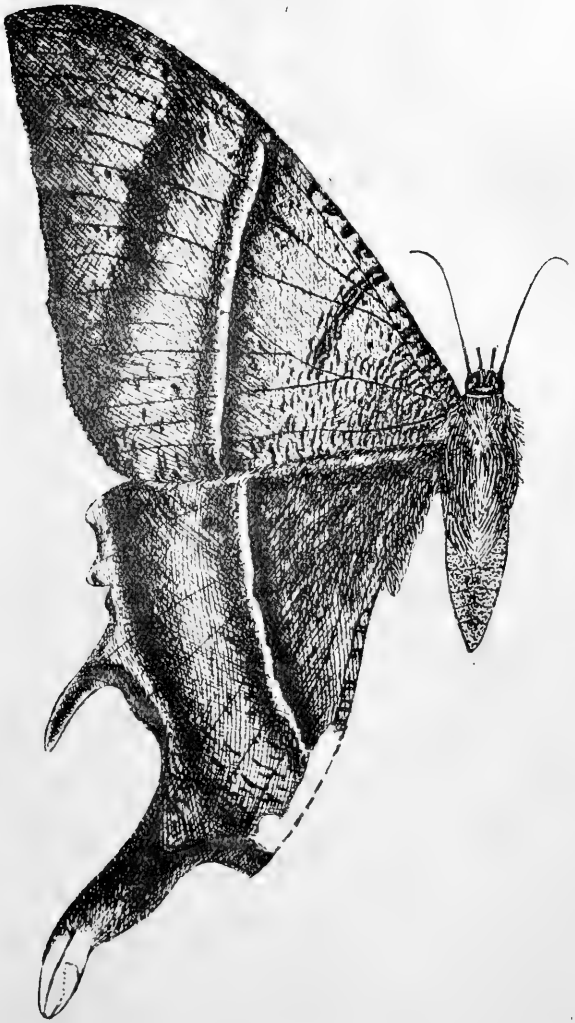

Fig. 11. *Nyctalemon patroclus*, Linn., ♂ (Colln. F. M. Mackwood).

Drawn from the original specimen lent to the Colombo Museum. Natural size.

NOTE "ON MYCALESIS SUBDITA," *Moore.*

By N. MANDERS, Major, R.A.M.C.

THIS species was originally described by Moore* from specimens collected at Udugama near Galle by Mr. John Pole. A pair is now in the Museum collection. So far as I know, very few specimens have been taken, but it probably only requires to be looked for at almost any time of the year in its particular haunts amongst bamboos, on which the larva probably feeds. With such few specimens to judge from, it is perhaps not quite certain that it is a good species, but to my mind it looks distinct enough.

In looking over Mr. Mackwood's collection of South Indian butterflies I was greatly interested to notice two specimens of this insect, which agree exactly with the types in the Museum; the insect therefore is of wider distribution than has been hitherto supposed; the specimens are unfortunately without labels, and the locality of capture is doubtful.

Colombo, December 17, 1902.

* Described in Moore's great iconographic work "Lepidoptera Indica," now being issued in parts. It is also described briefly by L. de Nicéville and Major Manders in their joint work, entitled "A List of the Butterflies of Ceylon, with Notes on the Various Species," in Journ. Asiat. Soc., Bengal. Vol. LXVIII., Part II., 1899, p. 181.

THE MAHSEER AND THE MURREL IN CEYLON.

By A. WILLEY.

THE Mahseer is probably the most admired game fish of India, and, in the opinion of experts, shows more sport than the salmon; not that it sustains so long a contest, but makes a more impetuous rush.* It is known to occur in the perennial rivers of the Bengal, Madras, and Bombay Presidencies, but anglers are not altogether satisfied that it occurs in Ceylon, although ichthyologists are aware that it does (*cf.* Day, "Fishes of India," p. 307).

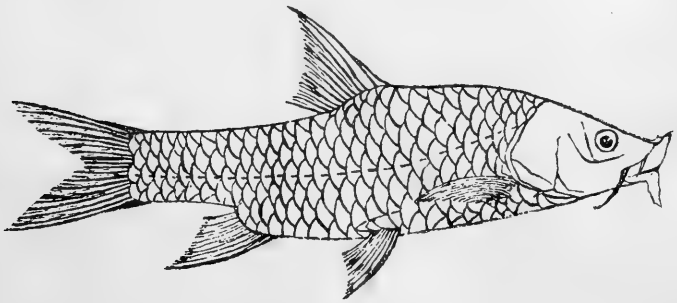

Fig. 12. *Barbus tor*. Sketch based upon a figure in Day's "Fishes of India."

The fact is that the mahseer is an exceedingly variable kind of barbel, exhibiting both local and individual variations, and different specimens may appear, at first sight, to be utterly distinct, owing to the circumstance that certain individuals possess a curious bilabiate growth proceeding from the upper and lower lips, while others, for some unaccountable reason, have no such lobes.† Whether or not this is a sexual character or a seasonal variation or a mere sport, I am unable to say. The specimen which I have examined, caught by Mr. C. A. Hartley in the Sítala-gaṅga, in which the processes were well developed, was a young male.

* Thomas, H. S., "The Rod in India." Mangalore, 1873. I am indebted to this book for details concerning the habits of the Mahseer. I also take this opportunity of acknowledging with thanks the receipt of specimens of the Ceylon mahseer from Mr. C. A. Hartley of Maskeliya and from Mr. A. C. W. Clarke of Pundalu-oya.

† The bilabiate form of the mahseer bears a striking resemblance to a fish recently described by Mr. G. A. Boulenger from the Kenya District in East Africa. under the name *Barbus labiatus*, n. sp. (P. Zool. Soc., London, 1902. p. 223. pl. XVII., fig. 1.)

The Ceylon mahseer (*Barbus tor*)* is co-specific with the Indian mahseer, though, perhaps, if a sufficient number of specimens were measured, weighed, and compared, it would be found to constitute an insular race of the species.

With regard to dimensions, Mr. Thomas notes an interesting correlation between the size of the Indian mahseer and that of the rivers which these fishes frequent, unfortunately without tabulating his observations nor even naming the rivers. "In some rivers," he says, "they do not run above 10 or 12 lb., whereas in others they have been taken weighing 40 lb. and 50 lb., and even as much as 74 lb."†

It is instructive to learn that the size, or what comes to the same thing, the importance of the fish caught, does not bear any sort of relation to the size of the bait used to tempt him, very small fishes being often captured upon very large spoons and *vice versâ*.

The mahseer is essentially a ground-feeding fish, preferring a diet of crabs, molluscs, and small fish. Like all members of the Carp family (*Cyprinidæ*), to which it belongs, its jaws are toothless and it kills its victims by compression, afterwards crunching them to fragments by means of teeth which are set far back in the throat, borne upon the inferior pharyngeal bones; these are the pharyngeal or throat-teeth. The mahseer will also devour seeds which fall into the water, or rice which may be thrown in, as well as aquatic weeds and insects. Finally it is, to a limited extent, a surface-feeder, and will take the fly. The barbels or feelers, four in number,‡ which fringe the mouth, are organs which are specially characteristic of bottom-feeding fishes, such as the barbels and catfishes (*Siluridæ*). The fleshy lips of the mahseer are well adapted to exert a powerful suctorial action upon rocks and stones, by which it is enabled to detach the molluscs which adhere to them.

According to Mr. Thomas's observations, the mahseer travels long distances up stream during the monsoon rains for the purpose of depositing its spawn in the more or less protected headwaters of the rivers. It does not spawn all at once, as the salmon does, but lays its eggs in batches, repeating the process several times in a season. This, it should be added, is inferred from examination of the ovaries, and is not the result of direct

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* Synonymous with *Barbus mosal*. The Sinhalese name is Léla.

† Mr. C. A. Hartley informed me last June (1902) that he had never taken one weighing above 2 or 3 lb. from the Sítala-gaṅga, but that probably larger individuals would be met with in the main Maskeliya river into which the Sítala-gaṅga flows. The largest specimen received at the Museum measured somewhat less than a foot in length.

‡ A rostral pair and a longer maxillary pair.

observation. The result of this graduated oviposition is that the mahseer, unlike the spent salmon, never becomes so emaciated as to be unfit for human food.

It may be useful to sportsmen and naturalists living in out-stations to explain the manner in which the mahseer in particular, and freshwater fishes in general, may be identified.

The mahseer may be recognized in the open by its fighting qualities, and in the laboratory or museum by the arrangement of its scales. Down each side of the body from the gill region to the tail fin there is one row of scales, which exhibits a series of minute perforations. These are the orifices of small tubular sensory organs composing the so-called lateral line apparatus, which is innervated by a special branch of the tenth cranial nerve known as the lateral line nerve.

The number of scales in the lateral line is an important diagnostic feature in the determination of any species of fish, taken, naturally, in conjunction with its other characters, *e.g.*, presence or absence of teeth, presence or absence of barbels, number of fin-rays in the fins, especially in the dorsal and anal fins. The mahseer has no jaw teeth; it has two pairs of barbels, twelve rays in the dorsal fin, of which the first three are osseous (the first very small), seven or eight rays in the anal fin, of which the first two or three are osseous, and twenty-four or twenty-five scales in the lateral line.* The tail fin is forked. In the middle line of the back there are nine scales in front of the dorsal fin. The body is elongated, the height being equal to about one-fourth of the length excluding the caudal fin.

Just as the mahseer, from an angling point of view, takes the place, in India and Ceylon, of the salmon of the West, so the murrel may be regarded as representing the pike in the economy of the inland waters, although all these fishes belong to totally distinct families.

The murrel or lúlá (*Ophiocephalus striatus*) is a large, nearly black, somewhat flat-headed fish, with long, many-rayed dorsal and anal fins and rounded tail fin (see fig. 2 facing p. 5). The dorsal and anal fins end abruptly behind and are not continuous with the tail fin. The lateral line does not extend in a straight line from the gill region of the head to the tail, but is bent downwards over two rows of scales at the level of the twelfth dorsal fin-ray, and is thence continued to the base of the tail fin. The Indian murrel attains a length of 2 to 3 feet. The Colombo Museum has a specimen of the Ceylon murrel with total length of

* In the case of the Indian Mahseer the number of scales in the lateral line is twenty-five to twenty-seven according to Günther and Day.

2 feet 3 inches and maximum breadth across the head of 4 inches; height of body behind pectoral fins 3½ inches (without reckoning the dorsal fin); weight (after removal of gut) nearly 4 lb.

The Ophiocephalidæ are commonly known as walking fishes on account of the fact that they are able to exist for lengthened periods out of water and can travel in a serpentine manner overland. Day* witnessed the exhumation of some *Ophiocephali* from the mud of a dried-up tank. They are capable of an amphibious mode of respiration in virtue of the existence of air cavities in the head (accessory to the true gill cavities), which impart a more or less labyrinthine structure to the pharyngeal bones though not so complicated as the elaborate suprabranchial apparatus of the Climbing Perch (*Anabas scandens*), the "Kávaiya" of the Siṇhalese.

The climbing and burrowing fishes of Ceylon were treated at considerable length by Sir E. Tennent, who reminded his readers that these phenomena were known to the ancients. "It is an illustration," he says on p. 344 of his work on the Natural History of Ceylon, "of the eagerness with which, after the expedition of Alexander the Great, particulars connected with the natural history of India were sought for and arranged by the Greeks, that in the works both of Aristotle [De Respiratione] and Theophrastus [De Piscibus in sicco degentibus] facts are recorded of the fishes in the Indian rivers migrating in search of water, of their burying themselves in the mud on its failure, of their being dug out thence alive during the dry season, and of their spontaneous re-appearance on the return of the rains."

Last year I picked up a "Kávaiya" which was toiling along the wayside in the Southern Province, and on arrival at the next resthouse placed it in a basin of water for the night. At daybreak the fish was found healthy and active on the floor, while the basin was tenanted by a drowned rat.

* Day, F., "Fauna Brit. Ind.: Fishes," Vol. II., p. 359.

ACCLIMATIZATION OF CEYLON CROWS IN THE MALAY PENINSULA.

INTRODUCTION.

THE transportation of an experimental consignment of common gray crows (*Corvus splendens*) to Penang at the request of the Resident-General of the Federated Malay States was briefly mentioned in the Administration Report of the Colombo Museum for the year 1902. As this is a matter of public importance besides having a certain scientific interest, it has been decided to publish the following correspondence, reports, and notes relating thereto.

ARTHUR WILLEY,
Director, Colombo Museum.

Colombo, March 30, 1903.

The Resident-General, Federated Malay States, to the Hon. the Colonial Secretary, Ceylon.

Resident-General's Office,
Selangor, Malay Peninsula, July 30, 1902.

SIR,—I HAVE the honour to ask you to be so good as to peruse enclosed copy of a letter, dated 22nd July current, which has been addressed to me by a prominent planter, Mr. E. V. Carey, who is Chairman of the United Planters' Association, Federated Malay States, advocating the importation of crows from Ceylon in the hope and expectation that they might prove beneficial in keeping down the numbers of the caterpillars which occasionally devastate estates in this country.

I shall be greatly obliged if you will inform me whether I can rely on the good offices of the Government of Ceylon in this matter.

I have, &c.,

W. H. TREACHER,
Resident-General, Federated Malay States.

E. V. Carey, Esq., Chairman of the United Planters' Association, Federated Malay States, to the Resident-General, Federated Malay States.

Klang, Selangor, July 22, 1902.

SIR,—I HAVE the honour to report that during the recent severe attack of caterpillars* on Bukit Raja estate some forty crows assembled and helped in the destruction of both caterpillars and chrysalids.

You will agree with me that this is a very unusually large number of these birds to be found in this country.

2. About the year 1885 the Ceylon cinchona plantations were devastated by a caterpillar† of the same family as that which has so often severely attacked our coffee over here, and it is well within the writer's memory that tens of thousands of crows came to the rescue and practically annihilated the caterpillars.

3. The Ceylon crow is a somewhat different bird to that found in the Malay Peninsula, but I think there can be no doubt that they would soon settle down over here if imported in sufficient numbers; they are the most useful of scavengers, and however much their numbers increased, would do no harm.

4. I would therefore suggest that overtures might be made to the Ceylon Government for shipment to this country of a large number of these birds, which could easily be collected if a small sum for each good healthy specimen were offered.

5. I believe that a fair proportion of the cost would be subscribed by proprietors of estates, but it is obvious that no overtures on the part of private individuals would stand the same chance of success as a representation from one Government to the other.

6. Within my knowledge there are six different caterpillars, attacking coffee, Para-rubber, *Ficus elastica*, cocoanuts, croton, and castor oil, which might at one time become gravely epidemic. All of these the crows would help to keep down, and I therefore earnestly beg your kind consideration of my suggestion.

I have, &c.,

E. V. CAREY.

Report of the Director of the Colombo Museum to the Hon. the Colonial Secretary.

I UNDERSTAND that the principal point upon which I have to report relates to the feasibility of transport and possibility of acclimatization of Ceylon crows in the Malay States.

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* Mr. E. E. Green says that the caterpillars referred to are the larvæ of *Cephonodes hylas*, the clear-winged hawk moth.

† The caterpillar of the oleander moth (*Daphnis nerii*). Both *Cephonodes* and *Daphnis* belong to the family of the Sphingidæ.

2. I think it would be comparatively easy to collect a large quantity of living crows here.

3. It would be necessary to construct an aviary for their reception and temporary storage.

4. They would of course have to be fed.

5. It would be of the nature of an experiment to ascertain how they behave in captivity.

6. From the analogy of other cases it may be said that it is quite probable, but not certain before trial, that they would accustom themselves to their new surroundings in the Malay States.

7. Their homing instincts appear to be strongly developed.

8. I have not been able to find any record of the visitation of caterpillars in the Ceylon cinchona plantations about the year 1885 .....

9. There are many caterpillars which are obnoxious to birds.

10. In the report on the Java Cinchona Plantations for 1883 (extracted in the *Tropical Agriculturist*, Vol. IV., 1885, p. 378) concerning the injuries inflicted by *Helopeltis antonii* and the ravages of a caterpillar, it is stated that "in regard to both, there seems to be but one remedy, the constant search for, capture, and destruction of the pestiferous insects."

11. If the proposed acclimatization be persevered in, I think it would be well to send over a small experimental batch of Ceylon crows to find out how they support the voyage, whether they would eat the caterpillars.....if offered to them; and eventually to let them go free in a circumscribed area and note as far as possible their subsequent behaviour.

12. It is well known that the introduction of exotic species of animals* and plants, although frequently beneficial, is sometimes attended by serious consequences, disturbing the natural equilibrium of a country in a deplorable manner.

ARTHUR WILLEY,
August 19, 1902. Director, Colombo Museum.

The Resident-General, Federated Malay States, to the Hon. the Colonial Secretary, Ceylon.

Resident-General's Office, Taiping,
October 1, 1902.

SIR,—I AM directed by the Resident-General to acknowledge the receipt of your letter of the 29th August last, with its enclosure, regarding the importation of crows from Ceylon to the Federated

* Examples of introduced animals which have multiplied beyond bounds are afforded by the rabbit pest in Australia, the mongoose in Jamaica, and the English sparrow in the United States of America.—A. W.

Malay States, and to express his cordial thanks to the Ceylon Government for the promise of assistance in this matter, and to Mr. Willey, Director of the Colombo Museum, for his report.

2. I am to inquire whether the Ceylon Government would be good enough to permit, and the Director be good enough to undertake to act on, the suggestions contained in paragraph 11 of his report and send over an experimental consignment of fifty crows at the expense of this Government, addressed to care of A. D. Neubronner, Esq., Perak Government Agent, Penang, to be forwarded to E. V. Carey, Esq., Klang, and to telegraph to Mr. Neubronner the name of the steamer and the date of despatch.

3. Mr. Carey, to whom the report of the Director was referred, has made the following suggestions :—

"I should say that the initial experiment might be confined to the capture of, say, fifty crows, rough wooden or bamboo cages being constructed for them and food supplied until they began either to die or to settle down sufficiently to admit of their being shipped across with a reasonable chance of arriving in good condition. Perhaps the Director of the Ceylon Museum would undertake the preliminary steps, or arrange for the fifty crows to be delivered, in good condition and well fed, on board ship. It would obviously be out of the question for a man to be sent over to Ceylon from here to attend to the matter, until, at any rate, it has been shown that the birds will stand confinement and the voyage across, and even then it would be cheaper and probably more satisfactory to contract for their delivery in large numbers on board ship in Colombo."

4. Mr. Carey adds :—

"Whilst on this subject I should mention that Mr. E. B. Prior of the Golden Hope estate, Selangor, reports that he has shot several crows amongst his cocoanuts, having found them knocking down and destroying the blossom. I cannot but believe that there is some mistake about this, but would suggest that the Director be asked whether there is any danger of anything of the sort occurring or if any similar experience has been recorded in Ceylon."

5. The Resident-General will be much obliged if the above paragraph may be referred to Mr. Willey for his consideration.

I am, &c.,

C. W. H. COCHRANE,

for Acting Secretary to Resident-General.

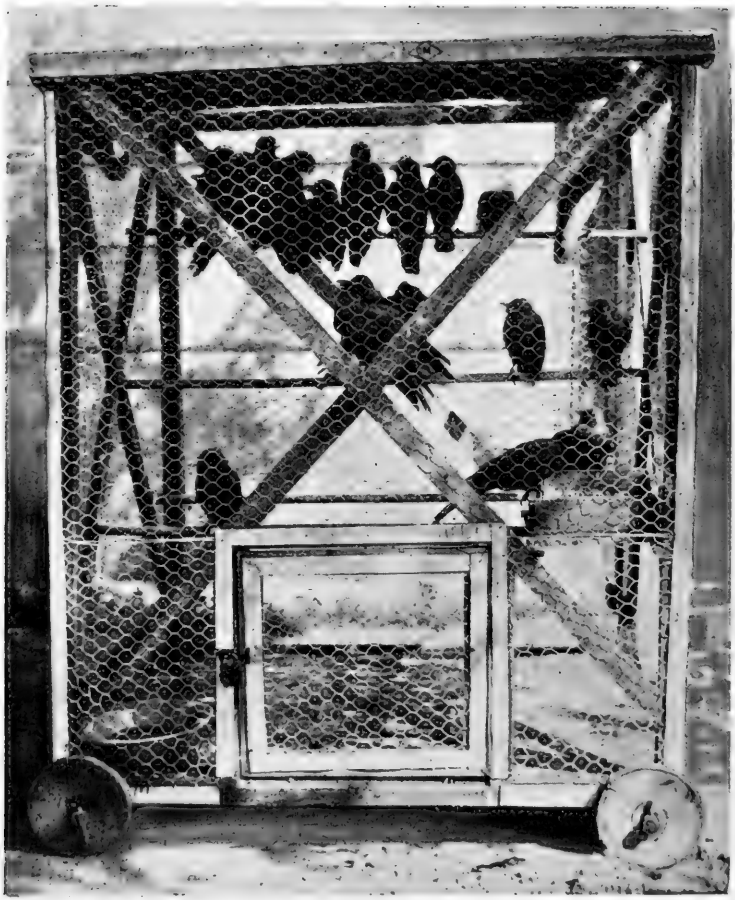

FIG. 13.—CAGE CONTAINING COLOMBO CROWS, TRANSPORTED TO SELANGOR.

To face p. 29]

Report of the Director of the Colombo Museum to the Hon. the Colonial Secretary.

It is not, I believe, the general experience that crows are detrimental to cocoanut trees. They are rather to be regarded as useful birds, and in the instance quoted relating to the Golden Hope estate, Selangor, it is not unlikely that they were in search of the injurious cocoanut beetles which attack the cabbage of the cocoanut palms.

If this be so, the crows might incidentally have done some damage without destructive intent.

October 18, 1902. ARTHUR WILLEY.

N.B.—It has frequently happened that insectivorous birds, which are really beneficial to man, have been blamed for the damage inflicted by their prey. In cases of doubt the truth may be ascertained by examination of the contents of the stomachs of the suspected birds.

——— A. W.

In consequence of the preceding correspondence steps were taken to secure a number of crows, and it was made known to the proprietors of boutiques where crows congregate that a price would be paid for every crow brought alive to the Museum. But crows are among the most intelligent of birds; they are not to be taken by frontal attack, and can rarely be captured by stratagem during the daytime. It is necessary to organize night surprises in the retreats where they roost. The most famous nocturnal retreat for the crows of Colombo is Crow island, which lies in the Kelani-ganga near its mouth, not far from the Leper Hospital at Hendala. The Superintendent of the Leper Asylum, Dr. W. H. Meier, was good enough to make representations to the villagers in that neighbourhood on behalf of the Museum, with the result that the full complement of crows was speedily obtained.

A black carrion crow (*Corvus macrorhynchus*) was brought to the Museum on the 24th October. It was fed upon rice which it vomited up, and died the next day. The stomach contained fragments of beetles (*Buprestidæ*); the intestine was parasitised by eight or nine cestode worms; the skin was covered by an immense multitude of minute acarids.

Three gray crows* (*Corvus splendens*) were caught near a butcher's shop and brought on the 29th October. During the day one became lame, sickened, and shortly died. Perhaps it had been

* Commonly known as the Indian crow. This species also occurs in every inhabited island of the Maldive group, but not on Minicoy. (See Dr. H. Gadow's Report on "Aves" in "The Fauna and Geography of the Maldive and Laccadive Archipelagoes," edited by J. Stanley Gardiner, M.A., Vol. I., Part IV., 1903, p. 373.)

hit by a stone, as the left thigh was suffused below the skin and the right tibio-tarsal joint was swollen to about twice the normal size.

During the succeeding days gray crows continued to arrive singly or in couples until the 8th November, when twenty-six birds were brought in baskets from Crow island; on the 9th eleven more came, and on the 10th another lot of thirty-seven.

The full number of birds required had now been collected, and it remained to keep them for some time in galvanized wire cages in order to study their ways with a view to ascertain the best mode of treating them in captivity. They were fed principally upon cooked rice and raw meat, with occasional insect grubs (which they greedily devoured), jakfruit, and biscuits.

Perhaps crows as a body are gluttons, but at any rate there are individuals among them who do not care to see their fellows enjoying a meal. Those are apparently the fittest who survive, while their less keen or less hungry companions starve. However this may be, the fact is that during the week following the last arrival chronicled above about twelve crows died of starvation.

As time passed on the importance of a plentiful supply of fresh water became increasingly evident. It was also found that they required a certain amount of exposure to the heat of the sun. Deaths were more frequent in one of the aviaries which was constantly shaded beneath a cadjan roof than in the others. It was proved that crows are as much dependent upon air, light, and water as human beings. They delight in bathing their whole bodies and then shaking out their feathers to dry in the sun. They may be seen daily bathing in the Colombo lake.

All the crows whose blood I examined were infected by microscopic thread worms or filariæ. Occasionally adult nematodes were found in the peritoneal membrane, both male and female. The females were ovoviviparous and contained innumerable young filariæ coiled up inside the egg membranes or free. One crow in particular, which died on 26th November, had nematodes in the peritoneum and vast quantities of filariæ in the blood. It seemed not improbable (although I could not prove either conclusion), firstly, that the bird had succumbed to the disease called filariasis; and secondly, that the filariæ of the blood were the progeny of the viviparous nematode worms of the peritoneum.*

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* This suggestion may serve to call attention to a matter which is worthy of investigation on the part of those interested in such questions. The life-history of nematoda is complicated in various ways, and no simple assertion or suggestion can approach the truth, although it might point the way.

At length it began to appear that, far from becoming habituated to their confinement, their continued captivity was re-acting injuriously upon them, and deaths became alarmingly frequent, as many as five birds dying in one day. It became necessary to replenish the stock and to hasten their departure.

Three large cages measuring about 5 feet high by 4 feet square, furnished with bars and feeding trough, were constructed. Each of them was stocked with twenty-four crows. These were despatched to the wharf on the 27th December, two crows dying on the way.

The cages were shipped on board the Austrian Lloyd ss. Austria with the Museum Taxidermist, Mr. H. F. Fernando, in charge. The vessel sailed on the following day, and reached Penang on the 2nd January, 1903, ten more deaths having occurred on the voyage.

During the voyage the cages were kept thoroughly cleansed, covered with tarpaulin to protect them from the cold winds, and the crows were fed twice daily with bread, rice, potatoes, raw and cooked beef, entrails of fowls, &c.

More than fifty crows reached their destination in good condition.

If there is any lesson to be learnt from the experiences recorded in the preceding lines, it is this, that the crows will survive a certain duration of captivity, but not an unlimited period, and the transportation from one place to another should be carried out without unnecessary delay.

The news of the arrival of the crows in the Malay Peninsula was greeted with an extraordinary outburst of objurgation on the part of the Straits Press. The undeniable impudence of crows has given them, so it appears, a bad name among the European residents of these parts. Personally, I do not think that the prejudice against them is well founded. It is said that they will steal jewellery, but jewellery disappears in ways other than down the gullets of crows, and one act of rapine is likely to be magnified a hundred-fold by common rumour.

A. D. Neubronner, Esq., Perak Government Agent, Penang, to the Director, Colombo Museum.

January 3, 1903.

SIR,—I HAVE the honour to acknowledge receipt of three cages crows, of twenty in each cage, brought by Mr. H. F. Fernando, and I am glad to say the birds arrived in very good condition judging from their appearance. Mr. Fernando must have doubtless taken

great care of them on the voyage. I have shipped them per steamer proceeding to Klang or Selangor, where the Resident-General and Mr. Carey are.

I have, &c.,
A. D. NEUBRONNER.

E. V. Carey, Esq., Chairman, United Planters' Association, Federated Malay States, to the Resident-General, Federated Malay States.

Klang, Selangor, Federated Malay States, January 28, 1903.

Ceylon Crows.

SIR,—IN continuation of my letter of the 5th instant* I have the honour to report as follows :—

1. There have been no more fatalities amongst the crows. The whole batch of 56 have now been set free, and so far show no inclination to desert the locality. They were released as recorded below :—

	Birds.
On 9th January	12
On 12th January	6
On 16th January	14
On 17th January	12
On 27th January	12
Total ...	56

The first lot were let out within four days of their arrival, because several of them looked weakly and as if they were suffering from the confinement. An equal number of healthy crows were at the same time given their liberty, as I thought that the example of those able to take care of themselves would perhaps be beneficial to their less robust brethren in the way of encouraging them to forage for food, &c. Finding the first birds disinclined to fly away from the place, I gradually let the others out as shown above, keeping a dozen only until yesterday, in order to observe their behaviour in captivity, and see if a prolonged confinement would in any way effect them adversely. I am pleased to say that, far from this being the case, they got fresher every day and their plumage brighter.

2. *Food.*—From the date of their arrival here the birds always fed well, preferring raw meat to anything, and not being inconvenienced by it being several days old. At one time they had a

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* This letter has not been included in the correspondence forwarded to me.—A. W.

plentiful supply of elephant meat, which kept them going for the best part of a week. They also ate bananas and boiled rice, though not with the same avidity, and were always specially fond of bathing in the pans of water which I had placed in their cages. When first they were introduced to the caterpillars of the bee hawk moth they regarded them with some suspicion, and only ate one or two. In a very few days' time, however, they devoured every caterpillar, chrysalid, and moth that they could get hold of. Many thousands of these insects have been given to them daily, and there have never been any left over. There can be no doubt whatever, therefore, that a caterpillar diet is quite acceptable to them, directly they get used to it. Since their release they have flown away to the coffee, and have evidently been looking for food there, but I have not been able to see them actually catch the bee hawk moth caterpillars though they very assiduously clean the plantain trees of the caterpillars which roll themselves up in the leaves of this plant. It seems to me that the utility of the crows as enemies to the coffee caterpillar will depend largely upon the numbers of the birds in the place, and the consequent scarcity of the food to which they have been accustomed in Ceylon, that is to say, the refuse in the vicinity of human dwellings. It is only natural that they should *prefer* such food, especially as it is more easily procured. It was only when the caterpillars appeared in very large numbers that the crows in Ceylon were attracted to them, and so it will be here, in all probability. But there is always the factor with our importations, that they will have got to recognize the coffee caterpillars and chrysalids as palatable articles of diet before they get their freedom. It has been suggested that the crows should be let loose amongst coffee trees that are badly attacked by caterpillars and which have been previously covered over with netting to prevent the birds from flying away. I should have given this a trial, as no harm could result from letting the birds understand where the caterpillars are to be found, but the present consignment is such a small one that it seemed better to leave them all together, and not separate them, as I should have been obliged to, for there are no coffee trees close by just now on which the caterpillars are to be found in any numbers. So I decided to leave this part of the experiment to a future occasion, when we get in a fresh batch.

3. *Breeding.*—I am satisfied that as soon as the crows decide on a suitable spot they will begin to breed. They are often to be seen flying about in pairs already, though I have observed no actual attempt to commence building their nests. Whilst the last

batch were still in their cages, it was evident that the question of mating had not been consigned to oblivion. There were at least two pairs whose attitude towards each other was distinctly suggestive of something more than ordinary friendship, and I also noticed that one of the caged birds had an obvious preference for one of those that had secured its liberty, calling regularly to the outside crow, which always kept in the vicinity of the cage.

4. It may be of interest to record that upon the arrival of the Ceylon crows some dozen or more of the ordinary carrion crow of this country appeared on the scene and seemed to regard the newcomers with considerable interest, but never made any attempt to molest them in any way. Indeed, as far as I can see, the Ceylon crows have nothing to fear from any natural enemies in this country. I have seen kites and eagles flying round since they have been here, but on no occasion have they attacked the crows. I have a large number of young ducks and chickens where the crows have been let loose, but they have not been disturbed by their new neighbours at all, and I do not think that the crows will do any mischief of this sort, as some people seem to anticipate. I may mention, however, that the young ducks proved too much of a temptation to the big carrion crows, which killed and carried off several every day, until I was obliged at last to shoot two of them. They were only wounded, and I was able to keep them in one of the empty cages for some days, when one of them, having evidently sustained internal injuries, died. The other, however is still alive, and it has been very interesting having the two species side by side for comparison. The carrion crow readily eats the largest cocoanut beetles and their larvæ, his powerful bill enabling him to split up and devour the former with the greatest ease. The Ceylon crows will also eat the larvæ greedily, but cannot manage the beetle unless it is killed and broken up for them first.

General.—I venture to think that the experiment, as far as it has gone, has been an unqualified success. It has been demonstrated that the crows will thrive in captivity; that they can stand without any serious ill-effects the long journey over to this country; that when released they do not at once fly away, but show every sign of an intention to adapt themselves to their altered circumstances; and that, when given to them, they readily eat the caterpillars, the destruction of which was the reason for their importation. It now remains to be seen if they will breed, and should they do so I do not see what more can be expected of them, for, as I have said, it is scarcely likely, while so few in numbers,

that they will hunt the coffee for caterpillars when there is so much food of other sorts available. The remedy for this is to import several thousands of the birds, and I shall sincerely hope to see this done.

I have, &c.,
E. V. CAREY,
Chairman, United Planters' Association,
Federated Malay States.

The Resident-General, Federated Malay States, to the
Hon. the Colonial Secretary, Ceylon.

Resident-General's Office,
Selangor, Malay Peninsula,
February 13, 1903.

SIR,—WITH reference to your letter of the 24th December last advising the shipment of a consignment of crows for Selangor, I am directed to inquire whether you would be good enough to make arrangements for furnishing a further supply of fifty birds, at the expense of this Government, addressed as before to care of A. D. Neubronner, Esq., in Penang, to be forwarded to Mr. Carey at Klang, telegraphing to Mr. Neubronner the name of the steamer and date of despatch.

2. Mr. Carey, who has had charge of the first batch, thinks that the experiment, so far as it has gone, has been an unqualified success, but is of opinion that experiments should be made with a further consignment before the crows are imported in large numbers.

I have, &c.,
OLIVER MARKS,
Acting Secretary to Resident-General,
Federated Malay States.

GORDIANS OF CEYLON.*

By Prof. LORENZO CAMERANO.
(*University of Turin.*)

THE Director of the Colombo Museum has sent me for study some Gordian worms from Ceylon. These specimens are interesting, because nothing was known with precision concerning the Gordians of this locality.

Oerley, in his work entitled "On Hair-worms in the Collection of the British Museum" (Ann. Nat. Hist., Series 5, Vol. III., 1881) mentions a female example from Ceylon, referring it without comment to the species *Gordius tricuspidatus* of L. Dufour.

Since the researches made by various authors and by me† concerning those species in which the females have the posterior extremity of the body divided into three post-cloacal lobes (Gen. *Paragordius*, Camer.), it has become necessary to re-examine Oerley's specimen in order to ascertain to which species of *Paragordius* it may belong.

Baird, in his "Catalogue of the Species of Entozoa contained in the Collection of the British Museum" (London, 1853, and P. Zool. Soc., 1853, p. 20), describes a *Gordius verrucosus*, giving as localities South Africa and Ceylon. In my Monograph of the Gordians, referred to above, I have, on page 416, pointed out that Baird's species cannot be identified by reason of the inadequacy of the description and figure given by the author.

Recently, by the courtesy of Prof. A. Skorikow, I have examined the rich material of Gordiidæ in the possession of the Zoological Museum of the Imperial Academy of Sciences at St. Petersburg. In this material I have found a female worm from Ceylon belonging to the genus *Chordodes*.

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* Translated from Prof. Camerano's report entitled "Gordii di Ceylan" in Boll. Mus. Torino, Vol. XVIII., No. 438, March 9, 1903.

The Gordiidæ are very long threadworms (Nemathelminthes) with smooth round body covered by a glistening cuticle in which no structure is discernible, without close examination. They are semi-aquatic and semi-parasitic, being found during certain phases of their life-history in water and moist earth and at other periods parasitic in the body of aquatic larvæ and carnivorous insects.

† L. Camerano, Monografia dei Gordii, Mem. Ac. Torino, Ser. 2, Vol. XLVII. 1897.

The specimen is incomplete, since it lacks the posterior part of the body; but from the examination of the structure of the external layer of the cuticle, it seemed to me to belong to an undescribed species. As such I have described it under the name *Chordodes Skorikowi*. The description, now in the Press, is included in the report relating to the above-mentioned collection, to be published in the "Annuaire du Musée Zoologique de l'Académie Impériale des Sciences de St. Pétersbourg."

The specimens which I have received from Dr. Willey belong to this same species, and as they are uninjured I am able to fill up the gaps which were inevitable in the original description.

1. Female. [Collected by J. H. Leak, Esq., C.C.S., Kurunegala.]

Total length 355 mm. [rather more than 14 inches].

Maximum width 2 mm.

2. Female from Kandy, taken in the act of issuing from the body of a species of *Mantis*. Collected by E. E. Green, May, 1902.

Total length 340 mm.

Maximum width 2 mm.

The colour [in spirit] is pale brown, whitish at the extremities of the body. The form is that which is characteristic of the females of *Chordodes*.

The outer cuticular layer presents :—

(1) Mulberry-shaped areolæ with not very prominent tubercular protuberances, of pale yellowish-brown colour.

(2) Papillary areolæ like the preceding, sometimes rather larger, more pronounced and darker, scattered here and there, frequently united in couples.

(3) Papillary areolæ like the preceding, which are produced at the apex into a delicate refringent process, slightly recurved.

(4) Papillary areolæ like those of the second category, disposed in groups of seven, eight, or ten around two larger papillæ, crowned at the summit with transparent hairs. Those placed along the median ventral line show tufts of long transparent processes.

(5) Here and there, more especially on each side of the median ventral line, are to be noticed spiniform transparent processes, of roughly conical shape, not curved at the apex.

NOTES ON THE HABITS OF THE GREEN WHIP-SNAKE (*Dryophis mycterizans, Daud.*) IN CAPTIVITY.

By E. Ernest Green, F.E.S.,

Government Entomologist, Ceylon.

Boulenger (Faun. Brit. Ind. "Reptilia and Batrachia," p. 369) records *Dryophis fronticinctus* and *D. prasinus* as being ovoviviparous, but no mention is made of the breeding habit of the other Indian species. I find that *D. mycterizans* is also ovoviviparous. One of these snakes gave birth to five living young in my vivarium on the 16th and 17th of April. The fifth was hampered by the egg-membrane and died two days later. The newly-born snakes measured 350 mm. from snout to tip of tail, and were of a pale olive green colour above, whitish below. They at first kept together, in an apparently tangled mass, amongst the branches of the plant. On the eighth day they all shed a skin and appeared in brighter tints, and were more independent in their movements. I am not sure whether they have taken any food or not. I have supplied them with young grasshoppers and other small insects, but have never observed them to take any interest in these insects. Boulenger mentions insects as the food of *D. prasinus* in early age.

The parent is quite tame, and allows itself to be handled freely without objection. It feeds readily upon young lizards of the genus *Calotes* and upon *Geckonidæ*. Its manner of capturing its prey is invariable. When a lizard is introduced into the cage the snake slowly frees the forepart of its body and coils itself in a zigzag fashion. Then, suddenly darting forward, it seizes the victim unerringly just behind the head, drags it from its support, and keeps it dangling without shifting its hold, but gradually tightening its grip, until the lizard is suffocated. This process may take perhaps 20 minutes in the case of a *Calotes*. The snake never commences to swallow its prey until all signs of life have ceased.

This *Dryophis* has moulted some four or five times during the six months that it has been in captivity. Sometimes the ecdysis has been more or less fragmentary. The skin of the head and neck

is first shed in a single piece. The remainder comes away in small fragments during the next few weeks. Patches of the earlier skin may even remain until the next moulting period. This failure to completely to divest itself is probably due to the unnatural conditions of captivity.

The Tamil name for the *Dryophis* is "kannu-kuttu pambu" (literally, the "eye-stabbing snake"), and the natives believe that it strikes at the eyes of persons or cattle.* It is curious that this same myth recurs with regard to the American whip-snakes. Oliver Wendell Holmes, in his novel "Elsie Venner," speaking of American snakes, writes :—"There is something frightful in the disposition of certain ophidians, as the whip-snake, which darts at the eyes of cattle without any apparent provocation or other motive." I do not know whether the American whip-snakes are allied to the Indian forms or not. Boulenger states that the genus *Dryophis* is confined to the East Indies. As regards *Dryophis*, I think that the native name must have been suggested, partly by the lance-like form of the head, and partly by its habit of coiling itself and facing any intruder upon its privacy—apparently following every movement of his eyes. When pressed, it will strike out blindly, often in the direction of the face of its opponent; but seemingly more with the object of scaring than of attacking its assailant.

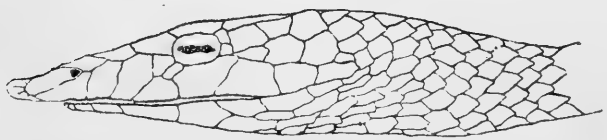

Fig. 14.—Head of *Dryophis mycterizans* in side view, showing the horizontal pupil of the eye and the rostral lobe. Natural size.

[* The Siṅhalese name for this snake is ẹhẹtullâ or ẹsgullâ (ẹhẹ, plural ẹs = eye). The belief that it deliberately strikes at the eye is also common in India, and a curious confirmation has been published by Mr. Frank Finn. (Note on the Long-snouted Whip-snake, *Dryophis mycterizans*, by F. Finn, B.A., F.Z.S., Deputy Superintendent, Indian Museum. J. Asiat. Soc., Bengal, vol. LXVII., 1898, pp. 66 and 67).

Mr. Finn tells us that he was holding a couple of these snakes in his hands, knowing them to be harmless, when the larger specimen suddenly darted at his eye inflicting a bite, which resulted in some small punctures on the eyelids, two on the upper and one on the lower eyelid. On rubbing his eye a few hours later Mr. Finn removed a tooth about 1/20 inch long from the puncture in the lower eyelid.—Ed.]

NOTES AND REVIEWS.

1. *Crystalline Rocks of Ceylon.*—Mr. A. K. Coomaraswamy, the newly appointed Government Mineralogist, has published an important series of papers relating to the Geology of Ceylon, more especially concerning the crystalline limestones and gneisses. One of the general conclusions to which the author's researches have led him is this, that the crystalline limestones which are found associated with the gneisses are probably of igneous origin, not sedimentary.

The following is a list of the papers referred to :—

(1) Origin of the Crystalline Limestones of Ceylon. Geol. Mag. Decade IV., Vol. IX., No. 458, p. 375. August, 1902.

(2) The Crystalline Limestones of Ceylon. Quart. Journ. Geol. Soc., Vol. LVIII., 1902, pp. 399–422, pls. XIII. and XIV.

(3) The Point de Galle Group (Ceylon): Wollastonite-Scapolite Gneisses. *Ibid.*, pp. 680–689, pl. XXXIV., Map.

(4) Serendibite, a new Borosilicate from Ceylon, by G. T. Prior and A. K. Coomaraswamy. Mineralogical Magazine, Vol. XIII., No. 61, pp. 224–227, 1903.

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2. *Zoological Gardens.*—In view of the rumours which have been circulating during the past twelve months or so regarding the establishment of Zoological Gardens in Colombo, it is interesting to read the "Report for the Year 1902" (Fourth Annual Report), by Captain Stanley S. Flower, Director of the Zoological Gardens at Giza, near Cairo, published by the Government of Egypt Public Works Department, Cairo, 1903.

During the five years 1898-1902 these Gardens have made extraordinary advances in the number of animals kept in captivity and in the erection of houses, paddocks, and cages to receive them. The total number of animals (Mammals, Birds, Reptiles, and Batrachians) alive in the Gardens on 6th October, 1898, was 270; on the same date in 1902 the number was 923.

The animals which are maintained in the Gardens are chiefly Central African species, including several examples of one of the

most peculiar and rare of the Central African birds, the shoebill or whale-headed stork, *Balaeniceps rex*.

"During 1902," we are told on page 17 of Captain Flower's Report, "the staff of the Giza Zoological Gardens were entrusted with bringing ninety live animals from the Soudan to Giza, including specimens for H. H. the Khedive, and certain foreign Zoological Gardens. These animals were :—

10 Lions.	18 Smaller Mammals.
4 Leopards.	5 Secretary Birds.
7 Cheetahs.	3 Shoebills.
4 Giraffes.	17 Storks, Cranes, Geese, &c.
11 Antelopes.	7 Tortoises.
2 Nuer Cattle.	1 Crocodile.
1 Antbear (*Orycteropus æthiopicus*).	

"Out of the ninety animals eighty-eight reached Giza in safety. The only accidents on the journey were the loss of a fine young male roan antelope and a gray crane, which had both been purchased in Khartoum for the Giza Zoological Gardens, and which both died suddenly near Berber on an exceptionally hot day in May."

The total number of deaths during 1902 was 196.

There would appear to be no definite reason why the grounds near the Colombo Museum should not be utilized for the exhibition of the wild animals of Ceylon. The only mammals living at the Museum at present are a Hog-deer, purchased at the beginning of the year; a young Sambur doe, presented by the Hon. C. A. Murray in May; four Lemurs, including a female carrying its young (since dead), purchased in May; and finally a young porcupine.

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3. *Marine Biological Laboratory at Galle.*—It may be hoped that the small though effective laboratory at Galle, which has served Mr. James Hornell for the last twelve months as a base for his researches into the life-history of the pearl oyster and the nature of pearls, will survive the close of this year's fishery and form the nucleus of a permanent biological station in the Island.

Marine biological stations or observatories are dotted all over the world, for example, in Italy, France, England, Scotland, Norway, United States, and Japan. The prototype of all is the Stazione Zoologica at Naples, the creation of Dr. Anton Dohrn. The success of all these stations depends at least as much on individual enthusiasm as on Government support,

The circumstances which led Professor Herdman and Mr. Hornell to fix upon Galle as the site for a Biological Station are described by Professor Herdman in his Preliminary Report on the Pearl Fisheries of Ceylon addressed to His Excellency the Lieutenant-Governor on 1st July, 1902.

"Galle," writes Professor Herdman, "seemed to us, after a careful investigation lasting over five days, to be without doubt the most suitable point on the coast of Ceylon for the establishment of a Marine Laboratory and the prosecution of observations and experiments on living oysters. Galle has a fringing coral reef round its western shore, inside which is in places a shallow lagoon with a hard bottom, formed partly of living animals and partly of dead coral fragments, making a deposit very like that on some of the 'Paars' at Mannar. At the opposite or south-eastern part of the bay, inside Watering Point, there is also some hard ground formed in part of coral, and at this spot we actually found the pearl oyster living."

The "Sixteenth Annual Report of the Liverpool Marine Biology Committee," edited by Professor Herdman (Liverpool, 1902, 70 pp.), contains an illustrated account of the new Biological Station at Port Erin, Isle of Man. The Liverpool Marine Biology Committee is a Committee consisting of local naturalists from Liverpool and neighbouring towns; it was formed in 1885 at a meeting summoned for the purpose by Professor Herdman.

In 1887 a small biological station was set up on Puffin Island off the north coast of Anglesey. This was transferred in 1892 to Port Erin Bay on the southern coast of the Isle of Man. At this place a three-roomed Biological Station was built and formally opened for work by Sir Spencer Walpole, the Governor of the Island. In 1893 an Aquarium was added to the establishment, and later on sea-fish hatching was undertaken. In 1898 an alliance was formed between a Committee appointed by the Manx Government and the Liverpool Marine Biology Committee, with the result that three years later a much larger building representing a combined Biological Station, Aquarium, and Fish Hatchery was erected. Of the three Departments, the Laboratory block is controlled by the Liverpool Marine Biology Committee, the Hatchery block by the Manx Committee, and the Aquarium in the centre is managed as a joint concern.

With regard to Ceylon it may be added that Professor Herdman has, in a private letter, called attention to the advantages likely to result from co-operation between the Colombo Museum and the Galle Laboratory in the event of the latter being made permanent.

4. *The Tea Tortrix.*—The third number of the second volume of the "Circulars and Agricultural Journal of the Royal Botanic Gardens, Ceylon," issued in January, 1903 (pp. 33–45), contains a full account of this tea pest by Mr. E. E. Green, Government Entomologist. It was originally described by Nietner in 1861 as an enemy of the coffee plant. Nietner named it *Capua coffearia.*

Instructions are given for fighting this disease of the tea in all its stages of egg, caterpillar, chrysalis, and moth. The eggs are deposited on the upper side of the mature tea leaves in compact masses of about 250. The eggs are disc-shaped objects, pale yellow, "overlapping each other like the scales of a fish, the whole mass coated with a varnish-like film."

Mr. Green's article is especially noteworthy on account of the admirable lithographic plate which illustrates it. The drawings show all the points referred to in the text; they were executed upon the stone by Mr. Green himself and printed at the Surveyor-General's Office.

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5. *Mosquitoes in Ceylon.*—Among the collateral achievements resulting from the brilliant discoveries of Ross and Grassi, which have established the truth of the Mosquito Theory of Malaria, the Monograph of the Culicidæ or Mosquitoes of the British Museum by Mr. F. V. Theobald (London, 1901) occupies a prominent position. This work consists of two volumes of text and one volume of coloured plates. In consideration of its size and importance it was produced in a remarkably short space of time.

The twenty-fifth Circular of the first series of the Royal Botanic Gardens, Ceylon, issued in December, 1901 (pp. 346–368), and entitled Mosquitoes and Malaria, by Mr. E. E. Green, concludes with a list of twenty species said to occur in Ceylon. Many of these were specially identified by Mr. Theobald during the preparation of his Monograph. Others, however, such as *Stegomyia pseudotæniata* and *Armigeres ventralis* (=*A. obturbans*) are not recorded from Ceylon in Mr. Theobald's pages. There is thus still room for a revision of the Culicidæ of Ceylon.*

The dominant genera of Culicidæ are *Culex* with upwards of 125 species scattered over the world, and *Anopheles* with 44 species. Certain species of *Anopheles* are the intermediate hosts

* The classification of the Indian species of *Anopheles* has recently formed the subject of a joint memoir by Drs. J. W. W. Stephens and S. R. Christophers in the seventh series of "Reports to the Malaria Committee of the Royal Society" (London, 1902), illustrated by four plates. This series also contains articles by the same authors on the relation of species of *Anopheles* to Malarial Endemicity: and a paper by Professor E. Ray Lankester "On a convenient Terminology for the various Stages of the Malaria Parasite."

for the malaria parasite and the vehicles by which the germ is carried from one human subject to another.

Mr. Green, in the article referred to above, tabulates the principal differences between *Culex* and *Anopheles* in the following manner :—

Culex.	Anopheles.
Eggs agglutinated into raft-like masses. Each egg placed vertically.	*Eggs* separate, floating horizontally.
Larva with long breathing tube at [hinder] end of body. Floats head downwards.	*Larva* without prominent breathing tube. Floats horizontally.
Adult insect [female] with palpi much shorter than proboscis. Wings usually clear and colourless. Rests with body parallel with support.	*Adult insect* with palpi as long as proboscis. Wings usually spotted or clouded. Tilts the body at an angle to the support.

The accompanying sketches, drawn from life by Mr. Green, and kindly lent by him for reproduction in this Journal, show the characteristic attitudes of *Culex* (*Armigeres*) *ventralis*, Walker Fig. 15), and *Anopheles maculata*, Theobald (Fig. 16).

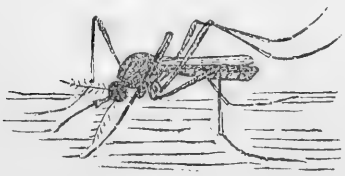

Fig. 15.—*Culex ventralis*, ♀.

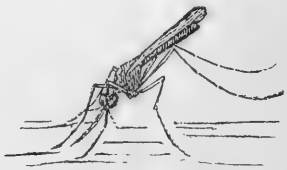

Fig. 16.—*Anopheles maculata*, ♀.

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6. *Mortality of Fishes in the Colombo Lake.*—About the 7th April and the following two or three days the Colombo newspapers announced the appearance of large numbers of dead fish of all sizes, up to as much as 2 feet in length, on the banks of the Colombo lake and floating on the surface. Various explanations were suggested to account for this unusual mortality, the most plausible being that which connected it with the sudden change in the weather and the torrential rains which fell about that time.*

Mr. F. D. Jayasinha, Clerk of the Royal Asiatic Society and Inspector of Watchers in the Museum, states that when on a visit to the village of Akurala in Madampe at Easter he ascertained that a similar phenomenon had been observed on 10th April in the canal which crosses the village. He was told that the fish were seen floating on the surface of the water in an intoxicated state and were collected by the villagers in hand nets. On questioning them as to the cause of this, Mr. Jayasinha was informed that it was

* 1·77 inch in Colombo on April 6th.

nothing new, but had been experienced on many previous occasions, that, in fact, it always happens so in stagnant lagoons, canals, and pools when rain falls in abundance after long seasons of drought.

Mr. Jayasinha thinks that this explanation is probably correct, because the fishes in the Madampe-oya, which enters the sea at Ambalangoda, have not suffered any such calamity. The canal referred to above cuts across Madampe, approaching the sea at Akurala at the 56th milepost on the road to Galle. The canal is not always flowing, as the mouth becomes blocked by sandbanks and the water is therefore stagnant until the mouth is cleared by the villagers to let out the water after heavy rainfall. The canal was cut by Government for the purpose of draining the neighbouring country during floods. It abounds in fishes of various sorts.

It is of course well known that many fishes are highly susceptible to sudden changes both of temperature and salinity, and the access of a large body of rain water would affect both, but especially the salinity, and might very well exert a toxic action upon the inhabitants which had become accustomed to the special conditions of stagnant water.

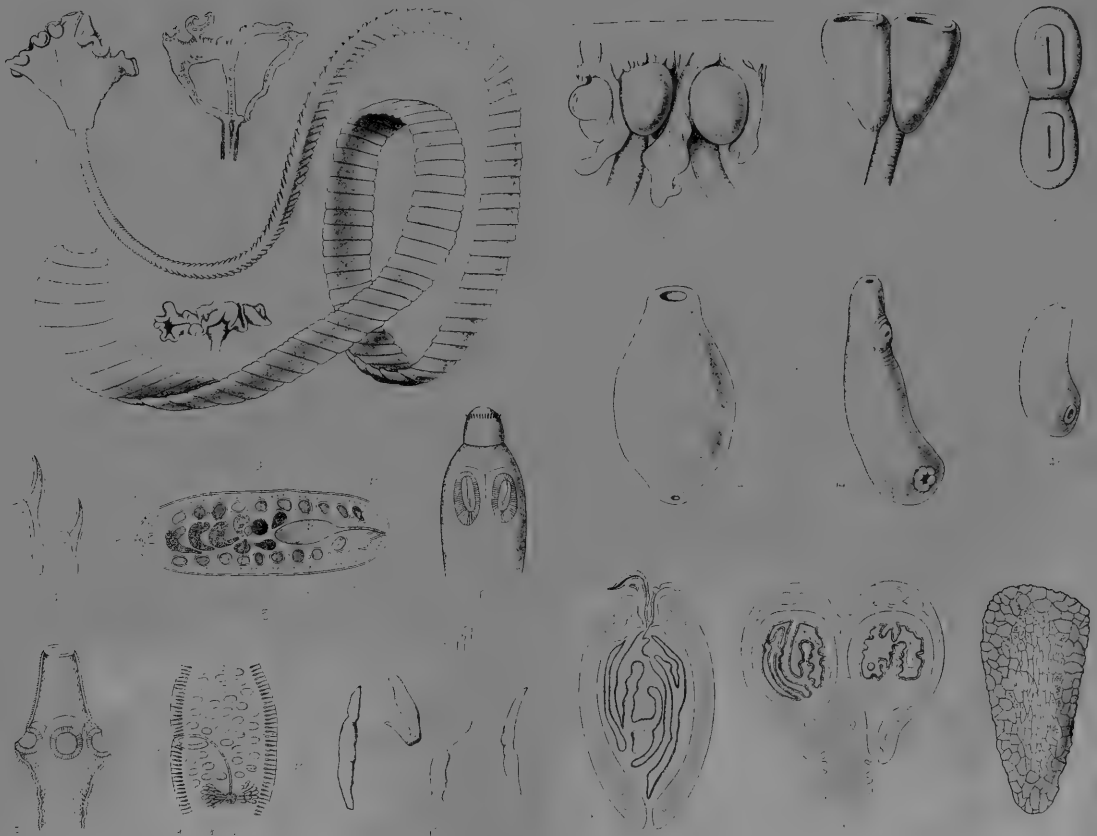
The incident reminds one of an analogous event which happened off the coast of New England, United States of America, in the year 1882. The following extracts from an article by Mr. F. A. Lucas,* published in the Report of the National Museum, 1889, may serve indirectly to throw light upon a matter which has mystified the Municipal authorities of Colombo :—

> In the months of March and April, 1882, vessels arriving at Philadelphia, New York, and Boston reported having passed large numbers of dead or dying fish scattered over an area of many miles, and from descriptions and the occasional specimens brought in it was evident that the great majority of these were tile fish (*Lopholatilus chamæleonticeps*, Goode and Bean). ..... As one account after another came in it became apparent that a vast destruction of fish had taken place, for vessels reported having sailed for 40, 50, and 60 miles through floating fish.....As there were no signs of any disease, and no parasites found on the fish brought in for examination, their death could not have been brought about by either of these causes.....
>
> Professor Verrill has noted the occurrence of a strip of water, having a temperature of 48° to 50° Fahr., lying on the border of the Gulf Stream slope, sandwiched in between the Arctic current on the one hand and the cold depths of the sea on the other. During 1880 and 1881 Professor Verrill dredged along the Gulf Stream slope, obtaining in this warm belt, as he terms it, many species of invertebrates characteristic of more southern localities. In 1882 the same species were scarce or totally absent from places where they

* Lucas. F. A., "Animals recently extinct or threatened with extermination. as represented in the collections of the United States National Museum," Rep. Nat. Mus. (Smithsonian Reports), 1889, see p. 647.

had previously been abundant, and this, taken in connection with the occurrence of heavy northerly gales and the presence of much inshore ice at the north, leaves little doubt that some unusual lowering of temperature in the warm belt brought immediate death to many of its inhabitants.

From analogy and from the known facts of the case it therefore seems possible that the fishes of the Colombo lake met their death in consequence of the recent sudden alteration of meteorological conditions. Unfortunately no specimens found their way to the Museum, so that it is impossible to say what families, genera, or species were most affected. This is the more to be regretted, because the identification of the fishes would have rendered it possible to put forward a more definite explanation of the occurrence, and at the same time would have afforded useful information for fishery purposes. In this connection it may be pointed out that one of the chief objects of this journal is to preserve exact and authoritative records of vital phenomena for future guidance and reference.



SOME PARASITES FROM CEYLON.

By ARTHUR E. SHIPLEY, M.A.,

Fellow and Tutor of Christ's College, Cambridge, and University Lecturer on the Advanced Morphology of the Invertebrata.

With Plate I.

"Nature is, of course, wonderful in all her works—in some even admirable—whilst there are others, such as the hippopotamus and the tapeworm, in which she can hardly be said to have attained more than a *succès d'estime*."

H. R. T., Camb. Rev., 1902, p. 216.

THE following is an account of a small collection of Entozoa composed of specimens in the Museum at Colombo, and of some others quite recently taken in different parts of Ceylon. The collection is a very varied one, and, with the exception of the Gordian worms, all the large groups which lead a primarily entozoic life are represented. Protozoa in the form of Sporozoa, Trematoda, Cestoda, Nematoda, Acanthocephala, Linguatulida, all are there.

I owe many words of gratitude to Dr. Von Linstow, Professor A. Railliet, and Professor O. Fuhrmann, who have helped me in certain provinces which they have made peculiarly their own. Indeed their patient responses to my much importunity have led me to the conviction that parasitologists are amongst the most good-natured and helpful of men. To my friend Dr. A. Willey, Director of the Colombo Museum, I am indebted for the opportunity of describing the collection.

PROTOZOA.

Class: SPOROZOA.

Order: SARCOSPORIDIA, Balbiani.

SARCOCYSTIS TENELLA, Railliet.

Pl. I., figs. 10 and 17.

Four specimens of a dirty gray colour outwardly, somewhat resembling proglottides of Cestoda, arrived with the collection from Ceylon. These were labelled "Found in piece of beef killed for food. Can migrate and go out of sight into the muscle."*

* These specimens were collected and presented to the Museum by G. W. Sturgess, Esq., M.R.C.V.S., Colonial Veterinary Surgeon.

I was quite unable to identify these organisms, never having seen anything like them, but Professor Railliet of Alfort, to whom I sent them, recognized them at once as specimens of *Sarcocystis*, one of the order Sarcosporidia, which Braun* places as the sixth and last order of the class Sporozoa, whilst Wasiliewski† places it as an appendix to the class.

The organisms were somewhat pointed, though not very sharply, at either end. One or two ends were truncated. The largest of them measured 30 mm. in length, 5 mm. in breadth, and 3 mm. in thickness, the thickest part being in the middle line.

In transverse section the animal is seen to consist of a number of polyhedral chambers with granular contents. The peripheral chambers were completely full, stained deeply, and showed a very fine granulation, like that of protoplasm. The central chambers were in some cases empty or almost empty. The others contained small corpuscles, which I take to be spores, but the state of preservation did not permit of certainty on this point. The outer coating consists of two sheaths, an outer one which is a continuous coating, and an inner one directly continuous with the partitions which divide one chamber from the next. Close under the coating in some places can be seen a few smaller chambers, but these may be simply the narrow ends of some of the others. The partitions between the chambers look like connective tissue. I am inclined to consider that this species is *Sarcocystis tenella*, Railliet.

It is just sixty years since Von Miescher‡ first described certain white cylindrical bodies lying in the voluntary muscles of the house-mouse, and since that date numerous other observers have described similar bodies lying in the muscles, and more rarely in the connective tissue, of mammals, birds, and reptiles. Nothing is definitely known as to the means by which the various hosts—many of which are confined to a vegetable diet—become infected. The parasite seems to first appear as a cell-parasite within a muscle-cell, which retains its striation and seems but slightly affected. The nucleus of the *Sarcocystis* then undergoes division, and we find later a poly-nucleated organism which gradually breaks up into a corresponding number of chambers. The nuclei and protoplasm of these chambers then break up into an enormous number of minute spores, often sickle-shaped, some of which have been described as having two flagella at one end or one flagellum at each end. The fate of these spores or sporozoites is varied, and not very definitely known. Some undoubtedly fail to

* "Die thierischen Parasiten des Menschen." Würzburg, 1903.
† "Sporozoenkunde," Jena, 1896.
‡ Verh. Ges. Basel. v., 1843, p. 198.

develop further, because the whole animal—as so often happens in the case of *Trichina spiralis*—becomes calcified. Some observers think that under happier circumstances the sickle-shaped spores become amœboid and wandering into neighbouring muscle-cells re-start the infection, but the matter is not clear, and a still greater mystery surrounds the first entrance of the parasite into its host.

TREMATODA.

Family: PARAMPHISTOMIDÆ, Fischoeder.

PARAMPHISTOMUM BATHYCOTYLE, Fischoeder.

Pl. I., figs. 14, 14*a*, and 14*b*.

In his recent revision* of the Amphistomidæ Montic.—a family name he replaces by Paramphistomidæ—Fischoeder describes amongst the genus *Paramphistomum* (= *Amphistoma*, Rud.) a new species *P. bathycotyle* found in a *Bos kerabau* brought from Ceylon to the Zoological Gardens at Königsberg. Dr. Willey has sent me a considerable collection of parasites which belong to the same species. These were taken from the stomach of *Cervus axis*, the spotted deer, shot at Weligatta.†

I have figured the outlines of several specimens, from which it will be seen that the various diameters of the body vary considerably.

CESTODA.

Family: BOTHRIOCEPHALIDÆ.

Sub-Family: DIBOTHRIOCEPHALINÆ.

DUTHIERSIA FIMBRIATA, Dies., 1854.

Pl. I., figs. 1 to 3.

Synonyms: *Bothridium du Varan du Nil.* Gaz. méd. Paris, 20e Année (3) V., 1849, p. 119.

Solenophorus fimbriatus, Diesing, S.B. Ak. Wien. XIII., 1854, p. 556.

Duthiersia expansa, E. Perrier, Arch. Zool. exp. II., 1873, p. 359.

Duthiersia elegans, E. Perrier, ibid., p. 360.

Duthiersia fimbriata, Diesing. Monticelli and Crety, Mem. Acc. Torino. Ser. 2. XLI., 1891.

Duthiersia fimbriata, Dies. Lühe, Verh. Deutsch. Zool. Ges., 1899.

The genus of tapeworm was carefully described by Edmond Perrier‡ in 1873. His specimens came from a "Varan à deux

* Zool. Anz. XXIV., 1901, p. 367. Die Paramphistomiden der Säugethiere Inaug. Diss. Königsberg, 1902, and Zool. Jahrb. Syst. XVII., 1903, p. 485.

† The same parasites occur in the country goat and in the sambur.

‡ Arch. Zool. exp. II., 1873, p. 349.

bandes" living in the Moluccas and from a "Varan du Nil" from Senegal, and he distinguished two species *Duthiersia expansa* from the first-named host and *Duthiersia elegans* from the other. Later writers however recognize but one species.

Some of the specimens sent me by Dr. Willey were taken from the duodenum and intestine of *Varanus salvator* taken at Horana, others from the duodenum of *V. bengalensis* taken at Bolgoda.

In the article by Monticelli and Crety quoted above, the authors place this genus with *Solenophorus* in a sub-family Solenophorinæ; on the other hand Lühe (and Braun in his Cestodes* follows Lühe) places *Duthiersia* with *Dibothriocephalus*, *Scyphocephalus*, *Bothridium*, *Diplogonoporus*, and *Pyramicocephalus*, in the sub-family Dibothriocephalinæ of the family Bothriocephalidæ.

Lühe remarks: "Die bisher angenommene feine hintere Oeffnung der angeblich trichterförmige Saugorgane ist an den von mir untersuchten Exemplaren des Berliner Museum nicht vorhanden, sie muss daher an der Pariser Exemplaren ein durch die Sonde hervorgerufenes Kunstprodukt sein. Die von Crety und Monticelli gebildete Unterfamilie *Solenophorina* (sic) verliert durch diesen Nachweis ihre Existenzberechtigung."

I have made two series of sections through the heads of two specimens of *D. fimbriata*,—all I could sacrifice to the knife,—and each of these series of sections, one of which was cut in the longitudinal vertical and the other in the longitudinal horizontal plane, shows the pore originally described by E. Perrier, opening posteriorly from each bothrium on to the outside.

The pore is truly very small, and if the section be in the plane of the narrow tube it scarcely occupies more than one section, but if it be cut obliquely it extends into three or four sections. It is much smaller in the Ceylon specimens than one would have expected from Perrier's illustrations, but it is most certainly there. The walls of the bothria are well supplied with large water-vascular trunks, which, when full, may give a certain tensity and rigidity to the organ. The nerve supply is also conspicuous.

BOTHRIDIUM PYTHONIS, Blainv.†

Pl. I., figs. 11 to 13 and figs. 15 and 16.

Synonyms: *Prodicœlia ditrema*, Lebl. Atlas to the work mentioned in the note † at the foot of the page.

Bothridium laticeps, Duvern. Ann. Sci., nat. XXX., 1833.

* Bronn's "Thier-reich," 1900, p. 1689.

† Bremser "Traité zoologique et physiologique sur les vers intestinaux de l'homme" trad. par Grundler: revu et augmenté des notes par M. de Blainville. Paris, 1824.

Solenophorus megalocephalus and *S. grandis*, Creplin, Ersch and Gruber's Ency. d. Wiss. u. Kunst. Leipzig, 1839. See also Rohoz, Zeitschr. wiss. Zool. XXXVII., 1882; Griesbach, Arch. mikr. Anat. XXII., 1883; Crety Atti. Acc. Lincei. Ser. 4, VI., 1890; Monticelli and Crety, Mem. Acc. Torino. Ser. 2, XLI., 1891; and Cohn, Zool. Jahrb. Anat. XII., 1896.

Bothridium pythonis, Blainv. Bronn's Thier-reich. Cestodes, 1894–1900; and Lühe, Verh. Deutsch. Zool. Ges., 1899.

Dr. Willey's specimens were very numerous, many were free, and again many were still attached to a piece of the wall of the duodenum of their host, a *Python molurus* taken at Weligatta, in the Southern Province of Ceylon. The same snake was also infested by a Nematode, probably *Ascaris rubicunda*, and by a Pentastoma, *Porocephalus moniliformis*, both found in the left lung.

Family : TÆNIIDÆ.

Sub-Family : TETRABOTHRIINÆ.

TETRABOTHRIUS EROSTRIS, Lönnbg.

Synonyms: *Bothridiotænia erostris*, Lönnbg. Ergebnisse der Hamburger Magalhænsischen Sammelreise I., Lief, 1896.

Prosthecocotyle erostris, Fuhrmann. Zool. Anz. XXI., 1898, p. 385, and Centrbl. Bakter. I., Abth. XXV., 1899, p. 871.

These specimens were removed from a tern or sea swallow, *Sterna bergii*, shot on the Negombo lake in August, 1902. This bird ranges from east and south-west Africa to Japan and Polynesia.

Sub-Family : TÆNIINÆ.

The three species of this sub-family represented in the collection have been described by Dr. Von Linstow,* and the subjoined account is an abstract of his article which I have thought well to add, so as to make this account of the collection of parasites of Ceylon sent to me as complete as possible.

TÆNIA POLYCALCARIA, Von Linstow.

Pl. I., fig. 4.

Length 108 mm., breadth anteriorly 1·5 mm., posteriorly 6·71 mm. The genital pores are irregularly placed on one edge or the other of the proglottides. The single lateral longitudinal vessel runs in the second and fifth sixth of the transverse diameter. The proglottides were all immature, the reproductive organs

* Centrbl. Bakter. XXXIII., 1903, p. 532.

undeveloped, and only the primordium of the testis and the genital sinus is recognizable. The central portion is separated from the peripheral by a dorsal and ventral broad band of transverse muscles. The calcareous bodies are closely packed and exceptionally numerous.

Since the reproductive elements are undeveloped the hooks on the rostellum demand especial attention as specific characters.

There are two rows of 19 hooks, measuring in length 0·238 mm. or 0·158 mm. These are straight with the short handle obliquely placed to the main axis; in the large hooks it is about in the middle, in the small hooks a little behind the middle and unsplit.

Amongst the cestodes living in allied carnivores the species belonging to the genera *Mesocestoides* and *Dipylidium* may be left out of account; *Tænia oligarthra*, Diesing, like *Tænia echinococcus* v., Sieb, consists of but 3-4 small proglottides. *Tænia laticollis*, Rud., has only one row of hooks. There remain for comparison *Tænia novella*, Neumann; *Tænia serrata*, Goeze; and *Tænia crassicollis*, Rudolphi.

Tænia novella, Neumann, has two rows of 20–21 hooks, which measure 0·25–0·26 mm. and 0·150–0·155 mm. The handle has its end directed towards the hook-end, and in the smaller hooks the root is much shorter than the hook-end and bent backward. The handle is split.

Tænia serrata, Goeze, has two rows of 17–24 hooks. The large ones measure 0·225–0·250 mm., the smaller 0·120–0·160 mm. The handle arises far in front of the middle in the large forms, but behind the middle in the small forms where it is split.

Tænia crassicollis, Rud., has two rows of 13–26 hooks, which measure 0·38–0·42 and 0·25–0·27 mm. respectively. The handle is stout and directed towards the point. It is situated behind the middle in the small hooks. Whilst these hooks are much larger than those of the new species they are much smaller than those of *Tænia cœnurus*, Rud.

Habitat: The intestine of *Felis pardus*. The stomach of this leopard contained monkey's hair. The host was shot between Wirawila and Tissa, in the Southern Province of Ceylon.

TÆNIA MÆANDER, Von Linstow.

Pl. I., figs. 5 to 7.

This tapeworm measured 18·2 mm. in length, 0·12 mm. breadth anteriorly and 0·99 mm. posteriorly. The maximum breadth is that of the proglottides a little behind the middle, where they are 1·42 mm. broad and 0·12 mm. long. All the proglottides are very short. The genital pores are on the edge and are unilateral.

The scolex is 0·13 mm. broad, the rostellum 0·062 mm. The latter bears about one-third from its anterior end a circlet of 24 hooks, each 0·0091 mm. in length. The suckers are oval with the longer axis longitudinal. They are 0·078 mm. long and 0·047 mm. broad. The cuticle is 0·0025 mm. thick, and beneath it lie two layers of longitudinal muscles, the external layer consisting of bundles of 2–3 fibrils, the internal of bundles of 6–8 fibrils. About twenty testicular follicles can be seen in each transverse section. The cirrus-sac is small and pear-shaped, the receptaculum seminis reaches almost to the middle of the transverse section; the yolk gland lies about in the centre of the segment, near it lies the small shell gland; the ovary lies in the central substance and consists of a number of groups of glands which spread out most on the side which does not bear the genital pores; the ova are 0·013 mm. in diameter.

No calcareous bodies are found. Two longitudinal excretory canals run along each side; one of them is markedly coiled. The eggs are oval, 0·052 mm. long and 0·042 mm. broad. The spherical onchosphere is 0·026 mm. in diameter, its outer capsule is beset with irregular tubercles.

Habitat: From the intestine of Schneider's leaf-nosed bat, *Hipposideris speoris*, Kalpitiya, Ceylon.

ACANTHOTÆNIA SHIPLEYI, Von Linstow.

Pl. I., figs. 8 and 9.

Only one specimen, a microscopic preparation, was available, and thus transverse sections could not be prepared. The tapeworm was 13·8 mm. long and anteriorly 0·11 mm. broad, posteriorly 0·49 mm. in breadth. The segmentation into proglottides is not shown at all anteriorly, and but slightly shown posteriorly. It is only indicated by the position of the reproductive organs. Posteriorly the proglottides are 0·97 mm. long and 0·49 mm. broad. The genital pores are irregularly placed in the centre of the proglottis edge.

The scolex is 0·24 mm. long, behind 0·18 mm. broad. The rostellum is 0·12 mm. long and 0·10 mm. broad. The cuticle of the whole scolex and of the body for a distance of 1·76 mm. is beset with thickly-set fine bristles.

In each proglottis there are some fifty testes. The cirrus-sac lies behind the vagina, and is crescentiform with the convexity anterior. The vagina bends back in a sweep towards the middle of the hind margin of the proglottis; here lie the rounded yolk gland and right and left a lobed ovary. The subcuticular cells are very powerfully developed. The eggs were not yet developed.

The diagnosis of this new genus is as follows :—The whole scolex and the anterior body-cuticle is beset closely with fine bristles. No hooks occur on the rostellum. Genital pores lateral, irregularly alternating. About fifty testes in each proglottis. The proglottis segmentation hardly recognizable externally.

Habitat: From the intestine of *Varanus* (*Hydrosaurus*) *salvator*. Taken at Horana, Ceylon.

CYSTICERCI.

One bottle contained four or five cysticerci, varying in size between a pea and a Lima bean. Before cutting these I had some hope that they would throw some light on the life-history of *Bothridium pythonis*, since they were taken from the peritoneum of a *Cervus axis*, a host which falls not unfrequently a prey to *Python molurus*. Sections, however, showed that we had to do with a *Tænia*, with four well-developed suckers and a double row of large hooks, twenty in each circle, alternating with one another. Probably this cysticercus is the larval form of *Tænia marginata*, which lives in the intestine of dogs and wolves.

NEMATODA.

ASCARIS RUBICUNDA ? Schneider.

In the same *Python molurus* whose duodenum was invested with the *Bothridium pythonis*, Blainv., and in the same lung that harboured the *Porocephalus moniliformis*, Diesing, was found a nematode. Dr. Von Linstow has been kind enough to examine this specimen, and reports that it is immature and cannot be accurately determined. Probably it belongs to the species mentioned here.

ACANTHOCEPHALA.

ECHINORHYNCHUS ROTUNDATUS, Von Linstow.*

The specimens were numerous, some free, but many with their proboscis sunk in the tissue of a piece of the intestinal wall of the host, the jungle crow, *Centropus sinensis*. In no specimen which I examined was the proboscis fully extended, always there was an invagination which concealed some of the hooks.

This parasite was described five years ago by Von Linstow from a *Centropus madagascariensis* taken in Madagascar. The Sinhalese specimens came from a bird labelled *Centropus rufipennis*,† Illiger, a species I have not been able to identify in the British Museum Catalogue.

* Arch. Naturg. 63 Jg., 1897, p. 33.

† This is the name given to the Common Coucal or Crow-Pheasant (Aettikukkula, Sinh.) in Captain Legge's monograph, p. 260. For a discussion of the synonyms and varieties of this bird Dr. W. T. Blanford's Vol. III., Birds, Fauna Brit. India, 1895, pp. 239-241, may be consulted.

GIGANTORHYNCHUS GIGAS (Goeze).

Five or six specimens of this parasite were taken from the stomach of a *Sus cristatus* killed at Batulu-oya. Judging from their size they were all males. The position of the parasite in the host is worth remarking. These animals usually come to rest in the small intestine, notably in the duodenum, but the specimens in question were found in the stomach. The secondary host of *G. gigas* is some species of beetle, most usually in Europe the cockchafer, *Melolontha vulgaris*, but *Cetonia aurata* is also incriminated. In North America the beetle *Lachnosterna arcuata* and allied species harbour the younger stages of the *Gigantorhynchus*.

LINGUATULIDÆ.

POROCEPHALUS MONILIFORMIS (Diesing).*

Synonym : *Pentastoma moniliforme*, Diesing. Denk. Ak. Wien. XII., 1856, p. 31.

A single specimen was taken from the left lung of a *Python molurus*, which also harboured the immature nematode, *Ascaris rubicunda* (?) Schn. The duodenum of the same snake was packed with the cestode, *Bothridium pythonis*, Blainv.

LIST OF PARASITES FROM CEYLON, WITH THEIR RESPECTIVE HOSTS.

PARASITES.	*HOST.*	*POSITION IN HOST.*
PROTOZOA.		
Sarcocystis tenella, Railliet	Beef	Amongst muscles.
PLATYHELMINTHES.		
TREMATODA.		
Paramphistomum bathycotyle, Fisch.	*Cervus axis*	Stomach.
CESTODA.		
Cysticercus ?	*Cervus axis*	Peritoneum.
Duthiersia fimbriata, Dies.	*Varanus salvator* and *V. bengalensis*	Intestine and duodenum.
Bothridium pythonis, Blainv.	*Python molurus*	Duodenum.

* Shipley, Arch. parasit. I., 1898, p. 72.

PARASITES.	*HOST.*	*POSITION IN HOST.*
Tetrabothrius erostris, Lönnbg.	... *Sterna bergii*	... Intestine.
Tænia polycalcaria v., Lins.	... *Felis pardus*	... Intestine.
Tænia meander v., Lins.	*Hipposideris speoris*	Intestine.
Acanthotænia shipleyi v., Lins.	... *Varanus salvator*	Intestine.
NEMATODA.		
Ascaris rubicunda? Schneider	... *Python molurus*	... Duodenum.
ACANTHOCEPHALA.		
Echinorhynchus rotundatus v., Lins.	... *Centropus rufipennis*	Intestine.
Gigantorhynchus gigas, Goeze	... *Sus cristatus*	... Stomach.
LINGUATULIDA.		
Porocephalus moniliformis, Dies.	... *Python molurus*	... Lung.

Zoological Laboratory, Cambridge,
May, 1903.

EXPLANATION OF PLATE

Illustrating Mr. A. E. Shipley's Article on "Parasites from Ceylon."

Fig. 1.—*Duthiersia fimbriata*, Dies. × 10.

Fig. 2.—A longitudinal horizontal section, × about 10, through the head of *D. fimbriata*, showing on the right side the anterior and the posterior opening into the bothrium.

Fig. 3.—The head of *D. fimbriata*, × 10, viewed *en face*.

Fig. 4.—Large and small hooks from *Tænia polycalcaria*, Von Lins. Slightly magnified. From Von Linstow.

Fig. 5.—Transverse section of *T. mæander*, Von Lins. Highly magnified. *c*, cirrus-sac ; *e*, external bundles of muscles ; *i*, internal bundles of muscles ; *lv*, lateral excretory canals ; *n*, nerve ; *o*, ovary ; *r*, receptaculum seminis ; *s*, shell gland ; *t*, testis ; *v*, vagina ; *y*, yolk gland. From Von Linstow.

Fig. 6.—Head of *T. mæander*, highly magnified. From Von Linstow.

Fig. 7.—Hook from *T. mæander*, highly magnified. From Von Linstow.

Fig. 8.—Head of *Acanthotænia shipleyi*, Von Lins. Showing the bristles. Highly magnified. From Von Linstow.

Fig. 9.—Proglottis of *Acanthotænia shipleyi*, Von Lins. Magnified. *c*, cirrus-sac ; *d*, yolk gland ; *k*, ovary ; *t*, testis ; *v*, vagina.

Fig. 10.—Four specimens of *Sarcocystis tenella*, Raill., × 1.

Fig. 11.—A portion of the duodenum of *Python molurus*, with specimens of *Bothridium pythonis*, Blainv., attached, × 12.

Fig. 12.—Head of *B. pythonis*, × 12.

Fig. 13.—Head of *B. pythonis* viewed *en face*, × 12.

Figs. 14, 14*a*, 14*b*.—Views of *Paramphistomum bathycotyle*, Fisch., × 5, showing different sizes and outlines.

Fig. 15.—Longitudinal vertical section through the head of *B. pythonis*, showing the anterior and posterior openings into a bothrium, and the way in which the villi of the snake's intestine are surrounded by the bothrium, × 24.

Fig. 16.—A longitudinal horizontal section through the head of *B. pythonis*, showing the posterior opening into one of the bothria × 16.

Fig. 17.—A transverse section of *Sarcocystis tenella*, Raill., showing the chambers and the granular contents or spores. Highly magnified.

A SKETCH OF THE CEYLON PEARL FISHERY OF 1903.

By EVERARD IM THURN, C.B., C.M.G.

IT is difficult to imagine a more picturesque incident than the "harvest of the sea," when pearls are the crop gathered in. The scene is in the shallow tropical sea which is shut in by Ceylon on the east, the coast of Southern India on the west, and on the north by "Adam's Bridge," a reef partly just awash and partly cropping up in the form of a chain of islands which connects Ceylon with India. In the Gulf of Mannar thus formed it was found at least some 300 years before Christ that there is an abundant growth of pearl-producing mussels—locally called oysters. The banks or "paars" on which these bivalves grow lie from 5 to 10 fathoms below the surface of the water. Thither for 2,000 years, when the rumour goes abroad that the harvest is ripe, divers have come together from the Red Sea and the Persian Gulf and the coasts of India, as well as from Ceylon itself, to gather in the Orient pearls which have been distributed to adorn stately men and beautiful women in many a function throughout the civilized as well as the barbaric world.

The coast lands of Ceylon nearest to the oyster paars is for the most part very sparsely inhabited, and, like the opposite coasts of Southern India, consists chiefly of rolling sand plains, with here and there a little coarse grass or low sparse vegetation or even occasional scrubby jungle. For some mysterious and hitherto unexplained reason this harvest of the sea has always been an uncertain one, apt suddenly, and at any stage in its growth, to disappear; and often it is many years before it re-appears. At most times of the year, and sometimes for years together when the oyster crop is known to have failed, the adjacent shore is a desert in which a human being is rarely to be seen. But nowadays, and throughout the past century, as each November comes round, an official from Colombo visits the paars, takes up a certain number of oysters from each, washes out the pearls, submits these and the facts connected with them to experts, and the Ceylon Government thus decides whether or not there shall be a fishery in the following March and April.

If the decision is in the affirmative preparations have to begin at once. The fact that there is to be a fishery is made known throughout India and the Eastern world, and even in Europe. This is done partly by the prosaic system of newspaper advertisement, partly by that far more wonderful passing of the word from man to man which, as is now well known, can carry news across a continent with amazing speed. On land which is at the moment a desert an elaborate set of temporary Government buildings have to be erected for receiving and dealing with many millions of oysters and their valuable if minute contents. Court-houses, prisons, barracks, revenue offices, markets, residences for the officials, streets of houses and shops for perhaps some thirty thousand inhabitants, and a water supply for drinking and bathing for these same people have to be arranged for. Lastly but, in view of the dreadful possibility of the outbreak of plague and cholera, not least, there are elaborate hospitals to be provided.

After an interval of eleven years it was announced at the end of 1902 that there would be a fishery in the following spring. The difficulty of making the above-mentioned preparations in due time vas enormously increased by the fact that so long an interval had elapsed since the last fishery, and that so few persons were conversant with what had to be done. Mr. Ievers, the Government Agent of the Northern Province, and his immediate assistants Messrs. Horsburgh and Denham were, however, equal to the occasion; and when the time appointed for the commencement of the fishery came, a complete temporary town had sprung as well and minutely ordered as are most permanent towns.

A fleet of some 200 large fishing craft had gathered, and with the help of an occasional steamer from Colombo had brought together, chiefly from India but partly from Ceylon, a population which during the course of the fishery varied from about 25,000 to perhaps 35,000 or 40,000 souls—men, women, and children.

It was my great good luck to pay two visits of considerable duration to the camp and, especially as I had had considerable part in arranging for it, to see it thoroughly. Many men have written and many others will write of this camp and of the Ceylon pearl fishery generally, but I believe that I saw it from a point of view peculiarly advantageous for seeing and understanding its general effect; and this is my sole excuse for acceding to the request of my friend Dr. Willey that I should describe, as I saw it, this great effort of recovery of spoil from the Ceylon deep in *Spolia Zeylanica*.

Another great advantage I had which has fallen to the lot of few other officials, and certainly never before to a Lieutenant-Governor with scientific leanings. On a suggestion made to me I gladly provided for the supply of diving dress and apparatus; and these being on the spot my innate curiosity induced me on several occasions to put on this dress and go down to visit the paars and see for myself how the oysters grow. I believe that Mr. Hornell, Captain Legge, and myself are probably almost the first persons to make use of the diver's dress for inspecting the bottom of the sea for purely scientific purposes; and some account of my own experiences may be not without use.

I have roughed it in so many places and so many ways that after the idea of myself going down had once suggested and commended itself to me I do not think that any qualms or doubts presented themselves. The sensation of being put into the dress is at first certainly rather trying. The weight is of course enormous and most oppressive, and I found that the operation of screwing up of the rivets fastening the very heavy helmet on to the rest of the dress was distinctly painful. Mr. Bartlett, professional diver, who valetted me on this occasion, certainly did his best to spare me as much inconvenience as possible. But a few months later when I was at the Maldive Islands with H.M.S. "Highflyer" and, moved by a desire to see for myself the wonderful coral forests and jungles and underwater cliffs of those atolls, I again donned the diver's dress, as supplied to His Majesty's ships, I found that both the weight and the painfulness of being screwed up were considerably less. I am assured that the equipment of the "Highflyer" is identical with those used in constructing the Colombo breakwater—it was one of these that I used at the pearl fishery; but I am positive that for some reason the "Highflyer" dress caused me the less inconvenience, and if any scientific man wishes to engage in the enterprise of deep sea diving, I should strongly advise him before acquiring his dress to consult the naval authorities.

The dress once donned and one's heavily encumbered body once got over the side of the ship and on to the ladder, the rest is easy. All that is necessary is to keep one's feet well down when descending the ladder and until one is entirely under water. Neglect, or rather ignorance of this precaution on one occasion brought me into difficulties. Having seen the professional diver swing himself off the ladder instead of first going patiently down to the lowest rung, I thought I would do the same; with the result that I fell on my back into the water, and that the air distributed within the dress instead of being forced gradually up from feet to head, as would

have been the case if I had gone down feet foremost, was forced to the front of chest and legs and kept me kicking on my back on the water.

After leaving the ladder feet downward pure passivity is to be recommended until one reaches the bottom. My first depth was 9 fathoms, but it certainly seemed to me to take a very long time to get down those 54 feet, and on the first occasion or two the pain in my ears was intense. I was told that the slower I went down the less acute would this pain be, but after various experiments I have not been able to make up my mind whether the longer endured but very slightly less acute pain is preferable to the quicker, sharper sensation. The most surprising thing to me was that as soon as the bottom was once reached all sensation of pain ceased—it was perhaps overwhelmed by the undoubted delight at the novelty of one's sensations and to exasperation at the small control one had at first over one's movements under that pressure of water. I could not by any effort keep my feet quite firmly on to the ground; and each twitch which the man who played Providence to me at the other end of the rope gave—doubtless in his nervous anxiety to guide me aright—had the unfortunate effect of throwing me over on to my back or my side or my face. Finally I found that getting about on all fours was the proceeding which gave me the greatest control over my own movements.

The light was wonderfully good, as a full green twilight, and I could distinctly see the ship 9 fathoms over my head. It is curious that at the same depth in different parts of the sea the quantity of the light varies considerably. This is probably due to the greater or less quantity of matter floating in the water.

The bottom where I first went down was a sandy, slightly undulating plain. Here and there at distances of a foot or so apart were small groups of from six to a dozen oysters, each group fastened by the byssus to a stone or piece of loose coral or dead shell; as far as I could see, no oysters were fastened to the actual bottom. Scattered about among the oysters on the sand were mushroom-shaped and other loose-growing corals, and here and there was a branched coral fastened to the bottom. The fishes and shrimps swam about utterly oblivious of one's presence, especially a lovely little ultramarine blue fish with a golden yellow tail. It was somewhat exasperating to throw an oyster at a fish and to find that the missile instead of going towards the fish dropped languidly to one's feet. Of big fish I hardly saw any, and of sea snakes, generally very plentiful in those parts, I saw only one, and that was while I was on my way down one day. Crabs were

fairly abundant, and I came across a striking-looking—indeed vicious-looking—animal of this sort (*Rhinolambrus contrarius*).

To one like myself who has as long as he can remember found a peculiar joy in seeing Nature from new points of view, it is pure delight to make one's way along the bottom of the sea, picking up shells, corals, starfish (very abundant), sea urchins, and a host of other things which had always before been to one lifeless "curiosities."

One of my chief purposes in going down was to see the divers actually at work. In but a few moments from leaving the ship and the world to which I had long been accustomed I reached a quite new world and, as it seemed, one apart from all other human beings. Then from the gloom of the distance—it was easier to see upwards than for any distance along the ground—some big thing came rapidly towards one; it might have been a big fish, but as it came quickly nearer it proved to be a naked Arab swimming gently but rapidly towards me, his rope between his toes, and his hands and arms rapidly sweeping oysters into the basket which hung round his neck. I tried to speak, forgetting that my head was buried in my helmet, but he glided close past me without taking any more notice of me than did the fish. He had perhaps thirty to forty oysters in his basket by that time. But his time was up—after all he could only stay down from 50 to 80 seconds, while I without inconvenience could stop down for half an hour. In an instant he had changed from a swimming to a standing position, and he was rapidly hauled up from me towards heaven, his feet being the last part to disappear.

As I gazed up after him something dark came down through the water and nearly hit me. It was a stone at the end of a rope thrown down for another diver. It was a warning that I had wandered from my own ship till I was under one of the diver's boats; and I beat a hasty retreat.

I had but to give a pull at the rope, a signal, and I felt myself being pulled rapidly up through the water. I went faster than the bubbles of air which had been rising from my dress, and was carried up through a stream of these bright bubbles. Suddenly it was very light, and some big dark broad thing covered with bubbles was directly above me, and the next moment I hit against it. It was the bottom of the launch, and my next task was to guide myself till I came to and with difficulty succeeded in getting on to the ladder. Then as I stood on the ladder, while the helmet was unscrewed and taken off and the fresh air came, I knew how good fresh air is.

While down on the first occasion or two my nose bled rather unpleasantly, but as this never happened to me afterwards I put it

THE PEARL FLEET REACHING HOME.

[*To face p. 61*

down to the fact that on those first occasions I had a heavy cold in my head.

I was once more back on the Master Attendant's barque, moored in the middle of the fleet on which the divers were all hurrying up to complete their day's load within the given time.

By noon most of the divers are tired out and, if it has been a fairly successful day, the boats are fairly loaded up. Moreover, at noon at this time of the year the wind almost invariably changes its direction and blows towards the land. At noon, therefore, a gun fired from the Master Attendant's barque gives the signal for pulling up the anchor, hoisting the sails, and beginning the run home. If the paar which is being fished is some distance from the land, the run home may take any time, according to the strength of that fair wind, from three to five hours.

The run home is, I am afraid, a busy and, from a Government point of view, a bad time. The men, other than the tired out divers, occupy themselves nominally in picking over their oysters, throwing away stones, shells, and other useless things which in the hurry have been gathered in with the oysters, and in preparing the loads for easy transport from the boats to the shore. But, as a matter of fact, it is well known that this opportunity and these hours are employed in picking over the oysters in a different sense. The finest pearls almost invariably occur just inside the edge of the shells, where they are held in position by so thin a membrane that they appear ready to fall out at any moment. There is no doubt that many of these finest, roundest, and best coloured pearls are picked out during the run home and concealed about the persons of the boat's crew, and this, despite the fact that each boat has a so-called Government guard on board, and that a further check is supposed to be provided by the Government steam launches which run in with the fleet, and the crews of which are supposed to keep their eyes very wide open for the illicit practices indicated. It is in this iniquitous practice of picking over that one chief reason why the Government does not get its fair share of the pearls lies.

It is as pretty a sight as one can well imagine, this homeward race before a strong wind and over a tropical sea of a hundred or so of ruddy-sailed craft, orientally fantastic in colour and shape, and each deck crowded with a motley crew of brown-skinned men and boys naked but for a few rags of brilliant coloured cloth. Each crew strives to get in first, in order to get first attention and so soonest to dispose of their loads and thus gain rest after a day of really hard labour. There is no lowering of sails as the shore is approached, no slackening of the speed till, as often as not, each

boat buries its bows deep in the high sandbank which forms the shore, and comes with a sudden thud so violently to a stand that the expectant crew, each man already loaded with his basket or netted pack of oysters, is almost hurled into the narrow openings in the high wattle fence which surrounds the Government "kottus," the sheds where the oysters are first deposited and divided.

Inside this fence is the huge wattle-walled and palm-thatched warehouse, where the division of the oysters between the divers and the Government is carried out. It is a vast rectangular building divided by rough posts and rails into long straight avenues of square pens, each pen numbered and provided with its Government clerks and counters.

The crew of each boat in some way gets itself, or is got by the officials, into a separate pen and there dumps down its oysters. Then the oysters are divided between the divers and the Government, in the respective proportion of one-third and two-thirds, by a process of quite admirable simplicity and ingenuity. The divers themselves, and unassisted, separate their own oysters into three heaps, roughly, but as accurately as possible under the circumstances. Then the Government clerk in charge of that particular pen, entirely at his own discretion, assigns one of these heaps to the divers, and this is forthwith bagged or basketed and carried off by them through the exit on the landward side from the enclosure. The actual process of exit is a little trying, for within this narrow opening in the wattle enclosure a small posse of Government officials with occasionally a few police stand on guard to keep order and to exercise a sort of rough search for illicitly concealed pearls. It is a rough and noisy but very good-humoured crowd; and in the course of this proceeding not a few pearls are in some mysterious way discovered and confiscated. If the departing crew is too obstreperous they are detained for such time as is necessary to deprive them of all their oysters. That this last proceeding is nothing more than rough justice is, I think, shown by the fact that the divers recognize it as such, and seldom or never complain once they have lost their oysters.

But even when a company of divers has successfully passed through the kottus and escaped through the narrow wicket gate on the landward side of that—for an hour or two each day—seething mass of humanity and oysters, their troubles of the day are not over, for they are at once swallowed up in a surging crowd of natives eager to buy from them their oysters by the dozen or the half-dozen, or even by twos and ones. The prices then given for each individual oyster or handful of oysters are comparatively enormous,

and the oyster bearer has often divested himself at highly remunerative rates of his whole burden before he emerges at the other side of the throng. If he has any left, he hurries to a native buyer and disposes of the remainder. Then he hurries to wash the brine off his tired limbs in one or other of the tanks specially reserved for the purpose ; and at last follows much-needed rest.

In time every boat has reached the shore and every boat's crew has, as above described, passed through the kottus.

No sooner has the load of any boat been deposited, divided into lots, and the diver's lot carried off, than the Government counters begin to count the share left for Government, and, by using an ingenious system of tallies, do this so quickly that the millions of oysters which generally form the Government share of a day's take are counted with remarkable accuracy within a couple of hours or so. Each counter reports his total to the representative of the Government Agent sitting in one corner of the kottu enclosure, and by eight or nine o'clock almost the exact numbers composing the great heaps of oysters on the kottu floor is known and reported. The kottus then are closed for the night, and a few sentries are left throughout the night to watch by the light of the long lines of dimly burning cocoanut oil lamps to see that none of the bivalves are removed or tampered with.

Here incidentally may be put on record a little incident within my own experience. A mouse wandering through the deserted kottus in the silence of the night and, impelled either by hunger or curiosity, put its head in between the gaping valves of an oyster and was caught before it could draw back. Oyster and mouse, the head of the latter tightly clipped by the former, now stand in a glass jar of arrack on my table. Such an incident appears to be not uncommon ; and Sir William Twynam in his interesting little museum at Jaffna has a bird imprisoned by an oyster in the same fashion.

At about 9 P.M. each night the Government Agent repairs to the court-house, where are collected all who wish to buy oysters wholesale. The Government Agent first announces how many of the bivalves are lying in the kottus and puts these up for sale by the thousand. Any number of thousands, from one to perhaps fifty thousand or more, are taken by individual purchasers or by syndicates. The prices in a single night vary curiously and inexplicably ; a high price, say, Rs. 35 per 1,000, may be given at the beginning of the evening, later not more than Rs. 22 can be extracted, and yet again later higher prices prevail. There is keen and zealous competition, the larger buyers competing against the smaller, or all combining in a ring against the Government auctioneer.

The day's catch is, however, generally sold within the same night, but if not the balance is disposed of privately the next morning.

Quite early the next morning each purchaser comes to the Government Agent for an order for the number of oysters knocked down to him the previous night, and at once sets to work to remove these to his own private shed; and before noon the Government kottu is cleared and ready for a fresh supply in the evening.

Meanwhile, at about the previous midnight or soon after, the wind then at that season of the year beginning to blow from the land out to sea, another fleet of boats starts out for the paars, reaches its destination by daybreak, anchors, and waits for the sea to become smooth and the light sufficient. While waiting, a narrow plank or bamboo platform is let down and fastened over each side of the ship; and on these platforms, when the day has advanced far enough, the divers rest squatting between their dives. And then the history already told of the previous day's take is repeated.

The washing of the pearls from the oysters is a most tedious, primitive, and somewhat disgusting process. The oysters are simply left to rot, the process being much assisted by the vast clouds of a black "housefly," which after the first day or two permeates the whole camp. After a week's rotting the seething and disgusting residue is sorted by hand, and the pearls, or such of them as are of sufficient size, picked out. The residue is then dried in the sun and becomes what is known as "sarakoo." This sarakoo is at leisure sorted and winnowed and examined over and over again till the smallest-sized pearls have been extracted.

Many of those who have come to the camp have come not to buy oysters, nor to wash them, but only to buy pearls. Of these, some are small people, but most are wealthy capitalists from the great towns of India and from Colombo. They live in two special streets, where all day long they sit on the ground in their open-fronted shops, toying with pearls spread on the dark coloured cloth which lies for that purpose on the ground in front of them. On the cloth, too, is a delicately formed copper scoop, shell shaped, for lifting the pearls, neat little scales with a quaint-shaped case to hold them and with weights, the larger of agate, the smaller of bright scarlet seeds, also a set of basket-shaped sieves for grading the pearls. When no one is present to sell they minutely weigh again and again the larger of the pearls, sort them according to size, colour, texture, and roundness, tie up the better specimens carefully in little screws of linen, put them away in the great strong box, which forms almost the only furniture of the shop, take them out again, and discuss each one over again with their partners and

MAIN STREET OF PEARL TOWN.

[*To face p. 64*

"FAKING" POOR PEARLS.

[*To face p. 65*

friends. Then some washer comes along with pearls to sell, and the whole joy of chafering begins, and lasts till one is tired of watching.

Meanwhile along the street a busy crowd is always passing in front of the shops. Many carry great brazen vessels of water from the tank, others drive home bullocks with loads of firewood or poles and palm leaves for new huts. Farther down the street are the shops of the silk or cloth seller, the brass and tinworkers, and countless provision shops.

Here and there in the middle of the broad street squat groups of pearl cutters, whose business it is on small wooden tables and with a primitive bow-drill to pierce pearls for stringing and to cut into something like presentable roundness the rough irregular pearl-like lumps which are found not in the flesh of the oyster, but attached to the inside of the shell.

So for some two months the business goes on, till the divers are worn out by diving and the pearl merchants are satiated with their purchases. Then the Government Agent is appealed to to proclaim the closing of the camp, and when he does so almost in a day the whole big population "fold their tents like the Arabs and as silently steal away," and in a very few days the once busy camp is left only to the jackals to scavenge up the refuse and to prowl among the great mounds of fresh oyster shells which have just been added to the accumulations of so many years' fishing.

The whole thing is intensely interesting and picturesque, but afterwards it leaves much to think about and much to hope for. The thing has been going on in the same way for centuries, and would so continue if the busy Western mind were not now turning to thoughts of how to improve on this old system, to make the harvest of the sea more regular in its occurrence, to economize the present vast expenditure of human energy now wasted in fetching up the oysters from the depth of the sea, and to extract the pearls from the oysters with greater rapidity, certainty, and with greater security that the Government gets its proper share, and with greater regard to sanitary conditions.

The whole thing is now at last about to change, and the points which I have just enumerated are to be attended to. Professor Herdman, with Mr. Hornell, is about to give us a long and full report on their careful investigations of the life-history of the pearl oyster in these seas; they are about to tell us why the crop is so uncertain, and how it may be made more continuous. Mr. Dixon and others are busy in bringing to fruition certain schemes for dredging up the oysters and for mechanical extraction of the pearl from the gathered oysters.

NOTE ON THE NIDIFICATION OF GALLINAGO STENURA.

By FREDERICK LEWIS, F.L.S.

THE question has been raised from time to time in Ceylon if the Common Pintail Snipe ever breeds here, and I propose in this note to record what instances have come under my personal observation.

The first instance I have is that some years ago, towards the end of the north-east monsoon, I flushed a snipe in a paddy field in the Pussellawa district and shot her. I noticed that her flight seemed to be slower than usual with snipe, and on picking her up and slightly pressing the abdomen with my thumb an egg, not fully formed, was extruded. On opening the body, which under these interesting circumstances I did, I found two more eggs, of which the smallest was barely half an inch long.

In none of the eggs was the shell formed, and therefore obviously I could not obtain any details as to colouring.

The second instance is more interesting. I was snipe-shooting with a friend at a place called Morahella, a few miles from the town of Balangoda, in the Province of Sabaragamuwa, when a snipe got up within a few yards of my companion, who shot it. He remarked, the same as I did, how slowly it left the ground, and we examined the place, as the field was nearly dry.

We found a nest of a few very flimsy materials, hardly worthy of the name of a nest, and in it were three eggs of a dull stone colour, broadly blotched with blackish sepia markings.

My companion took the eggs home to England with him, so unfortunately I could only depend on my notes for reference. On discussing the question a few days ago with Mr. E. Kynaston of Yatiyantota, he described an experience very nearly identical with my own, and has been kind enough to send me the two eggs he obtained. It will be observed that the sizes of the eggs Mr. Kynaston has kindly sent me represent—

First	...	... 1·34 inch by ·97 inch
Second	...	... 1·40 inch by ·98 inch

which rather closely approximate the size of the egg of the Painted Snipe (*Rostratula capensis**), that is 1·36 inch by ·98 inch,

* The Painted Snipe is named *Rhynchæa capensis* and the Common Snipe *Gallinago scolopacina* in Legge's "Birds of Ceylon."

while it is considerably smaller than the egg of the Common or Fantail Snipe (*Gallinago cœlestis*).*

The eggs now referred to correspond in markings with the eggs I referred to in the second instance I mentioned above, while I have no reason to doubt that the snipe obtained in each case was other than *Gallinago stenura*.

That snipe breed regularly in Ceylon I do not consider to be the case, but I think it is unquestionable that a few do, and I submit that the present instance may be taken as confirming that view, even though it might be contended that the eggs I now describe were not absolutely taken from *under* the snipe herself.

Egg of *Gallinago stenura*.

* See Blanford, Birds Ind., vol. IV., 1898, p. 286 and p. 293.

ON THE NESTING HABITS OF TRYPOXYLON INTRUDENS AND STIGMUS NIGER.

By E. Ernest Green, F.E.S.

TWO species of *Trypoxylon* occur in Ceylon—*T. pileatum*, Smith, and *T. intrudens*, Smith.* The latter is very common in the Kandy District. Its specific name is an apt one, for this little wasp is continually prying into any crack or cranny in search of a suitable nesting ground. An old nail hole, the hollow shaft of a key, or the stem of a disused tobacco pipe is frequently chosen for the purpose. Occasionally the vacated tunnel of another wasp, *e.g.*, *Stigmus*, is occupied. Another favourite position is a crevice between the covers or pages of a book; and a piece of corrugated cardboard is an irresistible attraction. This habit has enabled me to set a neat trap for the insect. By inserting pieces of narrow glass tubing (with aperture of about 4 mm.) in the corrugations of the cardboard I have induced the wasps to build in a glass house, which allowed me to watch their development from egg to imago. Fig. 2 represents a piece of glass tubing fully occupied by cells showing the insects in various successive stages of development. The partitions between the cells are composed of earthy matter. At the bottom of each cell a small yellowish-white elongate egg is first deposited. The cell is then provisioned with a number of paralyzed spiders sufficient for the needs of a single larva. In the nest under observation the spiders were all of one species—a small black *Attid* that frequents my room. I have noticed that the lower cells of the series are usually more fully provisioned than those nearer the upper extremity. The occupants of these lower (earlier constructed) cells almost invariably produce female insects, which have a slightly longer larval period. This would appear to be a provision for reducing the difference in the time of emergence between the elder and younger members of the same brood. In spite of this, the occupants of the earlier cells complete their transformations much sooner than those at the other end of the series, but must wait

* *Trypoxylon intrudens*, Smith, Trans. Zool. Soc., VII., 1872, p. 188. Bingham, Faun. Brit. Ind., Hymenoptera, vol. I., p. 224.

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2

2 a

Fig. 1. *Stigmus niger.*

Fig. 2. *Trypoxylon intrudens.*

until the latter have caught them up and made their exit. The adult wasp completely frees itself from the pupal skin, and expands its wings while still within the cocoon, and then waits patiently for its turn. The larva is at first of a pale greenish colour. It darkens as it increases in size, and when fully grown is of a dull greenish black tint with numerous white specks. The form of the cocoon is worthy of notice. Near the lower extremity there is a distinct constriction. The pupa rests in the upper part, while the lower part receives the excreta which are evacuated—once for all—immediately before pupation. The adult insect (fig. 2*a*), as described by Bingham, *loc. cit.*, is "Black, with glittering silvery pile; the second and third abdominal segments red, shaded with fuscous above; legs testaceous, variegated with black; wings hyaline and iridescent; nervures and tegulæ pale testaceous."

Another tube-inhabiting insect is *Stigmus niger*, Motsch.* The wasp does not utilize ready-made tubes, but constructs them by drilling out the pith from a grass stem or the slender twig of some plant. It generally selects a dead twig for the purpose. Fig. 1 shows a nest constructed in the pith of the "Mana grass" (*Andropogon nardus*), a very favourite site. The tunnel is often carried down for a considerable distance, perhaps 10 to 12 inches, the cells being disposed at the far end. *Stigmus niger* provisions its cells with *Aphides*, and must destroy a great number of these little pests. The partitions are formed of pulped pith. The fully grown larva has the anterior and posterior extremities pale yellowish, the median segments blackish green mottled with pale spots. Just before pupating the larva voids the contents of the alimentary canal and assumes a uniform orange-yellow colour. The pupa is naked. It is at first orange, with eyes and ocelli brown. As development advances it gradually becomes blackish. Only two species of *Stigmus* occur in the Indian region, *S. congruus*, Walk., and *S. niger*. Both species are found in Ceylon.

Royal Botanic Gardens,
Peradeniya, September, 1903.

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* *Stigmus niger*, Motsch. Bull. Soc. Nat. Mosc., 1863, p. 23. Bingham, Faun. Brit. Ind., Hymenoptera, vol. I., p. 267.

FURTHER NOTE ON SPECIES OF MYCALESIS.

By N. MANDERS, MAJOR R.A.M.C.

FOUR species of the *Calysisme* group of *Mycalesis* have been described from Ceylon, viz., *Mycalesis* (*Calysisme*) *rama*, Moore ; *subdita*, Moore ; *perseus*, Fab.; and *polydecta*, Cramer. Of these, *C. rama* is little known, only a few specimens having been taken by Mr. Pole near Udugama in July, and a note was made by me concerning it in *Spolia Zeylanica*, vol. I., part I., most unfortunately by a *lapsus calami* under the name *M. subdita*. With regard to the other three species, *M. subdita* can be easily distinguished in the male by the characters given by Moore, Lep. Ind., but the female is very difficult to discriminate from *M. polydecta* or *perseus*, especially in the dry-season form. All my females of *M. subdita* bred in the wet season can be distinguished from the wet-season *M. polydecta* or *perseus* by having a small additional ocellus on the under surface of the fore wing immediately below, and almost confluent with, the larger one, which is situated between the first and second median nervules ; but this is probably not a reliable character. I am unable to distinguish the unocellated dry-season females. I described the transformations of this insect (Journ. Bomb. Nat. Hist. Soc., vol. XIII.). So far as I know, *M. subdita* occurs only on the Trincomalee side of the Island, where it is uncommon, particularly the dry-season form, which I have very rarely found, and this is the more noteworthy as this side of Ceylon has a dry climate for the greater portion of the year.

M. perseus has two forms : the wet-season is *M. blasius*, Fab., and the dry-season *M. perseus*, Fab. *M. polydecta* has also two forms, *M. justina*, Cramer, being the wet and *M. polydecta*, Cramer, the dry. Whether these two insects are really distinct is a question which can probably only be decided by a series of breeding experiments. Ormiston thinks they are the same, and states that according to his experience elevation has a great deal to do with these various forms. I have eighteen specimens of this species from Ceylon selected from a large number. Of these, ten are *M. blasius* (the wet-season form) taken at Haldummulla in December, at about 4,000 ft. elevation, and two males of the same season from

Labugama, about 200 ft., also taken in December. These two latter can be distinguished from the Haldummulla specimens by having only two ocelli on the under surface of the fore wing, whereas the former have either four or five. My wet- and dry-season Haldummulla females have also four ocelli, and my one low-country female has, like the male, only two. The ocelli are very variable in this group, and a far larger number of specimens than I possess would be needed to determine the question of variation according to elevation. I mention it in the hope of stimulating inquiry among Ceylon entomologists. The few specimens I have tend to bear out Ormiston's opinion. Some of these females may be called *M. polydecta* and others *M. perseus*; it is a question only to be settled by breeding, but my opinion is that there is only one variable species dependent on season, and very probably elevation, for its various forms.

In a letter I received from the late Mr. De Nicéville in June, 1900, he expressed the opinion that "*M. polydecta* will be found a thoroughly bad egg," and this opinion will probably be eventually confirmed.

7, Salisbury Terrace,
Stoke, Devonport, July 9, 1903.

NOTES.

1. *Loris Gracilis and Pentatomid Bug.*—On giving a large Pentatomid bug (*Aspongopus singhalanus*, Dist.) to a captive *Loris gracilis*, the latter seized the insect, crammed it into its mouth, and crunched it up. The Loris immediately became ludicrously excited, reeled about in a peculiar drunken manner, micturating freely all the time. It tore pieces of the insect out of its mouth and threw them away, but collected them again and devoured every piece, afterwards licking its fingers with apparent relish. This Hemipteron secretes and ejects a pungent-smelling fluid somewhat resembling, in odour, essence of jargonelle. The action of the Loris suggested that the liquid was at first startlingly pungent, though the flavour was distinctly agreeable.

Peradeniya, June 11, 1903. E. ERNEST GREEN.

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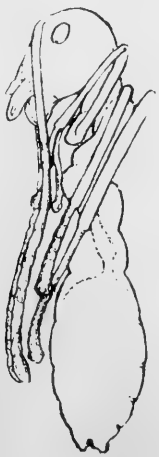
2. *Pupæ of the "Red Ant" (Œcophylla smaragdina).*—In my note "On the web-spinning habit of the Red Ant" (Journ. Bombay Nat. Hist. Soc., vol. XIII., No. 1, 1900), I wrote:



Pupa of *Œcophylla smaragdina*.

"It is probable that only fully-grown larvæ, ready to construct their cocoons, are employed for the work." I now find that *Œcophylla smaragdina* does not construct cocoons, but that the

pupæ of the workers—both major and minor—are naked. This seems to be explicable only on the theory that the silk that would normally be employed in the construction of the cocoon is systematically converted to the purposes of nest-building, and that the larvæ have consequently lost the habit of cocoon formation.

In a large nest of *Œcophylla* recently opened by me I found many hundreds of naked pupæ, but not a single cocoon. Can the absence of any silken covering to the pupæ of other species be similarly accounted for? Bingham, in his work on Indian Ants (Fauna B. I., Hymenoptera, vol. II.), does not specify which ants construct cocoons and which have naked pupæ.

At the time of the publication of my former note quoted above I was unaware that the same fact had already been observed and published, several years previously, by Mr. Saville Kent. A description and figure illustrating this habit appeared in Mr. Saville Kent's work, "The Naturalist in Australia," published in 1897, but I am informed that a still earlier note appeared in one of the Australian scientific journals.

E. ERNEST GREEN.

Peradeniya, July, 1903.

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3. *A Case of Protective Mimicry.*—In "Nature" of 25th June, 1903, is an illustrated article (taken over from the "Zoologist" for May) headed "New Case of Protective Mimicry in a Caterpillar," describing a Geometrid larva from Sarawak that disguises itself by attaching to spines on its back the buds of an Umbelliferous flower upon which it feeds. Failure to rear the caterpillar prevented the determination of the species.

I would draw attention to the fact that we have, in Ceylon also, a Geometrid larva that protects itself in a somewhat similar way. I have bred the insect and proved it to be the larva of *Comibæna biplagiata*, Moore, or, as it is now called, *Uliocnemis cassidara*, Guen. The caterpillar is figured in Lep. Heteroc., Brit. Mus., Part IX.,* plate CLXXVI., figs. 18, 18*a*. The segments of the body are armed with paired fleshy processes to which the larva attaches small pieces of leaves and withered flowers, which afford an excellent disguise as long as the insect remains motionless in its characteristic attitude.

E. ERNEST GREEN.

Peradeniya, July 20, 1903.

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* The Macrolepidoptera Heterocera of Ceylon, by Sir G. F. Hampson, 1893.

4. *Habits of Whip-snake.*—With reference to my recent note in *Spolia Zeylanica*, I have now to report that a freshly captured specimen of *Dryophis mycterizans* supports, by its actions, its popular native name of "Eye-piercing Snake." When first placed in the cage it repeatedly struck at my face, though it would not take any notice of my hand under any circumstances. It also struck repeatedly at the eye-pieces of a pair of binocular field-glasses. It struck at a piece of white sponge to which a small black disc had been attached (to represent an eye), but it never hit the disc, always catching hold of the sponge itself. It also struck at the plain sponge without the disc.

E. ERNEST GREEN.

Peradeniya, June 17, 1903.

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5. *Food of the Whip-snake.*—*Apropos* of Mr. Ernest Green's notes on the habits of the green whip-snake, I should wish to add my own experience of the reptile as a captor of small birds. Some years ago (may be five or six), while walking about the grounds of the School of Agriculture in Thurston road, Cinnamon Gardens, I was attracted by the cry of a bird in distress, and on looking about found a green snake, hanging to a branch by its tail, with a little bird in its jaws. While taking in the situation and thinking how to rescue the prey, I saw another tiny bird, which was flying by, caught up by a second snake hanging close to the first. My companion and I lost no time in releasing the two captives by vigorously throwing stones at the snakes, and had the satisfaction of seeing the birds flying off with a cry of joy, apparently none the worse for their experience.

C. DRIEBERG.

Colombo, July 20, 1903.

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6. *Hedgehogs in Ceylon.*—Last July a hedgehog was obtained by Mr. G. A. Joseph at Wellawatta near Colombo from a man who said he had taken it from a hole in the ground beneath a log.

This animal agrees in most of its characters with the South Indian hedgehog, *Erinaceus micropus*,* but presents certain differences. There is no nude median space on the top of the head dividing the spines into two groups, and the extreme tips of the spines are not white, but dark.

* Blanford, W. T., Mamm. Ind., 1888 1891, p. 218.

Kelaart thought it probable that hedgehogs would be found in Ceylon, and Jerdon (Mammals of India, 1874, p. 63) says that *E. micropus* "is probably one of the two species stated to be found in Ceylon." Sir Emerson Tennent never saw a specimen, but was told that they occurred here.

With all this there has never been an authentic record of a hedgehog in Ceylon. Accordingly it seemed to me to be very unlikely that a mammal new to the Fauna of Ceylon, even one with the retiring habits of the hedgehog, should turn up for the first time in Wellawatta of all places. I have been told, however, that hedgehogs have been seen by persons now living in Colombo. Others, on the contrary, who know the country and its inhabitants well, have never seen one here before.

In fact, I supposed that the Wellawatta specimen was in all probability an escaped pet, but as nobody has put in a claim for it, and as it seems to differ somewhat from the South Indian species, it is possible that it may be a genuine member of a Ceylonese fraternity.

It is very desirable that more material should be procured from unimpeachable localities and transmitted to the Museum, either as gifts, on loan, or for sale.

The specimen referred to is still alive, and thrives very well upon raw meat and cooked rice.

A. WILLEY.

Colombo, October 10, 1903.

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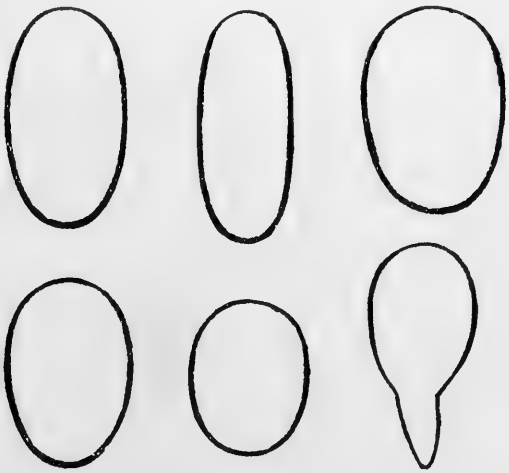
7. *Dwarf Eggs of the Domestic Fowl.*—Last December the Museum received from Mr. J. C. Dunbar of Kotagala eight small eggs out of a clutch of eleven which had been laid by an ordinary village fowl. Upon further inquiry being made it was ascertained that the hen had been acquired in a batch of village fowls about four months previously. The dwarf eggs were the first she had laid during that time, and it was said that she had never laid a normal egg. During the following week or so the hen laid five more dwarf eggs and was then allowed to sit upon a batch of normal eggs.

In every respect, except in the matter of oviposition, the fowl's behaviour was perfectly correct. In February of this year Mr. Dunbar kindly presented her to the Museum for investigation. She was kept here for some weeks, and her portrait was taken.

From February to April the hen continued to lay dwarf eggs at varying intervals and of varying shapes and sizes to the number of nineteen. All of these eggs were yolkless, containing albumen

only. Occasionally an opaque fragment was present, which appeared under the microscope to consist of yolk granules.

On 25th April the fowl was sacrificed upon the altar of Minerva. One naturally expected to find the ovary deficient in some respect On the contrary, the ovary was very large, contained ova in all stages of development up to submature and mature yolks, the largest of which measured $1\frac{1}{8}$ inch (28·5 mm.) across and $1\frac{1}{4}$ inch (32 mm.) from the stalk of attachment of the capsule to the opposite pole. There were also several collapsed capsules which had dehisced and presumably liberated their contained yolks into the body-cavity. What became of these it is impossible to say. It should be mentioned that the fowl was excessively fat.



Dwarf eggs of domestic fowl. Natural size.

There was no occlusion of the lumen of the oviduct, though the funnel was turned to the left away from the ovary, its two borders being placed in contact by the pressure of the neighbouring turgid ovary.

The hen was apparently egg-bound, though what causes operated to produce this result I am unable to say.

The actual dimensions of the dwarf eggs vary from 20 mm. to 30 mm. in length, and from 12·5 mm. to 18·5 mm. in maximum transverse diameter. The shape shows all gradations from elliptical to oval. The last egg laid on 23rd April carries a peculiar appendix or knob at the narrow end (see fig.). I am told it is a frequent occurrence here for the first two or three eggs of a fowl to be small and yolkless, and it is not impossible that this bird would have recovered its normal functions in time.

Colombo, October 10, 1903. A. WILLEY.

8. *Heralds of the Monsoons.*—The opening and closing of the monsoons, about which there is always a great deal of discussion, are occasionally demonstrated in an interesting manner, not by the ordinary flights of migratory birds and other seasonal occurrences in animal life, but by the stranding of birds, which have been overcome by the rising or setting of the wind and have been blown out of their course.

On 23rd October, 1902, a gaudily coloured bird, about the size of a thrush, drifted into the stable of my bungalow at Bambalapitiya, and was caught by the horsekeeper. It was placed in a cage and kept for a week, when it died without having become reconciled to its captivity, although it devoured worms, grubs, and insects greedily. It was obviously not a resident of the Island, and proved to be an Indian Pitta or "yellow-breasted ground thrush," *Pitta brachyura*,* a victim of the rising north-east wind.

It is called by the onomatopoeic name "Avichchiya" in Sinhalese, and is the subject of legends. It is a very common bird during the north-east season, arriving in October in vast numbers, according to Capt. Legge rather later than the Pintailed Snipe, which is wont to appear in September.

This year on 7th May a very rare and unwilling visitor was blown ashore at Wellawatta in an exhausted condition, and was brought to that hospital for sick birds, the Colombo Museum. This was none other than a fine young female frigate bird (*Fregata aquila*). This oceanic bird is a classical object not only on account of its immense power of flight, the altitude to which it soars, its occurrence far from land, and its piratical habits (pursuing terns, boobies, and gannets, and compelling them to disgorge their food which it catches in mid-air), but also on account of its ethnographic importance in the decorative art and symbolism of the South Pacific Islanders.†

Its power of flight is correlated with a great expanse of wing and tail (about 6 ft. from tip to tip of the outstretched wings), with a proportionate development of the pectoral muscles, which are said to weigh nearly one-fourth of the entire weight of the bird (Bennett, G., "Gatherings of a Naturalist in Australasia," 1860, p. 80), and lastly, with a special rigidity of the sternal apparatus brought about by the coalescence of the furcula with the keel of the sternum behind and below, and with the coracoids in front and above.

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* *P. coronata* (Legge, "Birds of Ceylon," p. 687).

† It is known to and venerated by the Melanesians under the name "Daula" (*cf.* Codrington, R. H., "The Melanesians, their Anthropology and Folk-lore." Clarendon Press, 1891.)

The specimen which was driven ashore by the rising south-west wind at Wellawatta last May was no longer able to fly. It lived for a day or two after being taken, and was subsequently mounted at the Museum. Its measurements are the following: Wing-expanse 5 ft. 10 in., length of wing 2 ft. 9½ in., total length from the end of the bill to the extremities of the forked tail 2 ft. 7 in., length of bill 3½ in., tail 1 ft. 1½ in., leg 5 in.

A striking fact which the above figures illustrate, besides the enormous wing-expanse and the length of the spreading tail, is the shortness of the legs, which are relatively very weak. The feet also are but feebly webbed.

A third visitor, captured on the beach at Colombo so recently as 3rd October of this year, may be welcomed as a token of the setting of the south-west monsoon. This is a Sooty Tern, *Sterna fuliginosa*, which, though not so rarely met with here as the frigate bird, is not common on these shores.

A. WILLEY.

Colombo, October 10, 1903.

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9. *Moths of Ceylon.*—A catalogue entitled "List of Moths Recorded from Ceylon up to the end of the Year 1902," has been issued this year from the Government Press for the Colombo Museum (price Re. 1). The first portion (261 pages) was compiled by Mr. A. Haly, the former Director of the Museum, and 228 pages were actually printed under his supervision. A supplementary list (pages 262–299) has been kindly furnished by Mr. F. M. Mackwood.

The preface contains a list of names which were included on insufficient data in the part which had been already printed. Mr. Mackwood has since noted another name to be expunged from the catalogue, 1364—*Lithosia intermixta*, which is a synonym of 1356—*L. brevipennis*.

A few literal errors have crept into the text, *e.g.*, *costipennis* instead of *ustipennis* on page 63, *postvitata* instead of *postvittata* on page 94.

Excluding the entries which have proved to be faulty, the catalogue contains the names of 2,022 species, of which 495, or nearly 25 per cent., are recorded as endemic.

Since the catalogue was published Mr. Mackwood has communicated further additions arranged in three categories. Part I. of the subjoined list includes names which were omitted by oversight from the published list. Part II. contains names of moths obtained some time ago, of which Hampson's identifications have only recently come to hand.

Part III. is a list of species recorded as new to Ceylon since the beginning of 1903.

PART I.

1390*a*. *Stictane obliquilinea*, Hmpsn.

1523. *Nola confusalis*, Hen-Schaff. Low-country to 4,000 ft.; September.

1535. *Nola argentalis*, Moore.

2223. *Blenina angulipennis*, Moore. West Haputale ; November.

PART II.

4302*b*. *Saluria minutella*, Hmpsn.

4331*a*. *Heterographis obscuralis*, Hmpsn.
Hambantota, Matale.

4341*b*. *Euzopherodes irroralis*, Hmpsn.
Hambantota, Puttalam.

4346*a*. *Mescinia olivescalis*, Hmpsn.
Kandy.

4348*b*. *Blabioides strigerella*, Hmpsn.
Nawalapitiya.

4349*a*. *Ptyomaxia trigonifera*, Hmpsn.
Puttalam.

4359*a*. *Nephopteryx rivulella*, Rag.

4359*c*. *N. myrmidonella*, Rag.
Puttalam.

4362*a*. *N. tumidella*, Hmpsn.

4363*a*. *N. atrisquamella*, Hmpsn.
Puttalam, Matale.

4363*b*. *N. albifascialis*, Hmpsn.
Matale.

4364*a*. *N. striginervella*, Hmpsn.

4370*b*. *N. calamalis*, Hmpsn.
Puttalam.

4384*a*. *Hypsipyla psarella*, Hmpsn.
Puttalam.

4384*b*. *H. elachistalis*, Hmpsn.
Hambantota.

4434*a*. *Etiella grisea*, Hmpsn.
Puttalam.

4442*a*. *Macalla plicatalis*, Hmpsn.
Matale.

4464*b*. *Stericta suspensalis*, Wlk.

4525*e*. *Eccopidia oinistis*, Hmpsn.
Kandy.

PART III.

857. *Miresa decedens*, Wlk.
Nitre Cave.
Diacrisia ? castanea, Hmpsn.
West Haputale ; February.
Asura uniformis, Hmpsn.
Haputale ; April.
Spodoptera postfusca, Hmpsn.
Nuwara-Eliya ; March.
Stictoptera xista, Swinh.
Gampola ; November.
2520. *Ophiusa triphœnoides*, Wlk.
Formosa, Himalayas, Bengal, West and South India.
West Haputale ; February.
2549. *Plecoptera reflexa*, Guen.
Throughout North India, Poona, Andamans.
West Haputale ; November.
2787. *Avitta quadrilinea*, Wlk.
Sikkim, Khasis, Nilgiris, Borneo.
West Haputale ; February.
Callopistria ? œthrops, Butl.
Haldummulla ; October.
2038. *Xanthoptera marginata*, Wlk.
Dharmsala, Nilgiris, Java.
Haldummulla ; December.
Corgatha atrifalcis, Hmpsn.
Wattegama ; May.
Rivula niphosticha, Hmpsn.
West Haputale ; November.
Acantholipes retracta, Hmpsn.
West Haputale ; November.
3323. *Garœus discolor*, Warr.
Khasis, Nagas.
Tonacombe ; January.

Colombo, October 10, 1903. ED.

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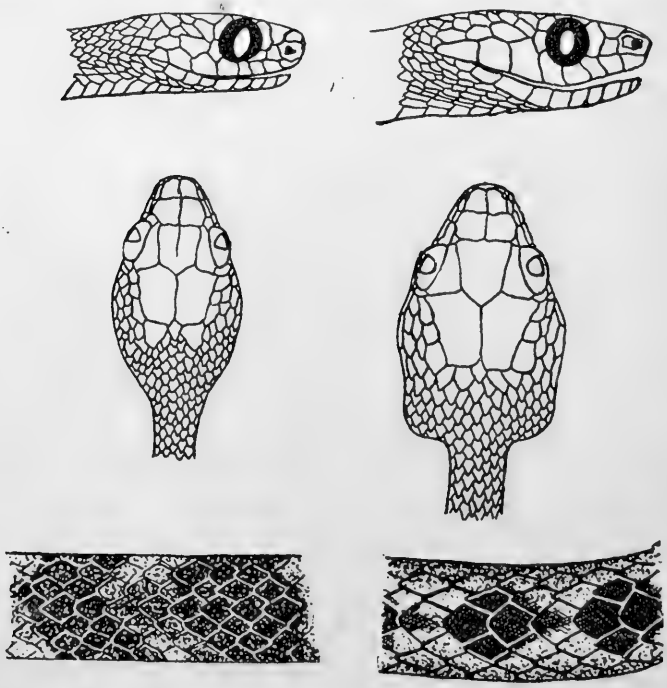
10. *Some Rare Snakes of Ceylon.*

I.—*Dipsas barnesii*, Günther. 1869.

Günther, A. Report on two collections of Indian reptiles. P. Zool. Soc., 1869, p. 506. (This paper includes a collection made by R. H. Barnes, Esq., of Gangaruwa, Ceylon.)

With the exception of the Python family (Boidæ) and the earth-snakes of the families Typhlopidæ, Ilysiidæ, and Uropeltidæ, all the Ceylonese snakes belong to one of two families, Colubridæ and Viperidæ. According to Boulenger's system of classification the Colubrine snakes comprise three parallel series of forms, namely, Aglypha, harmless snakes with simple solid teeth; Opisthoglypha, suspected snakes or slightly poisonous, one or several of the posterior maxillary teeth being fang-like and grooved; Proteroglypha, poisonous Colubrine snakes in which the anterior maxillary teeth are either grooved or perforated.

The Opisthoglypha are represented in Ceylon by the three genera *Dipsas*, *Dryophis*, and *Chrysopelea*. The Proteroglypha comprise terrestrial and marine snakes, the former being represented in Ceylon by the genera *Callophis*, *Bungarus*, and *Naia*.



Lateral and dorsal views of the head and dorsal views of portions of the body of *D. barnesii* (on the left) and *D. ceylonensis* (on the right). The vertebral scales of the latter are larger than the others.

Three species of the genus *Dipsas* occur in this Island, namely, *D. barnesii*, *D. ceylonensis*, and *D. forstenii*. Of these, the first is endemic, the second and third are found also in the Himalayas and Western Ghats of India.

The original description of *D. barnesii* was based upon a single specimen, and until this year it has not been numbered among the

Ophidia in the collection of the Colombo Museum. Now, however, thanks to the generosity of Mr. H. M. Drummond Hay, the Museum possesses an example from Balangoda.

It is a rather small elegant snake banded transversely, some scales having a black margin and pale centre; and a row of black spots along each side. The total length is nearly 23 inches (the maximum length of the species so far as recorded), of which the tail occupies 4 inches. It is chiefly distinguished from *D. ceylonensis* (which attains a maximum length of 4 feet) by the different proportions of the head-shields, eyes, and vertebral scales (see text fig.). As in the other species of the genus, the anal shield is entire and the subcaudals are in two rows.

In girth and general appearance *D. ceylonensis* is not unlike *D. barnesii*, but it is a much commoner species, the commonest of the three Ceylonese species of the genus. The Museum collection contains numerous specimens, including a series from Horana presented in 1901 by Mr. G. H. Swayne,* and one from Sigiriya presented this year by Mr. H. C. P. Bell. In *D. ceylonensis* (which in spite of its name is not confined to Ceylon) there is a well-marked dark brown streak proceeding from the eye to the angle of the mouth; in the only specimen of *D. barnesii*† which I have seen this streak is not or hardly distinguishable from the general dark ground colour. In both species the scales are in 19 rows, this number being constant for the sixteen specimens of *D. ceylonensis* which I have examined.

The third species of *Dipsas* which occurs in Ceylon, *D. forstenii*, is a much larger snake than the other two, attaining a maximum length of about 5 feet with a girth of 3 to 4 inches. The number of scales round the body varies in different individuals and in different parts of the same individual; there may be as many as 29. There is a dark streak behind the eye resembling that in *D. ceylonensis*, though broader. The anterior mandibular teeth of *D. forstenii* are very long, but the disposition of the head-shields is almost identical with that of *D. ceylonensis*, with the one distinction that the scales in the temporal region are more numerous in the former than in the latter.

This species (*D. forstenii*) is not very common in Ceylon, though not nearly so rarely met with as *D. barnesii*. In the Museum collection there are specimens recorded from Negombo, Kalutara, and Horana (Swayne coll.); and one example with length of

* The Swayne collection of snakes has not yet been fully worked out.

† Since the above was written I have discovered a second specimen of *D. barnesii* in a bottle labelled *D. ceylonensis*, unfortunately without any locality being given.

5 feet was sent this year to the Museum by Mr. H. C. P. Bell, who found it asleep on the top of a verandah pillar at Anuradhapura last May. Mr. Bell tells me that this is only the third of the kind which he has seen in thirty years.

The Sinhalese name for all the species of *Dipsas* is "mápilá."

II.—*Dryophis pulverulentus*, Dum. et Bibr. 1844.

Duméril et Bibron, Erpétologie générale, t. VII., 1844, p. 812.

The tree-snakes of the genus *Dryophis* are represented in Ceylon by two species, *D. mycterizans*, the common green whip-snake or eye-snake (see S. Z., Part II., p. 37), which ranges through India into Burma; and *D. pulverulentus*, a much rarer snake occurring only in Ceylon and in the Anaimalai Hills at an altitude of about 2,000 feet (Boulenger). In Ceylon it has been recorded from Ratnapura and Wadduwa (Haly). There is also a specimen in the Swayne collection from Horana, and another example has reached the Museum this year from the Kurunegala District, sent by D. J. M. Seneviratne, Schoolmaster at Weuda.

Finally, Mr. H. M. Drummond Hay informs me that he has collected two or three specimens at Balangoda.

Head of *Dryophis pulverulentus* in side view.

It attains a great length, nearly 6 feet, and has a very long whip-like tail. It differs from the commoner species in colour and in the character of the dermal appendage of the snout (rostral appendage). Instead of green the prevailing colour is a grayish brown, and the rostral appendage [which in *D. mycterizans* is formed by the modified rostral shield alone, which may be slightly wrinkled (*cf.* S. Z., Part II., p. 37, fig. 14)] carries some small accessory scales above at the base of the true rostral shield which is itself somewhat furrowed. In both species the body-scales occur in fifteen rows; the pupil of the eye is horizontal; anal divided; subcaudals in two rows.

D. pulverulentus is called "henakandaya" in Sinhalese.

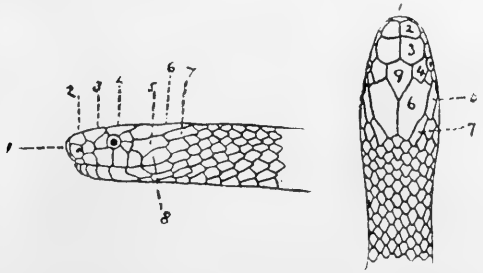
III.—*Callophis trimaculatus* (Daudin, 1810).

Daudin, F. M. Histoire naturelle générale et particulière des Reptiles, 1810. (*Vipera trimaculata*, VI., p. 25.)

Among a number of snakes sent to me some months ago for identification by Mr. H. M. Drummond Hay, who had collected

most of them on the Hopewell estate. Balangoda, there was one small snake which presented a difficulty in spite of the fact that the naming of Ceylonese snakes has been rendered a straightforward if not altogether an easy task by the publication of the volume on Reptilia and Batrachia in 1890 by Mr. G. A. Boulenger, F.R.S., in the "Fauna of British India." In this case, however, I deemed it advisable to appeal directly to headquarters, and Mr. Drummond Hay kindly permitted me to send the snake to the Natural History Department of the British Museum in London.

In his reply (dated July 2, 1903) Mr. Boulenger wrote: "The little snake is an interesting addition to the Fauna of Ceylon. It is a *Callophis trimaculatus* (Rept. Ind., p. 384), a species which was only known from India and Burma. I should have been glad to keep the specimen for the Museum, but as it is of so great local interest to you I return it with the request that, should a second specimen turn up in Ceylon, you will remember the British Museum."



Lateral and dorsal views of the head of *Callophis trimaculatus*. (Partly after Günther, P. Z. S., 1859, pl. XVI., fig. E). 1, rostral shield; 2. internasals; 3, præfrontals; 4, supraocular; 5, temporal; 6, parietals; 7, occipital; 8, sixth and last upper labial; 9, frontal.

I have since found that there was already a single example of this species in the Colombo Museum, which is recorded in Mr. A. Haly's "Report on the Collection of Reptilia in the Colombo Museum" (1891, p. 25) in these words: "One specimen, bund of the Tissamaharama tank, March. 1877 (bad state). Mr. H. Nevill obtained another specimen in the Trincomalee dockyard, 1890." It is not stated what became of Mr. Nevill's snake, but assuming that the identification was correct, Mr. Drummond Hay's specimen (which he has been good enough to present to the Colombo Museum) is the third known from Ceylon. It was picked up by him on the road between Dambulla and Trincomalee, the exact spot being where the road enters on the bund of the Kanthalai tank.

It is a very small snake, 10¼ inches long with a diameter not exceeding three-sixteenths of an inch. The maximum length of

the species is only 13 inches (Boulenger, Rept. Ind., p. 384). After preservation in alcohol and formol the specimen has assumed a pale neutral tint, except for the head and nape which are black: there are also black markings about the tail, a broad black ring behind the vent, another in front of the pointed extremity, and several intermediate black spots scattered irregularly on the paired subcaudal shields of the tail. The tail itself is three-fourths of an inch long; the anal shield is divided: there are thirteen rows of scales round the body exclusive of the ventral shields.

In the fresh condition we are told there is a yellow spot on each occipital shield; these spots can still be distinguished, appearing like a pair of pale ocelli. The lower parts of the body are described as being coloured uniformly red during life. According to Dr. Günther (P. Zool. Soc., 1859, p. 81) the genus *Callophis* is characterized by the arrangement of the colours of the upper parts in longitudinal streaks. Such streaks can be discerned in the specimen under consideration, the median or vertebral line being darker than the others; the back and sides of the body are also finely spotted, each scale bearing a brown spot.

The poison fangs are very small, grooved in front, and there are no other maxillary teeth behind them.

According to Sir Joseph Fayrer (Thanatophidia of India, 1872. p. 12), the poison is virulent, and fowls bitten by some of the species of *Callophis* succumbed in from one to three hours. They are not aggressive, bite reluctantly, and would probably not be able to inject a lethal dose into the human subject on account of their small size and the shortness of their fangs. They are said to feed chiefly upon other snakes, more especially upon *Calamariæ*, which, however, do not occur in Ceylon so far as is known.

IV.—*Dendrophis caudolineatus*, Günther. 1869.

Günther, A., *op. cit.* P. Zool. Soc., 1869, p. 506.

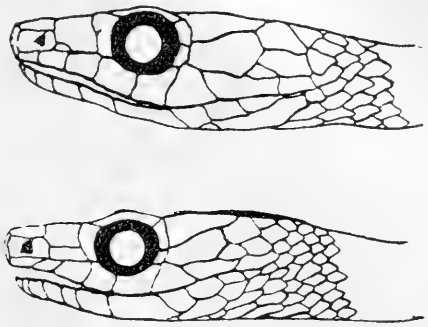
Dendrophis is a genus of tree-snakes belonging to the aglyphous section of the Colubridæ, the maxillary teeth being numerous and approximately equal, none being fang-like. Like *Dryophis*, it is represented in Ceylon by two species, one of which is common and widely distributed in the East Indies, the other rare and confined to Ceylon. The common species is *D. pictus* and the rare species *D. caudolineatus*. The former has fifteen rows of scales, the latter thirteen.

A third species, *D. bifrenalis*, is described by Mr. Boulenger* from three specimens in the British Museum. This is not present

* Rept. Ind., p. 338.

in the Colombo Museum collection; it seems not quite certain whether it is not an aberrant form or variety of *D. pictus*.

The object of the present note is to place on record the occurrence of an aberrant form of *D. caudolineatus*, which has been sent to the Museum by Mr. H. M. Drummond Hay, who had himself noticed the abnormality. The species has been already recorded from Balangoda, Udugama, and Illagolla (Haly).



Side view of the head of two specimens of *Dendrophis caudolineatus*. The upper specimen is aberrant, with a rudimentary loreal behind the nasal shield; the lower figure represents the normal condition.

In a normal example of *D. caudolineatus* there is a long narrow shield between the single præocular shield and the nasal shield, bounded below by the upper labials and above by the præfrontal. This shield is called the loreal. In the abnormal specimen there is no loreal on the right side of the head, the right præfrontal coming into contact with the upper labials. On the left side the left præfrontal is also in contact with the upper labials, but there is a very small loreal wedged in between it and the nasal. On the left there is reduction and on the right complete suppression of the loreal. On both sides there is a slight tendency towards duplication of the præocular.

One of the principal characters of *D. bifrenalis* is the possession of two loreals. No doubt in course of time, as material accumulates, one will be in a position to ascertain whether this is a constant character or merely a casual duplication.

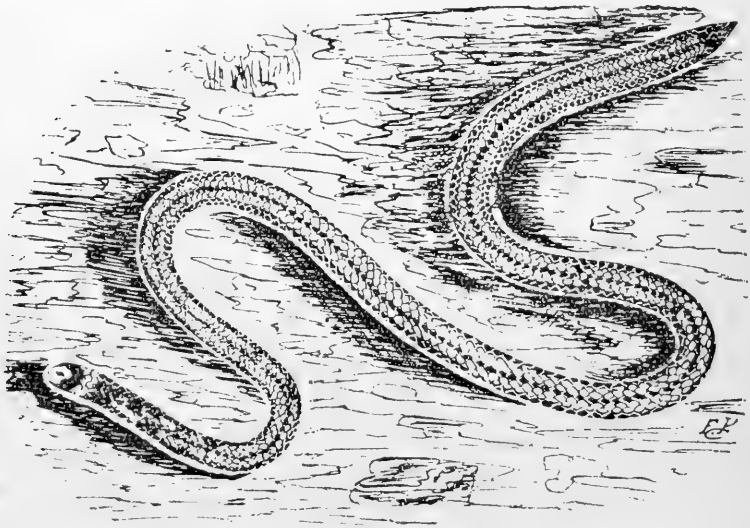
The species of the genus *Dendrophis* are called "háldandá" in Sinhalese. One of the distinctive marks which they have in common is the possession of a suture-like keel along the sides of the ventral shields. Furthermore, the pupil of the eye is round* the anal shield is divided, and the subcaudals are in two rows.

* There is a general superficial resemblance between *Dipsas* and *Dendrophis*, the head in both genera being distinct from the neck, but more elongate in the latter. They may be at once distinguished by the shape of the pupil of the eye which is vertically elliptical in *Dipsas*, round in *Dendrophis*.

V.—*Rhinophis punctatus*, Müller, 1832.

Müller, Joh., Beiträge zur Anatomie und Naturgeschichte der Amphibien. Zeitschrift f. Physiologie (Tiedemann u. Treviranus), IV., 1832, p. 249.

In October of last year, whilst travelling on the road from Puttalam to Chilaw, I picked up a dead though fresh "depatnaya" near Madurankuli, which excited my interest at the time, and subsequently proved to be the first specimen of the kind ever acquired by the Colombo Museum, namely, *Rhinophis punctatus*, a species peculiar to Ceylon, as indeed are all the other members of the genus *Rhinophis*, with one exception, *R. sanguineus* of Southern India.



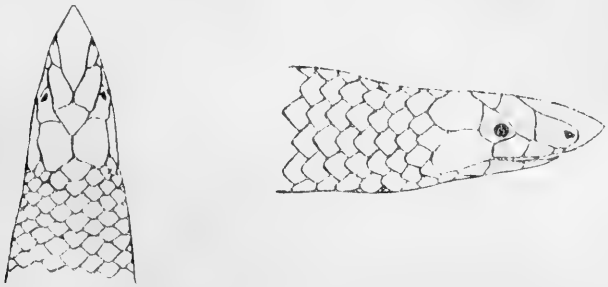
Rhinophis punctatus. Slightly reduced.

It is a long slender snake with inconspicuous head, and with a large tail shield. Its more superficial peculiarity depends upon the character and distribution of the pigment in the skin, producing a variegated appearance. In most snakes the ventral surface of the body is paler than the dorsal and lateral surfaces, but in this instance the scheme of coloration is reversed, and the upper surface is that which displays the least dark pigment.

This is in fact a very well-marked species, much more so in reality than would appear from written descriptions, though I have not had access to the figure of it contained in Peters's Monograph of the Uropeltidæ.

The median dorsal or vertebral scales have a black blotch in each, the series of blotches producing a moniliform pattern down the back; the submedian scales are pale, devoid of black pigment.

The rostral shield, which forms the pointed snout, has a length of 3·75 mm.* on the upper side of the head separating the nasals; it is distinctly keeled, with an orange-coloured tip. There is also some orange colour about the caudal shield, which is as long as the shielded part of the head, 6·25 mm. There are seventeen scales round the middle of the body as in all the Ceylonese species of *Rhinophis*, and about 6 subcaudal shields (according to Beddome 8 or 9 in the males, 6 or 7 in the females). The total length is about 14 inches with a diameter of 5·5 mm.



Dorsal and lateral views of the head of *R. punctatus*.

In his "Account of the Earth-snakes [Uropeltidæ] of the Peninsular of India and Ceylon" (Ann. Nat. Hist., ser. 5, vol. XVII., 1886, pp. 3–33) Colonel R. H. Beddome states that during the course of his investigations he only found a single example of *R. punctatus*. This, coupled with the fact that the present example is the first to find its way to the Colombo Museum, where there is a representative collection of Ceylonese snakes, entitles the species to be regarded for the present as a rarity.

A. WILLEY.

Colombo, October 10, 1903.

* Approximately 25 millimetres go to the inch, 300 to the foot.

NEMATODA IN THE COLLECTION OF THE COLOMBO MUSEUM.

By Dr. O. von Linstow.

(*Göttingen.*)

With two Plates.

THE small collection of endoparasitic Nematodes here described contains representatives of twenty-two species, of which thirteen are new and one is made the type of a new genus, *Ctenocephalus*.

The following is a list of the species recorded, together with their hosts :—

Ascaris.

The mouth is surrounded by three lips, of which the dorsal is placed symmetrically across the dorsal middle line, while the two ventro-lateral lips abut upon the ventral middle line; the

intestine is often prolonged into a cœcum, which lies below the œsophagus, and the latter frequently carries a tubular gland which rests upon the dorsal side of the intestine. The male possesses two equal spicula or cirri, but no bursa at the caudal end of the body.

Ascaris has the musculature characteristic of Schneider's Polymyaria, and belongs to the division Secernentes, in which the lateral fields or ridges are narrow and project well inwards; each ridge contains a canal, and the two lateral canals unite in front in the mid-ventral line, where they open to the exterior by a common *porus excretorius*, not far behind the mouth.

1.—*Ascaris rotundicaudata*, n.sp.

Pl. I., fig. 1.

Habitat: stomach and intestine of *Calotes ophiomachus* ("katussa," Sinh.), Colombo.

Cuticula annulate or transversely striate; lips broad and short, denticulate, without intermediate lips, papillæ set far back; dorsal lips nearly quadrilateral with rounded fore-edge, 0·22 mm. broad and 0·068 mm. long.

The œsophagus occupies $\frac{1}{20}$ of the entire body length in the male, $\frac{1}{24}$ in the female.

The male has a length of 46 mm. with a diameter of 0·73 mm. The tail is rounded with a conical extremity and equals $\frac{1}{58}$ of the body length. The cirri or spicula measure 8·8 mm.; at the tail end of the body on each side there are papillæ—thirty-one præ-anal papillæ and three post-anal. The præ-anal papillæ extend forwards to a distance of 3·2 mm. from the caudal extremity. Quite at the posterior end there is also a dorsal papilla.

In the female, with a length of 72 mm. and diameter 1·14 mm., the rounded tail occupies $\frac{1}{185}$ of the body length, and terminates in a fine conical prolongation. The vagina opens approximately in the middle of the body. The thick-shelled eggs are nearly spherical, 0·078 mm. in diameter; the shell surface is finely granulated.

2.—*Ascaris ceylanica*, n.sp.

Pl. I., fig. 2.

Habitat: (*a*) intestine of the Brahminy kite, *Haliastur indus*, Bodd., Colombo; (*b*) stomach of the fish eagle, *Poliaëtus ichthyaëtus*, Horsf., Kalpitiya.

This is a fairly large species, allied to *A. microlabium*, but not identical with it. All the specimens are fragmentary, so that measurements cannot be given.

Cuticula annulate; lips with large intermediate lips without denticulations (Zahnleisten); the inner pulp is produced forwards; the dorsal lip is 0·099 mm. broad, 0·073 mm. long; the tail end is conically attenuated.

The male is 1·22 mm. in diameter, the very short tail measures only 0·22 mm., the long cirri measure 5·53 mm.

The female has a diameter of 1·50 mm.; length of tail, 0·32 mm.; spherical thick-shelled eggs, 0·062 mm.

3.—*Ascaris brachyura*, n.sp.

Pl. I., fig. 3.

Habitat: intestine of *Calotes versicolor*, Dum. et Bibr., Colombo.

Cuticula broadly annulate; lips with tooth-rows, the denticles high and acute: intermediate lips absent; dorsal lip concave in front, 0·176 mm. broad, 0·097 mm. long; papillæ large, obliquely placed; body slender, tail very short and rounded; the œsophagus extends over $\frac{1}{14}$ to $\frac{1}{15}$ of the body length.

The male has a length of 31·6 mm. and a diameter of 0·91 mm.; the tail has a length equal to $\frac{1}{267}$ of the body, and carries a very fine style-shaped process; the falciform cirri have rounded ends and measure 0·62 mm.; at the caudal end on each side there are 22 præ-anal and two post-anal papillæ.

The female attains a length of 34·3 mm. and a width of 0·86 mm.; the tail is $\frac{1}{200}$ of the entire length, and is destitute of a styliform process at the end; the vulva lies somewhat in front of the mid-region of the body, dividing the latter in the proportion of 3 : 5; the reproductive organs leave the anterior third of the body free, and behind $\frac{1}{17}$; eggs were not mature.

4.—*Ascaris quadrata*, n.sp.

Pl. I., fig. 4.

Habitat: stomach of *Crocodilus porosus*, Gray, Bolgoda.

There is only one specimen in the collection, an immature female, but the formation of the lips is so characteristic, and diverges so much from that of the other Nematodes known from African and American crocodiles, that it is possible to diagnose the species.

The cuticula is finely annulate; lips without teeth and without intermediate lips; the dorsal lip is 0·132 mm. broad, 0·088 mm. long, quadrangular, with front angles rounded; the pulp (*pulpa*) is produced into two quadrangular projections. The length amounts to 15·8 mm., the diameter to 0·55 mm.; the œsophagus occupies $\frac{1}{4}$ of the entire length; a cœcum arises from the intestine

and extends forwards below the œsophagus, $\frac{2}{3}$ length of latter the short tail is conical, $\frac{1}{17}$ of the body length.

The Ascaridæ hitherto known from crocodiles are as follows :—

Ascaris helicina, Molin ;* lips with intermediate lips, the pulp gives rise in front to two spheres with forked processes ; body spirally involute ; North America.

A. agilis, Wedl. ;† lips with dentigerous ridges (Zahnleisten), narrow at the base ; pulp with three roundish projections : body spirally involute ; Egypt.

A. lanceolata, Molin ;‡ lips with two semi-circular dentate ridges in front ; North and South America.

A. tenuicollis, Rud., from North and South America, has been so defectively described that it is impossible to recognize the species.

5.—*Ascaris mystax*, Zed.

Habitat : *Canis familiaris*, L. ; passed by a young sucking puppy, Colombo ; also from intestine of young *Felis pardus*, L., Wirawila.

Cf. A. Railliet, Traité de zoologie médicale et agricole, Paris, 1895, pp. 402–405, fig. 265.

6.—*Ascaris vitulorum*, Goeze,

= *A. vituli*, Neumann.

Habitat : *Bos indicus*, L. ; passed by a young calf of four to six months, Colombo.

Cf. G. Neumann, Revue vétérinaire, Toulouse, 1883, pp. 1–20, pl. III.–IV.

[Collected and presented to the Colombo Museum by G. W. Sturgess, Esq., M.R.C.V.S.]

PHYSALOPTERA.

Two lateral lips at the head end, surrounded by a circular cuticular sheath ; the musculature is of the type of Schneider's Polymyaria ; the gênus belongs to the Secernentes ; at the caudal extremity of the male there is a lancet-shaped or bean-shaped bursa ; the two cirri of the male are unequal ; on each side of the cloacal aperture at the tail end, four stalked papillæ, median and unstalked papillæ in varying numbers.

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* *Cf.* v. Drasche, Verhandl. d. k. k. zool-bot. Gesellsch. Wien, XXXII., 1882, p. 120, tab. IX., fig. 9.

† Wedl, Sitzungsber. d. k. k. Akad. d. Wissensch. mathem. naturw. Classe. Wien, Bd. XLIV., 1861, p. 467, tab. I.–II., figs. 12–16.

‡ v. Drasche, *l.c.*, p. 133, tab. X., figs. 5–11.

7.—*Physaloptera varani*, Parona.

Habitat: stomach of *Varanus bengalensis* ("talagoya," Sinh.), Bolgoda. *Cf.* Parona, Elminti di Birmania, 1890, p. 776, tab. III., fig. 1.

8.—*Physaloptera*, spec.?

Habitat: intestine of *Calotes versicolor*, Colombo.

The collection contains only two specimens, which are not sufficiently well preserved to render a specific diagnosis possible.

Length 12·6 to 13·6 mm.; diameter 0·59 to 1·12 mm.; lips with three conical projections, of which the central is the highest and carries a tooth at its apex; the œsophagus is equal to $\frac{1}{5\cdot7}$ of the body length; the tail, rounded behind, $\frac{1}{1\cdot6}$th of the entire length.

Spiroptera.

Head sometimes with two lips, sometimes with four, and sometimes with none; the musculature corresponds with Schneider's Polymyaria—Secernentes; male with two unequal cirri; the caudal papillæ are arranged in two longitudinal rows, and on each side there are four præ-anal papillæ.

9.—*Spiroptera dentata*, n.sp.

Pl. I., figs. 5–7.

Habitat: stomach of wild boar, *Sus cristatus*, Chilaw.

Cuticula finely annulate. The mouth leads into a vestibulum, 0·11 m.m. in length; its entrance is armed with a dorsal and a ventral tooth; the mouth is a transverse slit, the border of which shows, both above and below, three notches with papillæ. The œsophagus measures $\frac{1}{8\cdot6}$ of the entire length, and presents a spiral musculature; in a young worm of 14·6 mm. the nerve ring surrounds the œsophagus 2·64 mm. from the head end, and at a point situated 0·31 mm. behind it the *porus excretorius* opens.

The male (25 mm. long by 0·79 mm. broad) has a closely involute tail, which resembles that of *Spiroptera strongylina*, Rud.; the cirri are respectively 0·35 and 0·92 mm. long, the shorter one bearing at its end a barb. Immediately in front of the cloaca, on each side, there are four closely packed præ-anal papillæ; behind it there is one papilla, and all have long stalks; the cloaca is surrounded by a broad ring, notched externally; the bursa shows longitudinal rows of oval scales.

The female grows to a length of 55 mm., with a width of 1·10 mm.; the short conical tail is curved over the back; the vulva is placed far behind the middle, and divides the body in the

proportion of 70 : 23; the eggs are small, thick-shelled, and cylindrical, measuring in length and breadth 0·039 and 0·017 mm. respectively.

10.—*Spiroptera triangulum*, n.sp.

Pl. I., fig. 8.

From body cavity of *Calotes ophiomachus* ("katussa," Sinh.), Colombo.

One male specimen, 4·1 mm. long, 0·51 mm. broad; cuticula annulate; at the junction of œsophagus and intestine there is a deep circular constriction of the body wall.

The head is rounded, and presents on each side a triangular mark with a small papilla at the apex; the mouth leads into a small vestibule; the spicula (cirri) are sub-equal and measure 0·41 mm.; they are attenuated and pointed at the end, and show externally a reticulate design; the œsophagus is equal to $\frac{1}{7\cdot7}$, the tail to $\frac{1}{153}$ of the entire length; the tail is flattened dorsally; on each side of it are four præ-anal and two post-anal papillæ; the former increase in size from before backwards, and the first post-anal papillæ are finger-shaped.

11.—*Spiroptera obtusa*, Rud.

From stomach of *Mus decumanus*, Pallas, Colombo.

See Von Linstow, Arch. f. microsc. Anat., Bd. 56; Bonn, 1900, pp. 363-366, tab. XV., figs. 3-4.

12.—*Spiroptera*, spec.?

From peritoneum of *Bufo melanostictus*, Schneider, Colombo.

A larva of 35 mm. by 1·18 mm.; head not distinct; reproductive organs not developed.

Stossich* describes under the name *Spiroptera bufonis* a larva from the peritoneum of the common toad (*Bufo vulgaris*), with a length of 44 mm. and breadth of 1 mm., which closely resembles the present example.

Heterakis.

Mouth generally surrounded by three lips; the musculature is of the type of Schneider's Polymyaria; the genus belongs to the Secernentes; caudal extremity of the male provided with a bursa, and in front of the cloacal aperture with a circular sucker, into which radial muscles are inserted; two unequal spicula.

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* Boll. soc. Adriat., vol. XX., Trieste, 1900, p. 5, tab. II., figs. 14-18.

13.—*Heterakis trilabium*, n.sp.

Pl. I., fig. 9.

From the intestine of the jungle crow (*Centropus sinensis*, Illig.), Horana.

Cuticle annulate; three semi-circular lips at the head end, of which the dorsal lip carries two papillæ, the two others one papilla each; the œsophagus occupies $\frac{1}{13}$ of the total length. The male attains a length of 26 mm. and a breadth of 0·69 mm.; the conical tail is $\frac{1}{19}$ of the body length and carries on each side four large præ-anal and six post-anal papillæ. One pair of the latter occupies a sub-median position close behind the cloaca. In front of the latter there is a circular sucker. The cloacal aperture is triangular; the long sub-equal spicula measure respectively 1·95 and 1·97 mm.; their hinder end is rounded.

The female (39 mm. by 1·11 mm.) has a conical attenuated tail $\frac{1}{38}$ of total length, with small digitate prolongation; the vulva lies behind the mid-body, dividing the body in the proportion of 8 : 5; the thick-shelled smooth eggs are 0·081 mm. by 0·047 mm. broad.

14.—*Heterakis anomala*, n.sp.

Pl. I., figs. 10, 11.

From the stomach of *Tropidonotus piscator*, Schneider ("dia polonga," Sinh.), Colombo.

Cuticle annulate; head with three elongate, sinuate lips; at their base the cuticle is swollen, and presents transverse rings with distinct posterior margins; the œsophagus equals $\frac{1}{8}$ to $\frac{1}{9}$ the total length.

The male measures 34 mm. by 1·14 mm.; the caudal end is pointed and occupies $\frac{1}{43}$ of the body length; on each side there are three præ-anal and four post-anal papillæ; of the latter one pair lies close behind the cloacal orifice, and the next two pairs of lateral papillæ are remarkably large and touch one another; the sub-equal spicula are granulated and measure 1·70 and 1·75 mm; the sucker-like organ is beset with eight roundish projections, of which the cuticle shows pore canals.

The female is 33 mm. long by 1·14 mm. broad; the finely pointed tail is $\frac{1}{66}$ of the body length; the vulva opens at two-thirds of the length from the head end; the thin-shelled eggs measure 0·055 mm. by 0·036 mm.

STRONGYLUS.

Body slender; the musculature is of the type of Schneider's Meromyaria, consisting of long rhombs generally arranged in six longitudinal rows; the genus belongs to the Secernentes; male

with two equal spicula ; a wide generally trilobed bursa at the tail end, supported by ribs ; the ribs of the bursa are muscular and terminate with a papilla ; head without buccal capsule, plainly rounded or with simple lips, frequently with six papillæ ; in the female the vulva lies behind the middle of the body.

15.—*Strongylus pigmentatus*, n.sp.

Pl. I., figs. 12, 13.

From stomach of hare, *Lepus nigricollis*, Cuv., Ranna, Southern Province.

This species is allied to *Strongylus retortæformis*, Zed.

The cuticle is annulate ; the head trilabiate, each lip carrying on its summit a small papilla ; the œsophagus occupies in the male $\frac{1}{14}$, in the female $\frac{1}{18}$ of the total length ; the tail is acuminate ; œsophagus, testes, uterus, eggs, and especially the ovaries are coloured black.

Size of the male 7·7 mm. by 0·12 mm. ; the spicula are short, 0·68 mm. ; they are pale brown, and have at the root a scutiform appendix ; they terminate behind in three branches, of which the largest is rounded, the others pointed ; the bursa has two strong lateral lobes and a very narrow median lobe ; the latter is supported by a rib which bifurcates, and each branch again divides into two branchlets which lie close beside one another ; the outer branches are the shorter ; the lateral lobes of the bursa are each supported by six slender ribs.

The female is 10·5 mm. long by 0·14 mm. broad ; the tail is $\frac{1}{66}$ of the total length ; the vulva is situated posteriorly, dividing the body in the proportion of 37 : 11 ; the eggs are 0·062 mm. long and 0·036 mm. broad.

The species differs from *Strongylus retortæformis*, Zed.,* in the formation of the head, the pigment, the cirri or spicula, and the position of the vulva. The spicula of *S. retortæformis* end in a point and are undivided and twisted ; the vulva of this species is only 0·75 mm. distant from the end of the tail, in contrast with *S. pigmentata*, where it lies 2·46 mm. from the caudal extremity, the two species being approximately equal in size.

Cylichnostomum.

Belongs to the Strongylidæ, Schneider's Meromyaria, and the Secernentes ; at the head there is a buccal capsule surrounded by two lateral and four sub-median papillæ, the lateral projecting freely above the cuticle ; the lumen of the capsule is lined by a

* See W. Stödter. Die Strongyliden in dem Labmagen der gezähmten Wiederkäuer. Hamburg, 1901, pp. 76–86, 92 ; tab. XI., figs. 6–8, tab. XII.

bacillary layer; the two halves of the male bursa are each supported by ten ribs, of which the second and third lie close together; the 8th, 9th, and 10th are ramifications of one rib.

16.—*Cylichnostomum tetracanthum*, Mehlis.

Passed by ponies on Iranativu; the animals succumbed to enteritis, anæmia, and exhaustion. Presented by G. W. Sturgess, Esq., M.R.C.V.S.

Syn. *Strongylus tetracanthus*, Mehlis; *Sclerostomum tetracanthum*, Wedl.; *Cyathostomum tetracanthum*, Molin.

See A. Looss. The Sclerostomidæ of horses and donkeys in Egypt, Cairo, 1901, p. 124, tab. IV., VI.–XI., XIII.

TRIODONTOPHORUS.

Strongylidæ, Meromyaria, Secernentes; large buccal capsule with six papillæ, two lateral and four sub-median; mouth surrounded by bristles; at the bottom of the capsule are three teeth; male bursa as in the preceding genus.

17.—*Triodontophorus serratus*, Looss.

From *Equus caballus*, L.; passed by ponies on Iranativu. Presented by G. W. Sturgess, Esq.

Cf. A. Looss, *op. cit.*, pp. 83–86, tab. III., figs. 31–38.

KALICEPHALUS.

Head with thick-walled chitinous mouth, laterally compressed, the wall traversed laterally by longitudinal tracts of parenchyma with a dorsal and ventral impression; œsophagus remarkably short and broad, the posterior half thickened to form a bulbus containing valves; the male bursa is broad and trilobed, the cirri are equal; lateral lines narrow and raised, with a vessel; vulva behind the mid-body; the genus belongs to the Strongylidæ, more particularly to the *Sclerostomina*, to the Meromyaria, and Secernentes. The species live in the stomach and intestine of snakes in South America and the East Indies.

18.—*Kalicephalus willeyi*, n.sp.

Pl. I., figs. 14–18.

From the stomach and œsophagus of *Vipera russelli*, Gray ("tic-polonga," Sinh.), Colombo and Weligatta; and from the intestine of *Coluber helena*, Daud., Horana.

The mouth cavity is large, compressed, and traversed by three paired parenchymatous bands ending in front in papillæ; there is a dorsal and ventral notch, rounded in front, acute behind;

the cuticle is smooth; the short œsophagus occupies in the male $\frac{1}{15}$, in the female $\frac{1}{22}$ of the body length; the posterior half expands to form a bulbus with valves; the nerve collar surrounds the œsophagus approximately in the middle at its thinnest portion; the *porus excretorius* discharges below the middle of the œsophageal bulbus in the female 0·39 mm. from the head end. Along the dorsal surface of the œsophagus occurs a gland, the duct of which lies at the dorsal side of the mouth opening; shortly before the orifice is reached the duct expands into a vesicle. The intestine has a thick lining membrane which is united with the outer or basement membrane on each side. The lateral ridges occupy the 10th part of the periphery of the body wall and project inwards far beyond the musculature; they are divided by a septum into a dorsal and a ventral half, and at the inner edge of the septum there is a canal with triangular lumen.

The material consisted of a very large number of females with only one male, which was 5·9 mm. in length and 0·33 mm. in diameter; the bursa is trilobed, the unpaired median dorsal lobe is supported by a forked rib, the inner fork again divides at the end; the lateral lobes have four ribs each, of which the anterior is double, while the others arise from a common root; the thin cirri measure 0·37 mm.

The female attains a length of 19 mm. with a breadth of 0·51 mm.; the vulva is circular and rather prominent, lying behind the middle, and dividing the body in the proportion of 18 : 5; the eggs measure 0·057 mm. by 0·036 mm.

The genus *Kalicephalus* was established by Molin,* who described seven species from Brazil, of which one was figured, viz., *K. inermis*. One of Molin's seven species, *K. appendiculatus*, was subsequently re-discovered by Stossich,† who also described an eighth species under the name *Strongylus ersiliæ*,‡ from the Indian *Python molurus*. The species here described is therefore the ninth of the genus.

Oxyuris.

Belongs to the Meromyaria and the Secernentes. The œsophagus is long, terminating in a bulbus containing valves; male with one cirrus; frequently three papillæ on each side of the tail; female with long acuminate tail; eggs generally asymmetrical; the species live in mammals, amphibia, reptiles, insects, and myriopods.

* Il sottordine degli Acrofalli. Mem. Ist. Venet., vol. IX., Venice, 1861, pp. 114–125, tab. VII., figs. 1–3.

† Boll. Soc. Adriat., vol. XX., Trieste, 1900, pp. 2, 3, tab. I., figs. 7, 8, tab. II., fig. 9.

‡ *Ibid.*, vol. XVII., 1896, p. 124, tab. IV., figs. 11–13.

19.—*Oxyuris poculum*, n.sp.

Pl. II., figs. 19-21.

Passed by ponies on Iranativu. Presented by G. W. Sturgess, Esq., M.R.C.V.S.

This species is nearly related to *Oxyuris curvula*, Rud., having the same form as the latter; the mouth is hexagonal with two large lateral papillæ in contradistinction to the six papillæ of *O. curvula*; the œsophagus in the male occupies $\frac{1}{7 \cdot 7}$ of the total length, terminating in a bulbus; the ducts of the three œsophageal glands lie quite anteriorly in the lumen of the œsophagus, and are cup-shaped with denticulate margin, whereas in *O. curvula* they are tubular.

The male is 14·2 mm. long by 0·99 mm. in diameter; the cirrus is 0·44 mm. long, finely acuminate; the tail carries four papillæ, of which two lie at the posterior angles of the quadrangular portion of the body and two are placed ventrally. The six median papillæ of *O. curvula* are absent in the present species.

The female has a long filamentous hind body, and attains a length of 65 mm. and breadth of 2·57 mm.; the eggs have a double shell; the outer shell is perforated at one pole, the orifice being closed by a plug; the eggs measure 0·081 mm. by 0·047 mm., those of *O. curvula* being 0·099 mm. by 0·042 mm.

20.—*Oxyuris acanthura*, n.sp.

Pl. II., fig. 22.

From rectum of *Calotes versicolor*, Dum et Bibr., Colombo.

Head rounded, without lips and papillæ; the œsophagus is long and narrow, ending behind in a strong bulbus; in the male it is $\frac{1}{4 \cdot 5}$ of the total length, in the female $\frac{1}{4}$; the intestine is wider than the œsophageal bulb; the cuticle is deeply ringed.

The male (2·29 mm. by 0·37 mm.) has a rounded tail end with a curved process bearing on each side one papilla, while the body has two papillæ on each side; the cirrus measures 0·065 mm.

The female is 5·84 mm. long and 0·55 mm. broad; the rounded tail, $\frac{1}{15}$ of the body length, ends with a style-shaped process; the vulva lies behind the mid-body, dividing the body in the proportion of 7 : 5. Eggs were not mature.

The species has affinity with *Oxyuris brevicaudata*, Duj., from *Ascalobotes fascicularis*. Parona* refers to an unnamed *Oxyuris* from *Calotes*, spec., with a length of 20 mm., the vulva opening in the anterior third of the body.

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* Elminti di Birmania. Ann. Mus., Genova, ser. ii., vol. VII., 1890, p. 771.

CTENOCEPHALUS, n.g.

At the head end a dorsal and a ventral erectile lip, whose end lobes interdigitate: four cervical glands with two orifices in the dorsal lip; cephalic cuticle thickened like a turban with transverse grooves; low and narrow lateral lines without vessel; excretory pore absent; two equal cirri; belongs to the Polymyaria and Resorbentes.

21.—*Ctenocephalus tiara*, Von Linstow.

Pl. II., figs. 23–27.

From stomach of *Varanus bengalensis*, Daud. ("talagoya," Sinh.), Bolgoda, and from stomach of *Varanus salvator*, Gray ("kabaraguwa," Sinh.), Horana.

I described this species in the year 1879 under the name *Ascaris tiara*.† I now perceive that it must form the type of a distinct genus. The original specimens were taken from the Natal monitor, *Varanus ornatus*, Daud.

The formation of the head is very remarkable, comprising a dorsal lip with three rounded projections and a ventral lip with four similar processes, interdigitating; the lips can also separate from one another and be erected; in their hinder portion there are four club-shaped glands with round lumen, reaching backwards 0·2 mm.; outwardly the glands are furnished with spiral muscles; the two glands on the right and left side, respectively, unite into a common duct, and both ducts (right and left) open to the exterior on the dorsal lip; the cuticle is deeply grooved at intervals of 0·088 mm.; the œsophagus measures $\frac{1}{3}$–$\frac{1}{4}$ of the total length; the tail is conical; dorsal and ventral tracts narrow; the lateral tracts ("Seitenfelder") are broad and low, and do not project inwards beyond the musculature; they occupy, on each side, $\frac{1}{8 \cdot 7}$ of the periphery of the body; a septum divides them into dorsal and ventral halves, but there is no vessel and consequently no *porus excretorius*.

The worms had bored with their heads deep into the wall of the stomach, which had grown firmly round them; the nutrition, therefore, cannot take place through the mouth, but evidently, as with Filaria and all other Resorbentes, through the cuticle; the lateral fields appear to play the part of absorbing organs.

The male is 18–20 mm. long and 0·63–1 mm. in diameter; the tail measures $\frac{1}{3 \cdot 5}$ of the total length; the two falciform cirri have pointed ends and a length of 1·6 mm.; there are on each side of

† Württemb. naturw. Jahresh. Jahrg., XXXV., Stuttgart, 1879, p. 320, tab. V., fig. 1.

the tail two præ-anal, one large par-anal, and three post-anal papillæ.

The length of the female amounts to 25–28 mm., with breadth of 1·2–1·3 mm.: the tail measures $\frac{1}{46}$ of the length of the body; the vagina opens behind, dividing the body in the proportion of 50 : 11; the eggs are 0·065 mm. by 0·042 mm. in size; they have thin shells, and their surface is beset with fine granulations.

Filaria.

Belongs to the Polymyaria and the Resorbentes; elongated Nematoda; low and broad lateral fields, which generally occupy $\frac{1}{6}$ of the circumference of the body; excretory pore absent; caudal end of the male generally spiral; two unequal cirri; at the tail end two rows of papillæ, on each side four præ-anal; in the female the vulva lies quite in front.

The species occur in Vertebrata, especially mammals and birds, in all organs except in the digestive tract.

22.—*Filaria vivipara*, n.sp.

From the peritoneum of *Corvus splendens*, Vieillot, Colombo.

The material only contained females, 16–21 mm. long and 0·32 mm. broad; the œsophagus measures $\frac{1}{28}$, the tail $\frac{1}{85}$ of the total length; the generative orifice lies in front 1·5–1·8 mm. from the cephalic extremity; the eggs with membranous chorion measure 0·039 mm. by 0·031 mm.; the species is viviparous,* and the uterus and vagina were filled with immense numbers of embryos. Both ends of the body are rounded; on each side of the head a small papilla; lateral fields $\frac{1}{6}$ of the periphery. The embryos are 0·043–0·364 mm. long and 0·0052 mm. broad, relatively very long and slender; the head of the embryo is rounded, the tail pointed, and no internal organs can be distinguished.

Presumably the embryos penetrate into the vascular system of the bird, where they live as blood-filariæ.

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* See "Spolia Zeylanica," part II., p. 28.

EXPLANATION OF PLATES

Illustrating Dr. von Linstow's Paper on Nematoda in the Colombo Museum.

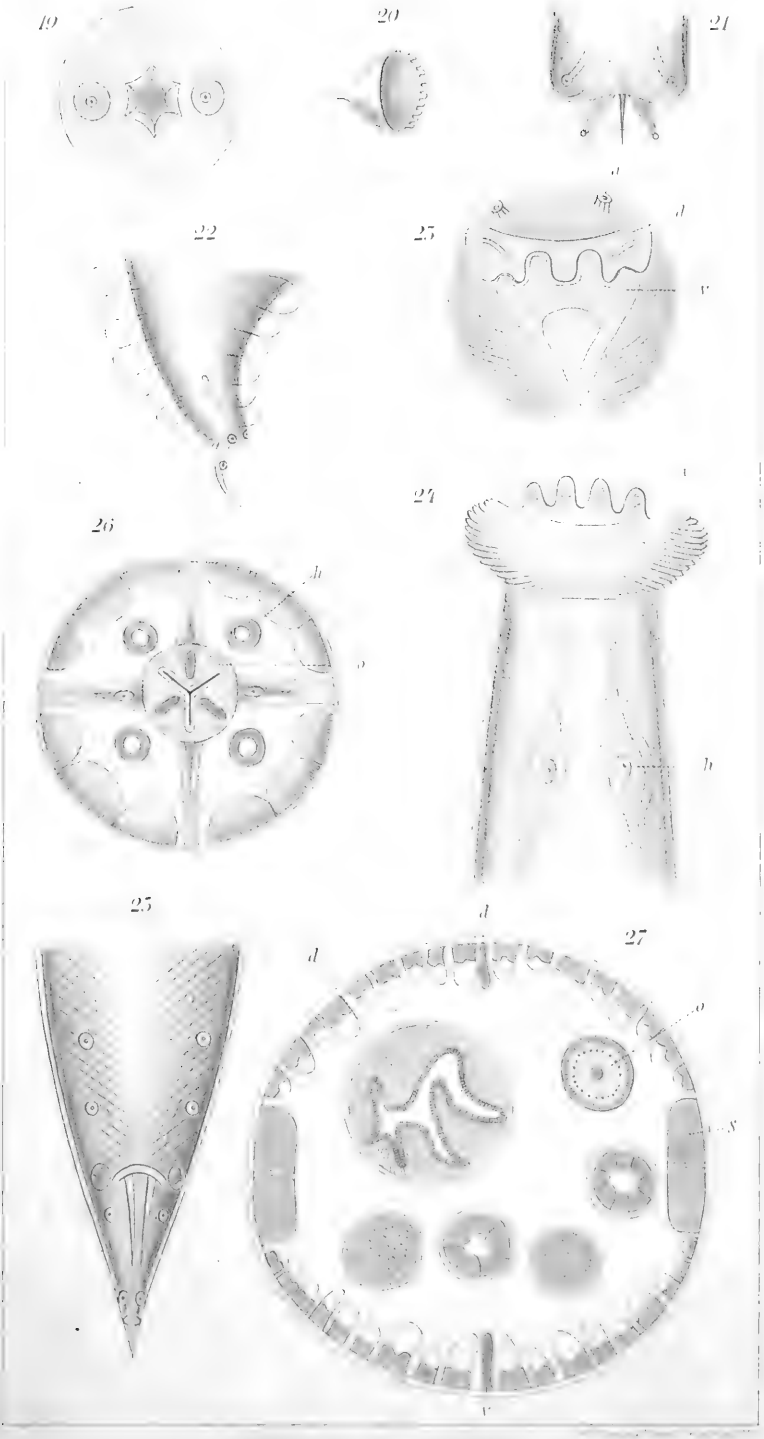
PLATE I.

Fig. 1.—*Ascaris rotundicaudata.* Dorsal lip.
Fig. 2.—*A. ceylanica.* Dorsal lip.
Fig. 3.—*A. brachyura.* Dorsal lip.
Fig. 4.—*A. quadrata.* Dorsal lip.
Fig. 5.—*Spiroptera dentata.* Head end from the side.
Fig. 6.—Same. Frontal view of head.
Fig. 7.—Same. Tail end of the male.
Fig. 8.—*Spiroptera triangulum.* Tail end of male.
Fig. 9.—*Heterakis trilabium.* Tail end of male; cirri omitted.
Fig. 10.—*H. anomala.* Head.
Fig. 11.—Same. Tail end of male.
Fig. 12.—*Strongylus pigmentatus.* Bursa of male.
Fig. 13.—Same. Cirrus of male.
Fig. 14.—*Kalicephalus willeyi.* Frontal view of head.
Fig. 15.—Same. Side view of head.
Fig. 16.—Same. Dorsal view of head.
Fig. 17.—Same. Bursa of male.
Fig. 18.—Same. Transverse section of body; *d.* intestine; *s.* lateral field; *g.* lateral vessel or canal.

PLATE II.

Fig. 19.—*Oxyuris poculum.* Frontal view of head.
Fig. 20.—Same. A cup-shaped expansion of the duct of the œsophageal glands.
Fig. 21.—Same. Tail end of male.
Fig. 22.—*Oxyuris acanthura.* Tail end of male.
Fig. 23.—*Ctenocephalus tiara.* Frontal view of head; *d.* dorsal lip; *v.* ventral lip; *a.* external orifice of the cervical glands.
Fig. 24.—Same. Ventral view of head; *v.* erected ventral lip; *h.* cervical gland.
Fig. 25.—Same. Tail end of male.
Fig. 26.—Same. Transverse section through the neck region; *o.* œsophagus; *h.* cervical gland.
Fig. 27.—Same. Transverse section through a female; *d.* dorsal tract; *v.* ventral tract; *s.* lateral field; *d.* intestine; *o.* ovary.

NEMATODA (ex LINSTOW)



NEMATODA - von LINSTOW.

THE CRYSTALLINE ROCKS OF CEYLON.

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THE following Paper is intended to give a brief account of the crystalline rocks of Ceylon, so far as at present known and studied.

The first question which arises is one of nomenclature. For a long time the rocks of Ceylon were somewhat summarily classified as *gneisses*, or as belonging to a "*metamorphic series*." It must here be pointed out that on the Continent the term "*gneiss*" is often used in its strict original sense and applied only to foliated crystalline rocks having the mineral composition of granites, and thus consisting essentially of orthoclase-felspar and quartz, with one or more of the minerals mica, hornblende, or augite. In this strict sense the term "gneiss" is only applicable to certain of the rocks of Ceylon. It has, however, been widely used in England and even abroad to designate rocks characterized rather by the possession of a "gneissose" structure than by any particular mineral composition. In this extended sense the term is applicable to many or most of the rocks of Ceylon.

The name "*granulite*" has been extensively employed to designate foliated crystalline rocks of fine grain in which orthoclase, quartz, garnet, and more or less biotite, hornblende, or augite occur, but which are especially characterized by the presence of garnet.

This term is thus particularly applicable to the majority of Ceylonese rocks, and its use is perhaps to be preferred to that of the term "gneiss."

Mr. Holland has recently named the rock series of Southern India (which closely resembles that of Ceylon) the *Charnockite Series*. Ceylon and Southern India form together a well-marked petrographical province, and there is no doubt that the rocks of Ceylon must be considered as forming part of the charnockite series. It should be noted that the term "charnockite" is used to designate both a whole group of rocks and also one of the types of rock (having particular and definite characters) characteristic of the group. It is thus safest as a general rule to speak of

the foliated crystalline rocks of Ceylon as granulites, and as belonging to the charnockite series of Ceylon and Southern India.

With regard to the use of the term "metamorphic series," it should be recognized that the evidence tends to show that the mass of Ceylon rocks is rather conspicuous for the small evidences of metamorphism subsequent to formation which it affords. The term "metamorphic," embodying as it does a very definite and, generally speaking, erroneous view, is thus to be avoided.

If we come to inquire as to the real nature of the rocks composing the granulite or charnockite series, we are at first struck by the appearances in the field suggestive of a sedimentary origin (figs. 1 and 2). It is not surprising that the conspicuous bedded character, varied mineral composition, and local abundance of alternating beds of limestone should have led to the supposition that such a gneissose series as we have here to deal with really represents the highly metamorphosed remains of some ancient sedimentary series. Closer examination of the rocks, however, reveals but little in support of such a view. Their mineral composition is found to indicate a chemical constitution differing in important respects from that of the great majority of sedimentary rocks, but similar to that of many well-known types of deep-seated igneous rock. Moreover, when we come to examine the minuter characters of the foliation or mineral banding so characteristic of the Ceylon rocks, we see that there is rather a lenticular than a definitely parallel structure (fig. 2), and also that some definite relation is evident between the lighter-coloured (more acid) rock types and those of a darker colour—the more basic.

This definite relationship may show us ovoid lenticular masses of heavy dark rock included in a much lighter-coloured, more acid rock that seems to have flowed around them. In other cases the more acid types give other evidence of their intrusive relation to the more basic bands and lenticles. When the rock examined possesses a general dark colour and basic character we often find the more acid portions existing as irregular patches a few inches or feet in diameter, which send long tongues of acid material in parallel bands along the foliation planes, giving a banded character to a rock which would otherwise present a more uniform appearance. Such phenomena, together with others which a microscopic examination of the rocks reveals, are known to be characteristic of many rocks whose igneous origin is undoubted. It may then be assumed with safety that at least the greater part of Ceylon rocks, so far as at present known, are of igneous origin and that their well-banded appearance (fig. 2) results

FIG. 1.—FOLIATION PLANES IN GRANULITES.

(*Charnockite series.*) *Near Teldeniya, Central Province.*

FIG. 2.—FOLIATION IN ROCKS OF THE GALLE GROUP.

(*Charnockite series.*) *Galle Fort. About 7 feet thickness shown.*

[*To face p. 106*

from the drawing out by flowing movement of the various parts of a heterogeneous magma, probably during its gradual consolidation under conditions of great pressure.

The observed relations of the acid and basic varieties show that the latter types were amongst the earlier products of the magma, the more acid types as usual crystallizing later and having a more or less intrusive relation towards the more basic. The continuous flowing movement accompanying intrusion and consolidation has had the effect of drawing out together in bands the acid and basic types and preventing the former from transgressing the latter in the form of dykes.

No very definite nomenclature can be applied to the different varieties of granulite, which shade insensibly into one another, and are sometimes so intimately interbanded as to make it difficult to collect even a hand specimen of uniform composition. The following general types, however, include the more conspicuous varieties, beginning with the most acid :—

Amongst the rocks of the charnockite series are abundant beds of *granular quartz rock* of very various thickness possessing a mineral composition which varies in different cases from nearly pure quartz, through types containing small quantities of felspar and garnet and sometimes mica, to others which are at once recognizable as the more acid types of granulite. We are thus led to regard the quartz bands as genetically connected with the other members of the charnockite series, and in fact, as the last and most acid products of the magma.

A less acid group is that of the *leptynites*, rocks composed essentially of quartz and felspar (orthoclase microperthite predominating), with or without more or less garnet and biotite and accessory minerals such as graphite, zircon, and apatite. These light-coloured rocks bulk largely amongst the granulites. The *garnetiferous leptynites* are especially conspicuous, the bright red garnets in a nearly white rock giving a very handsome appearance. An especially characteristic feature of some leptynites is the great elongation of the quartz grains.

Many conspicuous hills (*e.g.*, Bambaragala near Teldeniya, Central Province), with rocky summits weathered into "tors," consist almost entirely of a granular granite-like leptynite composed essentially of quartz and orthoclase microperthite, but often with a small amount of biotite as well. In such cases the rock seems to form a large ovoid mass amongst more basic types.

Typical charnockite consisting of quartz, felspars, and hypersthene has a very different aspect, being of a greenish colour and usually coarser grain, and having a greasy lustre. A considerable

range of types varying much in relative acidity have nevertheless a very similar appearance in the field, and we pass by gradual transitions to rocks having the composition of *norites* (labradorite-hypersthene rock) and *diorites* (hornblende-labradorite rock), &c. Most of these less acid types might also be called *pyroxene granulites*. The most basic types occur chiefly as lenticles and "pinched" bands amongst medium and acid types; they include rocks of which the principal constituents are hypersthene, augite, garnet, basic plagioclase, &c. It is generally more or less evident that these most basic types are to be regarded as amongst the earliest products of the granulite magma.

Rocks of anomalous or unusual composition are sometimes met with, *e.g.*, a felspar corundum rock from near Kandy, and a garnetiferous leptynite in which spinel is very abundant; attention may also be called to the remarkable rocks containing corundum, sillimanite, &c., described by Professor Lacroix. There occur also in the Balangoda district certain zircon granites containing a large quantity of well-crystallized zircon; little is known as to the relations of these rocks; it is not unlikely that they may have some connection with the occurrence of a group of rare minerals (including uraninite, &c.) found in the Balangoda district; they are probably intrusive in the charnockite series.

Pegmatite Dykes, consisting essentially of orthoclase and quartz with mica or hornblende or both, are found occurring as dykes crossing the granulite foliation planes and as sills running along these planes. The pegmatites must be in many cases regarded as segregation veins; they appear to have crystallized before the cooling of the matrix, as the minerals are interlocked at the junction, which is rather a transition than an abrupt junction.

An important series of rocks not yet referred to is that of the *crystalline limestones*. These rocks are found intimately interbanded with the ordinary granulites, the beds of limestone varying in thickness from hundreds of yards down to a few inches. Many varieties are dolomitic, but there is great variation in this respect. Many interesting accessory minerals occur, such as phlogopite, forsterite, graphite, spinel, apatite, amphibole, clinohumite, &c. The nature and origin of these rocks is exceedingly obscure. Many would perhaps regard them as the highly metamorphosed remains of some ancient calcareous sedimentary series included in the vast mass of granulites, and owing their characters to the effects of contact metamorphism. There are, however, great difficulties in the acceptance of such a view. Amongst these may be mentioned the, on the whole, small quantity of the limestone compared with the vast bulk of the

granulites, and the still smaller quantity of other rocks possibly of a metamorphosed sedimentary character, the frequent occurrence in the limestones of fragments of peripherally modified granulite, and the strong general similarity between the characters of the crystallized limestones and those of igneous foliated crystalline rocks.

Putting aside, however, the doubtful question of origin, it is clear that as far as their present characters are concerned the crystalline limestones are contemporaneous with the granulites; and there can be little doubt that they existed in a state akin to fusion at the time of the consolidation of the latter, and that their accessory minerals crystallized under conditions resembling those accompanying the cooling of such plutonic magmas as have for example given rise to the granulites themselves. The foliation of the limestones must have been acquired at the same time and in the same way as that of the granulites.

A group in some respects intermediate between the limestones and granulites includes rocks composed essentially of one or more of the minerals diopside, mica (phlogopite, &c.), amphibole, scapolite, spinel, sphene, and calcite, with more rarely felspars, marcasite, serendibite, &c. In these rocks the silicates are usually idiomorphic when moulded by carbonates. Of the minerals mentioned diopside and mica are predominant. The rocks occur (*a*) as junction rocks between limestone and granulite, (*b*) as inclusions in the limestones, (*c*) as dykes in the granulites, these dykes being usually narrow and having a zoned structure, and (*d*) as bands of rock interbedded with the granulites. Mica of commercial value may occur in rocks of this type. The bands rarely exceed 6 ft. in thickness and are often narrow. Continuity between the types (*c*) and (*d*) can sometimes be observed. Some of the types of rock included here are very handsome, especially the coarse varieties in which scapolite is conspicuous.

Rocks of the *Galle group* are also in some respects intermediate between the limestones and granulites, inasmuch as they contain numerous lime silicate minerals and differ in other respects from the typical granulites, although in many ways resembling them; the presence of wollastonite (not yet found elsewhere in Ceylon) and of scapolite and sphene (in addition to a green pyroxene and the quartz and felspars characteristic of the granulites) and absence of garnet, amphibole, and mica are distinguishing characters of the Galle rocks. As in the granulites, there is a wide range of types, from basic to acid, and mineral banding is very conspicuous (fig. 2).

A brief description of the crystalline rocks is now concluded, but a few other points remain to be considered.

Not a great deal can be said as to the conditions under which the rocks were formed: they must have crystallized under great pressure, and of course the temperature must have been high; during crystallization the magma was probably rather viscous than fluid. There was evidently much flowing movement. The magma was probably far from homogeneous to begin with, and in addition to this the basic minerals crystallized in general before the acid; this heterogeneity combined with movement produced the conspicuous mineral banding. Probably the rocks crystallized at a great depth, the absence of even ancient sedimentary rocks overlying the granulites showing that denudation has long been at work in Ceylon. In India as we proceed southwards the palæozoic rocks die out, and it is probable that the charnockite series is of prepalæozoic or archean age.

Since their formation the rocks have suffered from earth movements, but seemingly not of a violent character, inasmuch as there is little evidence of deformation, nor has evidence of the existence of thrust planes or similar phenomena been noted.

An important series of pressures has thrown the granulites into a main series of anticlinal and synclinal folds, and to this system of folds we may give the name of *Taprobanian;* the axes of the synclines and anticlines, some of which are of great size while others are quite small, have a more or less constant trend about 30° W. of N. in the Kandyan districts, and perhaps more nearly north and south in the Badulla and some other districts; no evidence to date the movements is available.

This structural feature of the mountains of Ceylon is rendered conspicuous by its effect on the directions of river systems and even of roads and railways; every one interested in Ceylonese topography must be acquainted with the north-west and south-east valleys which are so conspicuous and which are due to the rivers cutting their way along the foliation planes of the granulites, forming *strike* valleys*, with corresponding strike ridges separating them. Valleys, usually of less importance, have also been made by streams that have cut their way along the joint planes and thus occupy *joint valleys* oriented approximately at

* The inclination of a rock to the horizontal is termed its *dip*; a line drawn at right angles to the dip on the foliation plane is called the *strike* of the rock; or the strike might be definited as identical with the outcrop on a horizontal surface. In fig. 1 the rocks are dipping from left to right; the water line on the foliation planes serves to indicate the strike. Joints are divisional planes (other than foliation or bedding planes) occurring in a rock, and are usually approximately at right angles to the foliation planes.

right angles to the strike valleys. Sometimes a stream occupies a strike valley for part of its course and a joint valley elsewhere, the change being indicated by a sharp turn. Perhaps the best illustration of the occurrence of parallel strike valleys is found in the Hatton district; in a map of this district the parallel valleys, along which run road and rail as well as stream, are most noticeable (fig. 3).

There are no data available to estimate the actual thickness of the charnockite series in Ceylon (measured in a direction at right angles to the foliation planes), but it is clearly not unlimited, corresponding portions of the series being repeated by the foldings.

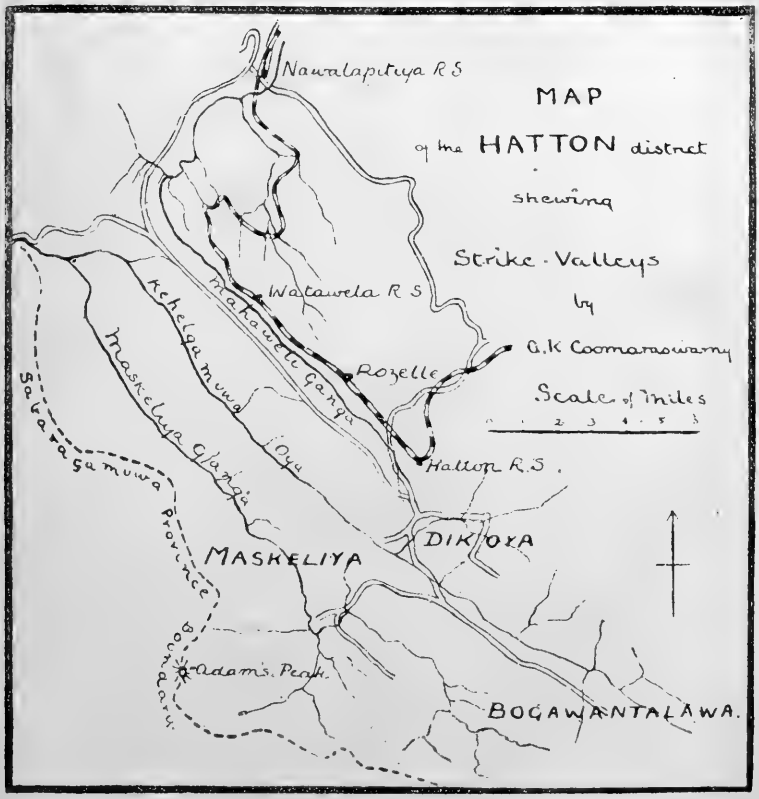

FIG. 3.—STRIKE VALLEYS NEAR HATTON.

NOTES.

1. *Uraninite.*—This mineral (otherwise known as pitchblende) is of considerable interest as being the chief source of radium at the present time, associated with other rare elements. The composition is somewhat variable, but the mineral is usually described as a uranate of uranyl, lead, usually thorium (or zirconium), often the metals of the lanthanum and yttrium groups, with the gases nitrogen, helium, and argon in varying amounts; radium is present in very small quantities.

A considerable quantity of uraninite in small cubic crystals has been obtained by Mr. R. D. Holland in the Balangoda district, but it is not yet known *in situ* in this area.

X2

Crystal of Uraninite from Ambalawa, Gampola.

It occurs also at Gampola, where it was found on Ambalawa estate by Mr. G. P. Gaddum. It is here found very sparingly, in lustrous sharp-angled cubic crystals in a pegmatite vein traversing granulite. The pegmatite is seen in several boulders on the upper slopes of the Ambalawa estate; the boulders are evidently derived from the hill above. The pegmatite vein consists of quartz, flesh-coloured orthoclase, and biotite (in six-sided crystals), with accessory greenish apatite, black tourmaline, and also uraninite. The uraninite is rather easily recognized by its high specific gravity (exceeding 9·0), black colour, and cubic form. The pegmatite vein does not exceed 14 inches in width, and runs mainly parallel to the foliation planes of the granulites, but sends off branches and tongues which cross the foliation and again run along the foliation planes. The minerals are interlocked at the junction, and there is rather a transition from pegmatite to granulite than a sharp junction. In other words the pegmatite, as is often the case in Ceylon, has rather the aspect of a segregation vein. This occurrence is of considerable interest, as the mineral

has not been previously recorded in Ceylon (there existed a massive fragment in the original Museum collection), and it is to be hoped that the examination of this locality will lead to its discovery in other districts.

A. K. COOMARASWAMY.

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2. *Peregrine Earthworms at Peradeniya.*—A collection of earthworms made by Dr. H. Uzel at Peradeniya in July, 1901, is the subject of a report by Dr. W. Michaelsen* of Hamburg, a copy of which has been courteously forwarded here from the Naturhistorisches Museum at Hamburg. The material consisted of earthworms belonging to twelve species, two of them being described as new. The remarkable feature of this collection is that it is hardly at all representative of the terricoline fauna of Ceylon (which is uncommonly rich), at least nine and perhaps ten of the species being foreign to Ceylon, having been introduced here from various parts of the world, presumably through the mediation of the Botanic Gardens.

Thus about 80 per cent. of Dr. Uzel's collection of earthworms belonged to the fugitive or peregrine element in the Ceylon fauna, and this fact is recorded by Dr. Michaelsen as affording the first numerical basis for estimating the influence of Botanic Gardens in modifying the fauna of a country in certain directions.

A former collection of Ceylon earthworms accumulated by Drs. Fritz and Paul Sarasin was submitted to Dr. Michaelsen† in the year 1887 and was found to comprise twenty-seven species, of which twenty-two were certainly indigenous to Ceylon, only about 15 per cent. being peregrine or introduced. The cause of this difference between the Sarasin and the Uzel collections is attributed by Dr. Michaelsen to the character of the localities, the former having been procured from different parts of the Island, often from districts remote from horticultural intercourse. The acclimatization of useful exotic plants in Ceylon has resulted in the less desirable acclimatization of exotic species of earthworms.‡

The Paper contains a table showing the further distribution of the so-called peregrine species which have been carried to and from such distant provinces as Madagascar, the Philippines, New Zealand, and Central America.

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* Michaelsen, W., Oligochaeten von Peradeniya auf Ceylon, ein Beitrag zur Kenntnis des Einflusses botanischer Gärten auf die Einschleppung peregriner Thiere. S. B. Böhmisch. Ges. Prag, No. XL., 1903, pp. 1–16.

† Michaelsen, W., Die Terricolenfauna Ceylons. Mt. Mus. Hamburg, Bd. XIV., 1887.

‡ *Cf.* Michaelsen, W., Die geographische Verbreitung der Oligochaeten, Berlin, 1903.

The indigenous species obtained by Dr. Uzel are *Plutellus uzeli*, n.sp., and *Pheretima taprobanæ* (Beddard), while *Perionyx ceylanensis*, n.sp., is called doubtfully endemic, being closely allied to a species, *P. sansibaricus*, from Zanzibar.

3. *Rhynchota of Ceylon.*—The order of insects which contains the bugs is called Rhynchota on account of the structure of the mouth-parts, which have the form of a jointed suctorial rostrum formed by the labium, the mandibles, and the maxillæ, modified to form a stylet or piercing organ which is carried bent back under the body when not in use. By means of their stylet these insects are enabled to perforate the epidermis and suck the juices from berries and young shoots. Some are carnivorous, preying upon other insects, and some are ectoparasitic. In mode of life most are terrestrial; a few families are aquatic, and there is a group of pelagic Rhynchota which skim over the surface of the high seas.

The term Hemiptera, referring to the half-coriaceous, half-membranous texture of the wings in many of the families, was formerly applied to the order of bugs, but the name is now superseded by the more comprehensive one Rhynchota, the character of the mouth-parts being of fundamental importance in classification throughout the animal kingdom.

The Rhynchota are divided into two principal sub-orders: the Heteroptera, in which the anterior wings are folded flat upon the back and present a different texture in the basal and apical areas; secondly, the Homoptera, where the wings meet along their inner edges, covering the body like a roof, their texture being commonly homogeneous.

There are some twenty-five families of Heteroptera, of which only the first three are dealt with by Mr. W. L. Distant in the first volume on the Rhynchota-Heteroptera of British India, published in 1902 (Fauna of British India. London, Taylor & Francis).

Statistics relating to the three families referred to are given in the subjoined table:—

Family.	Geographical Area.	Genera.	Species.
I. PENTATOMIDÆ ...	British India (including Ceylon and Burma)	199	542
	Ceylon (total)	51	80
	Do. (endemic)	3	28
II. COREIDÆ ...	British India	45	143
	Ceylon (total)	22	45
	Do. (endemic)	1	14
III. BERYTIDÆ ...	British India	3	4
	Ceylon (total)	1	1
	Do. (endemic)	1	1

Of the fifty-one genera of Pentatomidæ occurring in Ceylon, thirty-seven are represented by single species, or in other words are monotypic in the Island according to existing records. The genus of Pentatomidæ with the greatest number of local species is *Coptosoma*, with seven species, of which five are peculiar to Ceylon. These are small plant bugs somewhat resembling ladybirds (Coccinellidæ) in size, lustre, and general superficial appearance. In the whole of British India fifty-one species of this genus are described by Mr. Distant.

The Coreidæ "closely resemble both in form and position the Longicornia amongst the Coleoptera" (Distant, *op. cit.*, page 331). The family was formerly designated Supericornia on account of the insertion of the 4-jointed antennæ on the upper side of the head. In this sense it may be said that the Supericorn bugs are to the Rhynchota what the Longicorn beetles are to the Coleoptera.

Of the twenty-two genera of Coreidæ in Ceylon thirteen are represented here by single species. The most extensive or polytypic genus in the Island is *Homœocerus*, with eleven species, of which two are peculiar. This genus has thirty-four species altogether in British India.

The only representative of the Berytidæ at present recorded from Ceylon is *Hubertiella cardamomi*, Kirkaldy, a small, slender bug with very long legs, found by Mr. E. E. Green on the under surface of leaves of cardamom (Distant, *op. cit.*, page 424).

The Rhynchota-Homoptera (Cicadas, lantern flies, &c.) of Ceylon form the subject of a recent monograph by Dr. L. Melichar* of Vienna, who obtained his material from various sources, including a large collection made by Dr. Heinrich Uzel, who was recently in the Island. At Dr. Uzel's request the collection of Homoptera in the Colombo Museum was forwarded to Dr. Melichar for the purpose of this work, and was returned by him with names attached to the specimens. The monograph contains accounts of 349 species distributed among 147 genera, including 161 new species and 38 new genera.

The families of the plant lice (Aphidæ) and the scale insects (Coccidæ) also belong to the Homoptera, but are not included in Dr. Melichar's book.

An elaborate and richly illustrated treatise on the Coccidæ of Ceylon has been in course of publication since 1896 under the authorship of Mr. E. E. Green. Two parts, each containing thirty coloured lithographic plates, have been already published (London: Dulau & Co.).

* Melichar, L., Homopteren-Fauna von Ceylon, 233 pages, 6 plates. Berlin (Felix Dames), 1903.

Such of the Rhynchota as are of economic importance in respect of the injury which they inflict upon the tea plant are described in considerable detail in the second edition of "The Pests and Blights of the Tea Plant," by Sir George Watt and Harold H. Mann, Calcutta, 1903: *see* Chapter XIV., pages 247–319.

In this useful volume we are told that "the damage done by the tea mosquito* and the tea green fly† alone probably equals that of all other pests taken together." Nearly forty pages are devoted to the discussion of the attacks of the "tea mosquito" and of the ways in which they may be withstood or prevented. Mr. E. E. Green's discovery‡ of the "hibernation" of the insect on the tea bush itself is quoted and confirmed as an important guide in devising methods of isolation and prevention. During the dormant periods, when the pest is not active, the mature females, which may be found lurking in the bushes by careful searching for them, contain on the average more than half as many eggs again as are found during the attacks, *i.e.*, twelve to thirteen eggs per insect during the dormant periods, as against eight eggs during the periods of attack (*see* Watt and Mann, *op. cit.*, page 269).

With regard to remedial measures the authors come to the conclusion that careful collection of the insects in the early part of the year is the best method of grappling with the evil.

In Ceylon it appears from Mr. Green's observations, quoted by the above-named authors on page 265 of their book, that the periodicity of the insect is subject to fluctuations within the year. In the Kelani Valley, for example, the worst attack takes place in July and August, after which it decreases to a minimum in November, increasing again in virulence until a second though less serious climax is reached in March. After this the pest declines, practically disappearing in May. The recrudescence commences towards the end of June. There are thus two periods of major infestation in March and August, and two minor or quiescent periods in May and November. The March rise coincides with a period of comparative drought, and the August crisis is accompanied by heavy rains (Green, Circ. Roy. Bot. Gardens, 1902, No. 2, page 24).

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4. *Dendrophis bifrenalis*, Boulenger (Rept. Ind., p. 338).—Since reference was made to this tree snake on pages 86 and 87 in

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* *Helopeltis antonii*, Signoret; sub-order Heteroptera, family Capsidæ.

† *Chlorita flavescens*, Fabr. = *Empoasca flavescens* [Melichar, *op. cit.*, p. 215], sub-order Homoptera, family Jassidæ.

‡ Green, E. E., Further Observations on Helopeltis, Circ. Roy. Bot. Gardens, Ceylon, vol. II., No. 2, June, 1902.

"Spolia Zeylanica," Part III., an example of it has been presented to the Museum by Mr. H. M. Drummond Hay, who found it close to his bungalow at Punagalla, Yatiyantota, in November, 1903. Another specimen had been found by Mr. Hay at Hopewell, Balangoda, on a former occasion. It is distinguished from its congeners by the presence of two loreal shields and by the dark olive colouration of the lateral portions of the ventral shields above the lateral keels.

In the letter accompanying this welcome addition to the Museum collection of Ceylon types, Mr. Hay gives interesting particulars illustrating the local distribution of certain snakes. He writes :—"I have had a great many specimens of *Dendrophis pictus* brought to me while I have been here (Yatiyantota), but none of *D. caudolineatus*;" on the other hand, "on Hopewell I found *D. caudolineatus* to be a common snake, and I only came across one specimen of *D. pictus*."

Coluber helena and *Lycodon aulicus*, both frequently taken in Colombo, occur at Yatiyantota, but apparently not at Balangoda; at any rate they were not found on the Hopewell estate, where *Lycodon carinatus* was rather common. The burrowing snake, *Cylindrophis maculatus*, is another species which is often taken in Colombo and other parts of the low-country (*e.g.*, Tangalla, Sigiriya) ranging up to the elevation of Kandy, but was not found by Mr. Hay on Hopewell, though very common on the adjoining estate Allupolla, the highest point of which lies at a lower elevation than 3,000 ft. above the sea, lower in fact than the lowest point of Hopewell.

With the exception of the earth snakes (Uropeltidæ), Mr. Hay found that by far the commonest snake on Hopewell was the poisonous pit viper, *Ancistrodon hypnale*, one of the snakes known as "karawalá" (Sinhalese). Two living specimens of this snake were sent to the Museum in October last by Mr. E. E. Green, who obtained them from Dumbara. One of them died after a few weeks of captivity, but the other survived until near the middle of December, feeding upon insects. It has also been sent to the Museum by Mr. G. G. Ross Clarke from Calsay estate, Nanu-oya, where it is associated with *Dipsas ceylonensis*.

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5. *Symbiosis between Bees and Mites.*—A remarkable instance of symbiosis or special adaptation on the part of a host for the accommodation of its parasite has been brought to light in recent years by two independent observers, Messrs. E. E. Green and R. C. L. Perkins.

The hosts are species of the great black wood-boring bees, very common in Ceylon, of the family Xylocopidæ belonging to the genus *Coptorthosoma*.* This genus is characterized principally by the structure of the basal segment of the abdomen, which fits against the hinder wall of the thorax. This segment is attached to the thorax by a somewhat narrow pedicle below; the rest of the front wall of the segment presents a sharply truncate free border and a concave anterior surface. When the border of the basal abdominal segment is closely applied to the thorax a closed chamber is produced owing to the aforesaid concavity of its front wall. "If," says Mr. Perkins,† "the basal concavity of the first abdominal segment be examined in the female bee, a distinct orifice will be found in the middle, generally small and overhung with hairs, but in some species large and quite exposed."

This orifice leads into a wide chamber which projects backwards, filling a large part of the interior of the segment.‡

The chamber is inhabited by species of mites (Acaridæ), two of which have been named *Greenia perkinsi* and *Greenia alfkeni* by Dr. A. C. Oudemans. Sometimes the acarids are so numerous as to fill the chamber, and occasionally they may be noticed projecting through the orifice. Perkins found the chamber in the females only of seven species of *Coptorthosoma*, namely, *C. latipes*, *tenuiscapa*, *æstuans*, *verticalis*, *cærulea*, *caffra*, and *trepida*. The last two species are from South Africa, the others from the Indo-Malay region.

The fact that the chamber is only found in the female bees is interesting, because "the male bees are short-lived and vagrant, rarely returning to the nest for more than a few days" [Perkins], so that it is an advantage to the parasites to confine themselves to the more stable females. Mr. Perkins, however, found that "not every species of *Koptorthosoma* possesses the chamber, for Dr. Willey has brought home from New Britain females of a species, very closely allied to *K. æstuans*, which show no more trace of it than do the males of those species above mentioned."

Also no species of the genus *Xylocopa* in its restricted sense were found to be provided with an acarid chamber in the female.

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* Sometimes written "*Koptorthosoma*."

† R. C. L. Perkins. On a special acarid chamber formed within the basal abdominal segment of bees of the genus *Koptorthosoma* (Xylocopinæ). Ent. Monthly Mag. (second series), vol. X., February, 1899, pp. 37–39.

‡ A drawing of the chamber showing the position which it occupies in the body of the bee is reproduced in a paper entitled "On some Parasites of *Xylocopa tenuiscapa*, Westw.," by E. E. Green, in Ent. Monthly Mag. (second series), vol. XIII., October, 1902, pp. 232, 233.

Quite recently Dr. Oudemans* has returned to this subject, having ascertained that the existence of an acarid chamber in wood-boring bees had been noticed many years ago.

Of late years, as indicated above, this example of symbiosis was discovered in February, 1898, by Mr. Green, who found it in two species of *Coptorthosoma*, *C. tenuiscapa* and *C. bryorum*, occurring in Ceylon, and sent specimens to Colonel Bingham, the well-known hymenopterist, and to Mr. A. D. Michael, the acarologist in London, but did not publish his discovery. Quite independently, in October of the same year, Mr. Perkins made the same observation and published the paper on the subject quoted above. Dr. Oudemans points out that Mr. Perkins was therefore the "official discoverer" so far as the present incident is concerned.

Dr. Oudemans, however, has since unearthed earlier records of this form of symbiosis in various journals, proceedings, and archives of societies in Holland. In 1856 R. T. Maitland, a Dutch entomologist, described an abdominal sac in *Xylocopa* (*Coptorthosoma*) *latipes* containing acarid parasites, which he named *Gamasus saccicola*. Still earlier, in 1846, a similar instance was described by H. Zollinger, the bee-host being probably referable to *Coptorthosoma æstuans* and the acarid parasite a species of *Trichotarsus*.

Finally, the observation goes back to the year 1839, when Herr Brilman recorded somewhat vaguely the occurrence of mites in the abdomen of wood-boring bees.

Between 1856 and 1898 the phenomenon appears to have been overlooked, a circumstance which illustrates how effectually an interesting and important biological observation may be buried in a publication unless it is followed up and placed in a category with analogous facts drawn from other sources.

End of Vol. I.

* A. C. Oudemans. Symbiose von Coptorthosoma und Greenia. Eine Prioritätsfrage. Zool. Anz. Bd. XXVII., December, 1903, pp. 137–139. This paper contains further bibliographical references.

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