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SPOLIA ZEYLANICA.

THE DISTRIBUTION OF BIRDS IN CEYLON AND ITS RELATION TO RECENT GEOLOGICAL CHANGES IN THE ISLAND.

By W. E. Wait, C.C.S.

THE fauna of an island can never fail to be of interest. Owing to its isolation there are usually to be found within its limits a greater number of peculiar species and genera than can be expected from a continental area of the same extent. If the island has been separated from adjacent lands for only a short geological period, the insularity of its fauna is not well developed; but the longer the period of separation, the more marked become the differences.

As a consequence, the study of an insular fauna will throw considerable light upon its geological history, corroborating the geological evidence, or supplementing gaps in the geological record. Take, for instance, the British Islands. We know that at a quite recent geological period—that of the great Ice Age—the whole of the north of Great Britain was covered by an enormous sheet of glacier ice, and that even the south of England was too cold to support anything but an arctic fauna. When the ice receded and the temperature grew warmer, the present temperate fauna gradually came over from the Continent. To allow for the influx of mammals there must have been a land connection, not only between England and the Continent, but between England and Ireland.

Now, a fair number of animals which came over into England failed to reach Ireland, so it is evident that Ireland became an island after the Ice Age, but before Great Britain became separated from the Continent.

This comparative study of the distribution of animals is of the greatest importance in working out the geological history of Ceylon, as our geological record is so imperfect.

The rocks of which the Island is composed belong to the oldest geological period, and it is fairly certain, from the

absence of any large accumulations of sedimentary rocks, that throughout the manifold variations of the earth's surface during the changing geological periods the main part of Ceylon was never submerged for any length of time. As it is the animal and vegetable fossils of the sedimentary rocks which give us the information of the age of the strata, our information regarding Ceylon is almost a blank. The only strata in the Island which, to my knowledge, contain fossils are recent shell beds on the north, north-west, and south-east coasts, and certain river gravels here and there through the Island.

Apart from there being so few rocks which can give us fossils, the study of geology in Ceylon is rendered difficult by the fact that in most places the strata are so covered with jungle undergrowth and topsoil that their outcrops are hidden, and one cannot get at them to study them. The present Mineralogical Survey is largely for economic purposes, and is concerned more with petrography, or the composition of the rocks, than with the physical geology of the Island as a whole.

Consequently, in order to throw light on the recent geological history of Ceylon, we are thrown back mainly upon the study of its fauna and flora, and upon the relations they bear to those of the adjacent mainland.

Now, there is no doubt from the close connection between our fauna and that of Southern India that Ceylon is a mere appanage of that land, and has not been separated from it for any tremendous length of time.

Wallace, who was one of the great pioneers in the science of zoo-geography, in his "Geographical Distribution of Animals," published in 1876, divided the world into six main zoological regions. The Palæarctic Region roughly comprised Europe, Africa north of the Sahara, and Asia north of the Himalayas. The Ethiopian Region took in the rest of Africa. The Oriental Region contained India, Further India, Southern China, and the islands of the Malay Archipelago, down to the famous "Wallace's Line," which separates Bali from Lombok and Borneo from Celebes. The islands beyond Wallace's line, together with Australasia, formed the Australian Region; while North and South America were divided into the Nearctic and Neotropical Regions.

Wallace was so struck with the peculiarities shown in the fauna of Southern India and Ceylon that he made them into one of the four sub-regions of the Oriental Region ; the others being the Indian—which took in the rest of India ; the Indo-Chinese, comprising Burma, Siam, and South China ; and the Indo-Malayan, which included the Malay Peninsula, the Philippines, and the Oriental portion of the Archipelago.

More recent researches have extended the range of many of the animals supposed by Wallace to be peculiar to the Ceylonese sub-region and have modified Wallace's grouping.

So far as India is concerned, a full summary of our knowledge of the subject will be found in a paper read in 1900 before the Royal Society by Dr. Blanford, on the " Distribution of Vertebrate Animals in India, Ceylon, and Burma."*

As Dr. Blanford is one of the foremost Indian Geologists, the author of the volume on Mammals in " The Fauna of British India," part author of the four volumes on Birds, and editor of the whole series relating to Vertebrates, one could scarcely find an authority more competent to deal with the subject.

In this paper Dr. Blanford divides the Indian Empire into the following five primary geographical divisions :—

A.—The Indo-Gangetic Plain.
B.—The Indian Peninsula.
C.—Ceylon.
D.—The Himalayas.
E.—Assam and Burma.

These five regions are again subdivided into nineteen zoo-geographical tracts.

The Indian Peninsula splits up into—

No. 4.—The Central Indian or Rajputana tract.

No. 5.—The Deccan tract.

No. 6.—The Behar-Orissa tract.

No. 7.—The Carnatic or Madras tract, which includes that part of the peninsula south of the river Kistna and east of the Western Ghauts, thus comprising the Carnatic and Mysore. This tract is fairly dry, the average rainfall being 35 inches.

* " Phil. Transactions of the Royal Society," Series B., Vol. CXCIV., 1901, pp. 335–436.

No. 8.—The Malabar tract comprises the Western Ghauts and the western coast lands from a little way north of Bombay down to Cape Comorin. The average rainfall varies from 74 inches at Bombay to 261 at Mahableswar.

Ceylon is divided into two :—

No. 9.—The Northern Ceylon tract, comprising north and east Ceylon and that part of the south of the Island east of Tangalla. The rest of the Island is classed as No. 10, the Southern Hill tract.

Of the Northern tract, he remarks : " This is, in fact, a part of the Carnatic with a higher rainfall and with much more forest ! The rainfall varies from 35 inches at Mannar to 61 at Trincomalee."

Of the Southern tract, he says : " South-western Ceylon, to which, as Legge* has shown, the peculiar fauna of the Island is largely restricted, must be regarded as part of the Malabar Coast."

The difference between the fauna of these divisions and subdivisions is more marked in some cases than in others ; that is to say, the divisions are of varying zoological importance.

As Blanford says, the Indo-Gangetic plain forms a geological boundary of the highest importance.† Many geologists believed that this great plain was until quite recent times covered by part of a large sea, which cut off South India from the country north of the Himalayas, as the Mediterranean now cuts off North Africa from Europe ; and that in those days the Himalayas were represented by a chain of islands of quite moderate altitude.

This was Wallace's opinion, but Blanford states that there is no geological evidence to show that this former sea ever extended eastwards of Delhi.‡

Again, the place occupied by Ceylon as a primary division is purely local, and not of great account zoologically, as will be seen from the remarks introducing the subdivision into

* Legge : " History of Birds of Ceylon," Introduction, p. xvii., and map.

† Blanford, *loc. cit.*, p. 343.

‡ " Manual of Geology of India," Introduction, p. lx., and also p. 393.

tracts. Northern Ceylon throws in its lot with the Carnatic; and South-western Ceylon, though not so closely, with the Malabar tract.

If we look at the five tracts of the Indian Peninsula, the difference between the fauna of the first four is mostly specific and not generic, but the fauna of the Malabar tract differs widely from that of the adjoining areas.*

It was these differences that led Wallace to make Ceylon and South India into a separate sub-region. They are largely due to the presence of certain isolated species and genera which show connections with such widely separated areas as the Himalayas, Africa, Malaya, and even Australia.

The presence of these elements in the fauna of Ceylon is described by Dr. Willey in a paper in the first number of *Spolia Zeylanica*,† and their bearing on the past history of Ceylon is shown by Wallace in his work, to which I have already referred.‡

As regards the Australian element, it is practically confined to the earthworms, an order low down in the organic scale. Such lowly organisms change slowly, and their presence may be accounted for by a land connection far back in the geologic ages, when a continent stretched from Asia to Australia. The African or Madagascan and the Malay elements, many geologists hold, may be explained by postulating the existence of a great continent, which in tertiary times stretched from South India and Ceylon to Madagascar on the one hand and to Malaya on the other. It is quite probable, however, that our connection with Malaya is rather later than that with Madagascar.§ These peculiar elements are shared in a varying degree by Ceylon with the Malabar tract, and I have dealt with them now as they belong to a period when Ceylon still formed part of the South Indian Continent and had not yet become an Island.

As I believe that an examination of the distribution of the Himalayan, Malabar, and Carnatic elements among our birds

* Blanford: "Phil. Transactions," &c., p. 392.

† Willey: "Constitution of the Fauna of Ceylon," *Spolia Zeylanica* Vol. I., Part I., p. 1.

‡ "Geographical Distribution of Animals," Vol. I., p. 328.

§ Wallace, *loc. cit.*, p. 361.

will throw some light on the geological changes which have separated Ceylon from South India, I will leave all discussion as to their significance until I have summarized that distribution.

In the course of his paper already alluded to, Dr. Blanford has given a complete tabulation of all the genera of vertebrate animals found in the nineteen tracts of the Indian Empire, and the differences and affinities shown in these tables are the bases on which he has founded his conclusions. He has stopped short at generic and not gone into the further detail of specific differences, partly because the work would have been too enormous, and partly because differences in species are not so sure a guide as differences in genera.

He has also attached far more weight to the distribution of mammals than to that of other vertebrates, because the means of dispersal in the case of mammals is more limited than in other orders. They cannot fly over arms of the sea, nor can they cross mountain ranges as easily as birds.

However, as I am not competent to deal with any vertebrates but birds, as my investigations cover a more limited area, and as the differences between the birds of Ceylon and those of the adjoining tracts are largely confined to differences merely of species and not of genera, I must go into greater but less sure detail, and take as my unit the species.

First of all it is necessary to examine the division of Ceylon into zoo-geographical districts.

Blanford divides the Island into two tracts as described above, but for a more detailed examination one cannot do better than follow the divisions given by Captain Legge in his Introduction to the "Birds of Ceylon." He divides the Island into four districts: the dry forest areas of the north and south-east; the arid maritime belt of the north-west coast, with which he groups the similar belt on the south-east; the damp western forest region; and the hill zone of the Kandyan districts.

The first two make up Blanford's Carnatic tract of Ceylon, and the last two his Malabar tract.

Now, it is true that the south-east "arid maritime belt" is exactly suited to the dry-country birds which inhabit the

north-west belt, but in the former area there are some notable omissions, to which I shall call attention later on; while if we examine the large portion of the Island which is classed as the dry forest area, we shall find the Carnatic forms gradually diminishing as we go from north to south, while the Malabar and peculiar species diminish as the country spreads away from the Kandyan frontier.

I wish at the outset of my summary to state that in it I have confined myself mainly to birds of weak powers of flight and of limited range. My object is to show the affinities and differences between our birds and those of Malabar and the Carnatic, and in some cases with those of the Himalayas.

Migrant birds and those which have a wide Indian range will not receive notice where they do not afford evidence of peculiar distribution.

As regards the distribution in Ceylon of the various species, my information rests upon Legge's "Birds of Ceylon" and my own observations. As regards India, it is taken from the tabulation in Dr. Blanford's paper and the ranges given in the volumes on "Birds" in the "Fauna of British India."

As I cannot pretend to complete knowledge even in Ceylon, it is quite probable that there are many more inaccuracies in the Indian distribution, where my knowledge is solely dependent upon books, in which the information regarding the range of each species is more general than detailed.

Beginning with the Passerine birds, our two species of Crow are found all over India, but in Ceylon the Gray-necked Crow—*Crone splendens*—so common in Colombo, is worth notice, as it is probably a new comer. It is found only round the coast, and whereas in Legge's time it was not found in the south of the Island between Kalutara and Arugam Bay, it has now, to my knowledge, spread from Kalutara southwards and eastwards as far as Hambantota, and possibly all round the Island.

The Ceylon Magpie, found in the hills—*Cissa ornata*—belongs to a Himalayan genus, otherwise not found between the headquarters of the genus and our Island. This species is peculiar to Ceylon, where it is confined to the higher elevations of the hill-country.

The *Crateropodidæ*—a large family, which includes the Babblers and Bulbuls—are mainly short-flight birds, and include a good many of our peculiar species.

In the sub-family *Crateropodinæ*—the Laughing Thrushes—out of four species three are found only in the Kandyan districts of the Island. *Crateropus rufescens*—the Ceylonese Babbler—occurs in the damp forests of the Western and Central Provinces, the Province of Sabaragamuwa, and the Galle District.

Crateropus cinereifrons—the Ashy-headed Babbler—is even more circumscribed, being found only in the deep forests of the wettest zone. On the other hand, we have *Crateropus striatus*—the ubiquitous Seven Sisters—occurring all over the Island up to 3,000 feet. It is found in India from Madras southwards, but is especially common on the mainland opposite Mannar and in the north-west of Ceylon, so that it appears to be an invader from the Carnatic.

Pomatorhinus melanurus—the Scimitar Babbler—again, is peculiar to Ceylon. Its headquarters are in the Kandyan districts, but its range extends towards a part of the northern forest tract. An allied species—*P. horsfieldi*—is found in the Malabar tract, but the genus is wanting in the Carnatic.

In the sub-family *Timeliinæ*—the Quaker Thrushes—out of four species three are peculiar to Ceylon, and only one, *Dumetia albigularis*—the Small White-throated Babbler—also occurs in India, where it is noted only from the western part of the peninsula. It is a bird found on the ragged edges of civilization and scrub jungle, not in deep forest. It is more common in the south of the Island than in the north, and is apparently unknown in that part of the Carnatic which lies opposite to Ceylon.

Of our three peculiar species, *Pyctorhis nasalis*—the Ceylon Yellow-eyed Babbler—is closely allied to another species—*P. sinensis*—found all over India. Its range in Ceylon approximates to that of *Dumetia albigularis*. *Pellorneum fuscicapillum*—the Brown-capped Babbler—has spread all over the Island, except in the Jaffna Peninsula and on the Mannar coast. One species of the genus—*P. ruficeps*—is found on the mainland of South India, both in the Carnatic and Malabar tracts.

Of the *Brachypteryginæ* we have three species, two of which are confined to the upper hills of Ceylon.

Arrenga blighi—the Ceylonese Arrenga—is the sole species in the genus. Its nearest relative is the genus *Myiophoneus*, which has its headquarters in the Malay sub-region, so that the bird is one of our scanty links with the Malayan fauna. *Elaphrornis palliseri*—the Ceylon Short-wing—is placed by itself in a genus not found outside Ceylon, and its affinities have not yet been determined with any degree of certainty. The third species, *Larvivora brunnea*—the Indian Blue Chat—is with us a migrant. Being of weak flight it works its way slowly down from its crossing place at Mannar to the central hills.

In the sub-family *Sibiinæ* we have two species, both belonging to the genus *Zosterops*. One, *Z. palpebrosa*—the Indian White-eye—is common all over the low-country, and has a wide range in India; the other, *Z. ceylonensis*—the Ceylon White-eye—is peculiar to the Island, but is common at elevations over 2,000 feet.

The sub-family *Liotrichinæ*, which includes the Green Bulbuls, does not furnish us with any peculiar species.

Ægithina tiphia—the Bush Bulbul—has a wide range, so has *Chloropsis jerdoni*—Jerdon's Bulbul; *Chloropsis malabarica*—the Malabar Green Bulbul—is found in the Malabar forests, and is sparingly distributed in Ceylon, while *Irene puella*—the Fairy Blue Bird—is a rare visitor to our hill districts. It hails from Malabar, and is unknown in the Carnatic.

The last subdivision of this large family is the *Brachypodinæ*—the true Bulbuls. We have six species, two of which are peculiar. *Hypsipetes ganeesa*—the South Indian Black Bulbul—is found in the hill forests of the Malabar district and in the Kandyan districts of Ceylon. It extends a little way into the northern forest tract, as I have found it in East Matale, but it is a rare straggler into the North-Central Province and Trincomalee District.

Molpastes hæmorrhous—the Common Bulbul of our gardens—is found nearly throughout India. *Iole icterica*—the Forest Bulbul—is not found in the Carnatic, but occurs in

the Malabar tract. In Ceylon it is found in the Kandyan forests up to 3,500 feet, and penetrates some way into the northern forest zone. *Pycnonotus melanicterus*—the Black-capped Bulbul—is a peculiar species found throughout the Island in forest country up to an elevation of 5,000 feet. It appears, however, to be commonest in Kandyan forests. *P. luteolus* is found throughout the southern half of the Indian Peninsula, and with us is common everywhere in the low-country. *Kelaartia penicillata* is the sole species in a genus peculiar to the Island. It is found only in the upper hills, down to 4,000 or 3,500 feet.

The *Dicruridæ*, or Drongo family, are also of interest as regards distribution. We have six species in the Island, four of which belong to the genus *Dicrurus*.

Dicrurus ater—the Black Drongo—is found through the whole of India, but in Ceylon is confined to the Jaffna Peninsula and the strip along the north-west coast as far as Puttalam. Elsewhere in the Island the common Drongo is *D. leucopygialis*—the White-vented Drongo—which is a paler form of *D. cærulescens*, a species which is said to be found in the same parts of the Island as *D. ater*.*

Dicrurus longicaudatus—the Indian Ashy Drongo—is a migrant during the north-east monsoon to the east of the Island.

Turning to the Crested Drongos, *Dissemurulus lophorinus*—the Ceylon Black Drongo—is peculiar to the Island. Its headquarters are the deep forests of the Kandyan districts, and it is replaced in the north-east and south-east by another species—*Dissemuroides paradiseus*—the Racket-tailed Drongo, which has a large range throughout suitable localities in India, and extends its range to Burma and the Himalayas.

Many of the Warblers—*Silviidæ*—are so widely distributed that I do not propose to go through them all. The only two species which are not common to Ceylon and the Malabar and Carnatic tracts are *Locustella certhiola*—Palla's Grasshopper Warbler—and *Scœnicola platyura*—the Broad-tailed Grass Warbler—both of which have only been recorded once or twice from our Island.

* *Vide* "Fauna of British India Birds," Vol. I., p. 316; but see also Legge: "Birds of Ceylon," p. 394.

Our Shrikes—*Laniidæ*—in general are either migrants or fairly widely distributed. One species, however, *Lannis erythronotus*—the Rufous-backed Shrike—is in Ceylon confined to the Jaffna Peninsula and Mannar coast, though it is found nearly throughout India.

The *Eulabetidæ*—the Grackles, or Hill Mynahs—have a curious distribution.

The genus *Eulabes* is not found in the Carnatic tract or in northern Ceylon, but in the southern half of the Island we have two species : *Eulabes ptilogenys*—the Ceylon Grackle—a peculiar species, which ranges from Avissawella through Sabaragamuwa to the summit of the main range, and *E. religiosa*, which is found in more open country throughout the Kandyan districts below 1,500 feet. It does not appear in the northern forest tract, except here and there on the southern edges. In India it appears to be confined to the Malabar tract.

The Starlings—*Sturnidæ*—are represented in Ceylon by four species. *Pastor roseus*—the Rose-coloured Starling—is a rare and occasional migrant. *Acridotheres melanosternus*—the Common Ceylon Mynah—is found all over the Island, but nowhere else. A closely related species—*A. tristis*—occurs throughout India.

Sturnornis senex—the White-headed Mynah—belongs to one of our peculiar genera. It is found only in the wild hill forests of the Province of Sabaragamuwa and in the Pasdun korale, where it descends to within a few hundred feet of sea level.

Temenuchus pagodarum—the Black-headed Mynah—is found in the dry districts. In India it is found in many parts, but would appear to be rare on the Malabar coast, though common in Rameswaram in the Carnatic. Thence it appears to have crossed to Mannar and made its way round the dry coasts of the north and east as far to the south as Tangalla. It is unknown between Chilaw and Tangalla, and it is found only in dry scrub jungle.

Many of our Flycatchers—*Muscicapidæ*—like our Warblers, are migratory, or have a wide distribution. I propose to notice only two. *Stoparola sordida*—the Dusky Blue Flycatcher—is

found in the Kandyan hills above 2,000 feet. Its nearest relative is *S. albicaudata*, which is confined to the hills of the Malabar tract.

Rhipidura albifrontata—our Fan-tailed Flycatcher—is found nearly all over India, but has a curiously restricted range in Ceylon—a restriction shared by several other species found in the Uva basin. It is abundant round Bandarawela, and equally common southwards from the Haputale range to the dry chenas of Tangalla and Hambantota. Its western range would appear to be a line drawn south from Haputale to Dikwella, ten miles west of Tangalla. North and east of Bandarawela it appears to range through the park country to Polonnaruwa in the North-Central Province, where it stops short on the boundary of the park country.

Many of our Thrushes—*Turdidæ*—show Malabar affinities, and are restricted to the Kandyan districts; others are migrants, or have a wide range. *Pratincola atrata*—the Hill Bush Chat—is found on the South Indian hills above 5,000 feet. In Ceylon it is found on the higher patanas down to about 4,000 feet. *Merula kinnisi*—the Ceylon Blackbird—is peculiar to the Island, being found only on the higher ranges. There are two nearly allied species on the hills of the Malabar tract.

Oreocincla imbricata—the Ceylon Thrush—and *O. spiloptera*—the Spotted-wing Thrush—are both hill species peculiar to Ceylon. The former is confined to hill forests over 3,000 feet, the latter inhabits the central hill region below 4,000 feet, and in places is found far into the low-country forests. The genus occurs in the Malabar tract, but is unknown in the Carnatic.

Of the *Plocidæ*, or Weaver Birds, we have ten species, belonging to three genera, all of which are common to the Malabar and Carnatic tracts. Most of our species, too, are found to have a wide range in India, but there is one, *Uroloncha kelaarti*—the Ceylon Munia—which is confined to the hills of Ceylon at elevations of over 2,000 feet. A closely allied species is found on the Malabar hills.

The Finches—*Fringillidæ*—are largely Himalayan, only two species of Sparrow venturing as far south as Ceylon, both of which are widely distributed in India.

The Swallows with their migratory habits and powers of flight would not seem likely to furnish us with a peculiar species, but of the four species of *Hirundo* which occur within our limits, one, *Hirundo huyperythra*—the Ceylon Swallow—does not occur elsewhere, though found nearly all over the Island; and another, *Hirundo javanica*—the Nilgiri House Swallow—is really a Malayan bird found within the limits of the Indian Empire only on the hills of Ceylon and Malabar.

The *Motacillidæ*, which include the Wagtails and Pipits, are largely migrant birds, and those species which are resident with us are found over the greater part of India. The same remark applies to the Larks, of which we have only three species. One of these, *Pyrrulanda grisea*—the Ashy-crowned Finch Lark—though found nearly throughout India, in Ceylon is confined to the dry coast districts.

Of the dainty little Sunbirds—*Nectariniidæ*—we have four species, all belonging to the genus *Arachnechthra*. *A. minima*, a Malabar species, has been found only once or twice in Ceylon, and the others are found throughout a large part of the Indian Peninsula.

The equally small *Dicæidæ*—Flower-peckers—contain one species worthy of note.

Acmonorhyncus vincens, long known as *Pachyglossa vincens*—Legge's Flower-pecker—is one of our few Himalayan relicts. Its nearest relative, *Pachyglossa melanoxantha*, occurs in Sikkim and Nepaul. Our species has retreated, not to the hills, but to the deep forests in the wettest zone of the low-country between Adam's Peak and the sea.

The sole Ceylon representative of the *Pittidæ*, or Painted Thrushes, is with us a migrant.

Turning from the enormous order of the Passerine birds, we now come to the *Pici*—Woodpeckers—an order of which the distribution in Ceylon is full of interest, as it appears to illustrate in a most striking manner an older Malabar element and a more recent Carnatic invasion. They are birds of heavy build and weak powers of flight, so that they are not fitted of their own accord to cross any but the narrowest stretches of water, nor are they likely to be storm-driven for any great distance. Their means of dispersal, therefore, are limited.

We have nine authenticated species in Ceylon belonging to six genera. Of these six genera, two, *Gecinus* and *Micropternus*, are absent from the Carnatic and north-west coast of Ceylon, but present in the Malabar and Ceylon forests. A third genus, *Liopicus*, is absent from Malabar, but found in the Carnatic and the dry zone of Ceylon. In two of the remaining three genera, viz., *Brachypternus* and *Chrysocolaptes*, we have a species peculiar to Ceylon, with its headquarters in the southern part of the Island, together with a more widely distributed species, which in Ceylon is found solely or mainly in the dry Northern tract.

Going into details more fully, the genus *Gecinus* is represented in Ceylon by two species, *G. striolatus*—the Green Woodpecker—which is almost entirely confined to the patanas of the Central Province, and *G. chlorogaster*—the Yellow-naped Woodpecker—which occurs in the foothills and the forests of the low-country, except in the north of the Island.

As I have mentioned above, the genus is unknown in the Carnatic.

On the other hand, *Liopicus mahrattensis*—the Yellow-fronted Pied Woodpecker—is not found in the Malabar tract, and in Ceylon it is confined mainly to the sandy scrub country round the north-west coast, but some birds have crept round the east coast to the similar region in the south-east, its western limit on this side lying a few miles east of Tangalla.

Iyngipicus gymnophthalmus—the Ceylon Pigmy Woodpecker—is found mainly in the forests of Ceylon and the Malabar tract. It would appear to be rare in the Carnatic, and there are sub-specific differences between the Ceylon and Malabar races.

Micropternus gularis—the Malabar Rufous Woodpecker—is not found in the Carnatic. Its main haunts in Ceylon are the forests at the base of the hills, but it spreads almost through the northern forest tract.

The genus *Brachypternus* is represented in Ceylon by two species.

B. aurantius—the Golden-backed Woodpecker—which is found throughout India, in Ceylon does not occur south of

the North-Central and North-Western Provinces. Its place throughout the rest of the Island is taken by *B. erythronotus*—the Red-backed Woodpecker—which is extremely common. In the North-Central Province the two species overlap and apparently interbreed, as intermediate forms are found. In addition, the specimens of *B. aurantius* from this district are generally orange-coloured on the back, while those of *B. erythronotus* are of a less pure red than birds from the Southern Province.

We have an almost similar distribution in the genus *Chrysocolaptes*.

C. stricklandi—Layard's Woodpecker—is peculiar to Ceylon, and occurs in forest country all over the Island. It also, like *B. erythronotus*, has a red back. It is replaced in the Malabar forests by a golden-backed species, *C. guttacristatus*. A third species, *C. festivus*—the Black-backed Woodpecker—is rare on the Malabar coast, commoner in the Carnatic, and occurs locally in the northern half of the Island, though a few specimens, like those of *Liopicus mahrattensis*, appear to have worked round to the north of the Hambantota District.

The next order, that of the *Zygodactyli*, which comprises the Barbets, is also interesting. Out of four species two are peculiar to Ceylon. *Therciceryx zeylonicus*—our Common Large Barbet—ranges nearly all over India, but *Cyanops flavifrons*—the Yellow-fronted Barbet—is found only in Ceylon, chiefly in the foothills, and belongs to a genus which otherwise is confined to the north of the Indo-Gangetic plain. Our species, therefore, is a Himalayan exile.

The remaining two species, *Xantholæma hæmatocephala*—the Coppersmith—and *X. rubricapilla*—the Small Ceylon Barbet—respectively belong to the Carnatic and Malabar contingents. *X. rubricapilla* occurs in the wet zone and part of the northern forest tract. It is peculiar to Ceylon, but is closely akin to *X. malabarica*, which occurs only in the Malabar forests.

X. hæmatocephala is common in the Carnatic and the dry districts of Ceylon, but it is rare in the Malabar tract, and not found in the wet zone of our Island.

The Rollers—*Coraciæ*—show a similar division. *Coracias indica*—the Indian Roller—is a common Indian bird, but in Ceylon it appears to be a newcomer by way of the Carnatic. Its headquarters are the Northern and North-Central Provinces, where it is quite a feature of the landscape. It migrates occasionally as far south as the Western Province, but it has not penetrated to the dry districts of the south-east, where one would expect to find it. On the other hand, *Eurystomus orientalis*—the Broad-billed Roller—belongs to a Himalayan genus. The species is found in the Malabar hills, and is a rare resident in that part of Ceylon which stretches from Haputale south-west to the hills of the Morawak korale.

The Bee-eaters—*Meropes*—have a like distribution. *Merops philippinus*—the Blue-tailed Bee-eater—is with us a migrant. *Merops viridis*—the Green Bee-eater—has a wide range in India, but in Ceylon keeps to the dry northern and eastern side, being practically unknown in the Western Province and the Galle District. There and up-country it is replaced by *Melittophagus swinhoii*, which does not occur in the Carnatic.

Of the seven species of Kingfishers—*Alcedinidæ*—found within our limits, two, *Alcedo beavani*—Beavan's Kingfisher—and *Halcyon pileata*—the Black-capped Kingfisher—have been found only two or three times in Ceylon; the other five species occur both in the Malabar and Carnatic tracts.

The evidence afforded by the distribution of our Hornbills is rather conflicting.

Lophocerus gingalensis—the Little Ceylon Hornbill—is peculiar to the Island, and occurs throughout the Island up to elevations of 4,000 feet. An allied species, *L. griseus*, is found only in the Malabar coast. As against this, *Anthracocerus coronatus*—the Crowned Hornbill—a heavy ungainly bird, incapable of a long sustained flight, is wanting in the Carnatic, but its headquarters in Ceylon are the drier forests in the northern half of the Island. It thus forms a solitary exception to the general rule.

Our only Hoopoe, *Upupa indica*—the Indian Hoopoe—is found practically throughout the Indian Empire.

Most of our Swifts and Nightjars—*Macrocheires*—are of widely distributed species, but certain of them are worthy of note.

Collocalia unicolor—the Indian Edible-nest Swiftlet—is a rock-loving species found in the hills of Ceylon and the Malabar tract, but not in the Carnatic. Again, the weird-looking Frogmouth—*Batrachostomus moniliger*—belongs to a genus which is found in the Himalayan region, in parts of Burma, in certain of the Malabar districts, and in the deep forests of Ceylon. Our species is confined to Ceylon and Malabar. With us it is more plentiful in damp forests up to a moderate elevation, but I have found it as far north as Anuradhapura, and as far south-east as the banks of the lower Walawe-ganga.

Our only Trogon, *Harpactes fasciatus*—the Malabar Trogon—is found throughout the Island in heavy forest. It is very rare in the Carnatic.

The large family of the Cuckoos—*Cuculidæ*—is represented in Ceylon by seventeen species, distributed among two sub-families and eleven genera. Though most of them are migrants, or range over a wide area, we have two peculiar species, and several others are worthy of mention.

Penthoceryx sonnerati—the Banded Bay Cuckoo—the sole species in the genus, is common in the forests of Malabar and Ceylon, but very rare in the Carnatic.

Surniculus lugubris—the Drongo Cuckoo—which mimics the Drongos, has a similar distribution, though it is everywhere a rare bird.

The Red-faced Malkoha—*Phœnicophäes pyrrocephalus*—is found only in Ceylon, and is the most noteworthy among the few surviving relics of our Malayan fauna. It is found in the deeper forests all over the Island, except on the higher hills. Lastly, of the widely distributed genus *Centropus* we have two species. *Centropus sinensis*—the Coucal or Crow Pheasant—is a very common jungle bird all over Ceylon and India. *Centropus chlororhyncus* is confined to Ceylon, where it is restricted to the damp forests lying between Adam's Peak and the sea.

The large order of the Parrots—*Psittaci*—is not largely represented in the Indian Empire. Only three genera occur, two of which are found in Ceylon.

Out of the genus *Palæornis* we have five species, two of which are peculiar to the Island. One of these, *P. eupatria*—our large Parroquet—is found nearly all over the Island, and the difference between it and *P. nepalensis*, which is widely distributed in Northern India, is very slight.

The beautiful Blossom-headed Parroquets have in general a much more local range.

P. cyanocephalus—the Western Blossom-headed Parroquet—may be met with in suitable localities in Ceylon and the Peninsula of India. *P. calthropæ*—Layard's Parroquet—is confined to the centre and south-west of our Island, being replaced in the Malabar tract by *P. columboides*, which is rather doubtfully recorded from Ceylon.

Loriculus indicus—the Ceylonese Loriquet—belongs to the Malabar contingent. The genus is represented by our species, which is found in the central and south-western parts of the Island, and by *Loriculus vernalis*, which in the Indian Peninsula occurs only on the Malabar hills, though it reappears in the Eastern Himalayas and Burma.

Of the Owls—*Striges*—we have eleven species.

Strix flammea—the Barn Owl—though distributed throughout India, with us occurs only in the Jaffna Peninsula.

Asio accipitrinus—the Short-eared Owl—was unknown in Ceylon until a few years ago, when a good many specimens suddenly appeared in the Western Province.

Syrnium indrani—the Brown Wood Owl—one of the candidates for the post of the Devil Bird, occurs most commonly in the Kandyan forests, but extends wherever there is high jungle. It ranges through the Malabar coast, and is found on the Himalayas, but would appear to be rare or wanting in the Carnatic.

Huhua nepalensis—the Forest Eagle Owl—connects us with the Himalayas. It is a hill species, also occasionally found in the forests at the base of the mountains. Its range south of the Ganges is restricted to the South Indian hills and Ceylon.

Scops giu—the Little Scops Owl—is found all over the Empire, but Ceylon specimens show slight differences from those of the peninsula. The same may be said of *Scops bakkamœna*—the Collared Scops Owl—which is so common round Colombo.

Of our two species of *Glaucidium*, *G. castanonotum*—the Chestnut-backed Owlet—is peculiar to the Island. Its nearest relative, *G. radiatum*—the Jungle Owlet—is found, like the last species, in the Kandyan forests, but it is also common throughout the Malabar coast. The genus is rare or wanting in the Carnatic.

The Hawks—*Accipitres*—are, in general, birds of powerful flight, and therefore, as might be expected, birds of wide range.

Many, indeed, are migrants or mere occasional stragglers to the Island.

Among the order there is one curious gap in our fauna. Only once has a specimen of a Vulture—*Neophron ginginianus*—been recorded from Ceylon. That specimen, a young bird, was obtained at Nuwara Eliya in 1879.

It will be necessary to note only a few species. *Ictinætus malayensis*—the Black Eagle—is mainly a Himalayan and Malayan species wanting in the districts south of the Ganges, except in the Malabar and Ceylon hills. With us it occasionally wanders into the low-country.

Spizætus kelaarti—Legge's Hawk Eagle—was long thought to be peculiar to Ceylon, but it has now been found in the Travancore hills. *Milvas govinda*—the Pariah Kite—a widely-spread species in India, for some reason or other in Ceylon confines itself to the northern scrub jungle tract, its place elsewhere in the low-country being taken by *Haliastur indus*—the Brahminy Kite—an equally common Indian bird.

Two rare Kites are *Baza lophotes*—the Black-crested Baza—and *B. ceylonensis*—Legge's Baza. The genus is represented north of the Ganges, but south of that river it occurs practically only in the Malabar tract and Ceylon. *B. lophotes* is with us only a rare migrant from the Himalayas or Malay Peninsula, while *B. ceylonensis* has been obtained several times in the Kandyan hills, and once in the Wynaad.

The Doves—*Columbæ*—found in Ceylon number twelve species, divided among eight genera, but two of these genera—*Crocopus* and *Ænopopelia*—are represented solely by one or two recorded specimens of *Crocopus chlorogaster*—the Southern Green Pigeon—and *Ænopopelia tranquebarica*—the Red

Turtle Dove. Two more species in other genera—*Alsocomus puniceus* (the Purple Wood Pigeon) and *Turtur ferrago* (the Indian Turtle Dove)—have but the same slender claims to a place in the Ceylon list.

Of our two common Green Pigeons, *Osmotreron pompadora*—the Pompadour Green Pigeon—and *Osmotreron bicincta*—the Orange-breasted Green Pigeon—the former is peculiar to the Island, but is found in numbers throughout the low-country forests. A closely related species, *O. affinis*, is confined to the Malabar coast. *Osmotreron bicincta* is equally common throughout our low-country, but is not quite such a forest-loving bird. This species ranges through Malabar to Orissa, but is almost unknown in the Carnatic.

Carpophaga ænea—our fine Imperial Pigeon—found in deep forest throughout the low-country, is likewise absent from the Carnatic, though it ranges through the Malabar coast region. *Chalcophaps indica*—the beautiful Little Bronze-wing Pigeon—has an almost similar distribution in Ceylon and the Indian Peninsula.

Columba intermedia—the Indian Blue Rock Pigeon—is a local bird in Ceylon, being chiefly confined to a few islands round the coast. It occurs through a large part of India. *Alsocomus torringtoniæ*—the Ceylon Wood Pigeon—is confined to the hill forests of Ceylon, and its nearest relative, *A. elphinstonii*, is found only on the Malabar hills. The genus does not occur in the Carnatic.

Leaving out the accidental stragglers mentioned above, we have two Turtle Doves in Ceylon: *Turtur suratensis*—the Ash Dove—which is found throughout India, and *Turtur risorius*, which is common throughout India in open country, but not in forest. It is rare on the Malabar coast, and in Ceylon it is confined to the northern coast belt of scrub jungle.

This distribution of our Pigeons emphasizes to a remarkable degree our Malabar and Carnatic connections. Out of eight species which have real claims as inhabitants of the Island, two are common to the three tracts. Only one other species is common to Ceylon and the Carnatic, and in Ceylon it is found only in that part of the Island which adjoins the Carnatic, while it is rare on the Malabar coast. The other

five species belong to genera common to Ceylon and Malabar, but rare or wanting in the Carnatic.

The Game Birds—*Gallinæ*—tell almost the same tale. With the exception of the Quails, some of which are migrants, they are generally birds with a local distribution. The Peacock—*Pavo cristatus*—at present is practically confined to the drier scrub jungle tracts of the north, east, and south-east of the Island, but the Sinhalese name for the bird enters into place names, such as Monara-gala and Monara-natana-hena (the chena where the peacock dances), in localities where the bird is no longer found. It may be a Carnatic invader, or as the bird is so often kept for show, it may have been introduced in historic times by human agency.

Our Jungle Cock—*Gallus lafayetti*—is peculiar to Ceylon, but has spread all over the Island. Its nearest ally—*G. sonnerati*—occurs both in the Malabar and Carnatic tracts, but I do not think it is found on the sandy tracts on the Rameswaram side of Adam's Bridge.

Our Spur Fowl—*Galloperdix bicalcarata*—occurs chiefly in the south of the Island. On the south-east coast a few stragglers wander right down to the sandy seashore, but on the northern side it stops within a short distance of the foothills south of Dambulla. An allied species is found in South India.

Our Quails are fairly widely distributed, but all are rather rare or sporadically scattered here and there through the low-country. The Common Bustard Quail—*Turnix pugnax*—is not a true Quail, but belongs to another order. *Francolinus pictus*—the Painted Partridge—has a peculiar local distribution, being found only on the Uva patanas, and from thence eastward to the low-country by Nilgala and Bibile. *F. pondicerianus*—the Gray Partridge—is confined to the northern scrub tract. It is unknown on the Malabar coast south of Bombay, but ranges through the Carnatic to Afghanistan.

With the order *Grallæ*, which comprises the Rails, we enter upon the vast assemblage of water birds, waders, and birds of the shore or of inland sandy tracts.

These water birds include in their ranks the larger number of our migrants, and the resident species and genera are mostly widely diffused. Most of them are found all over

India wherever conditions are suitable. For this reason, as regards Ceylon, comparatively few of them need be looked for in the Kandyan districts. There are few large tanks for the swamp birds, few suitable lagoons for the waders, and no sandy tracts for the shore birds.

With reference to the haunters of sandy shores and wastes, we have two suitable centres in Ceylon. One the northern scrub tract, where the Ceylon coast approaches the Carnatic, and a similar stretch near the south-east coast. Now there are several species found in the northern tract which are not found in the south-eastern, and in running through the remaining orders of birds I wish specially to note these species, for a reason which will become apparent later on.

To return to the Rails. They belong to an order which also contains the Cranes and Bustards, the two last noteworthy gaps in our avifauna. Of our Rails, the three Water Hens—*Porphyrio poliocephalus* (the Purple Water Hen), *Amaurornis phœnicurus* (the White-breasted Water Hen), and *Gallinula chloropus* (the Moor Hen)—are all birds with a wide range. Five other species are rare migrants to our shores, and only one, *Gallicrex cineria*—the Water Cock—is noteworthy, as not occurring in the Carnatic. It is locally distributed through our low-country swamps, but as far as my experience goes it is more scarce in the north of the Island.

Turning to the *Limicolæ*, or Waders, of the three families *Œdicnemidæ*, *Dromadidæ*, and *Glareolidæ*, which comprise our aberrant Plovers, we have in Ceylon six species. They are all birds which love sandy tracts near the sea or in river beds. Four of them—*Œdicnemus scolopax* (the Stone Plover), *Æsacus recurvirostris* (the Great Stone Plover), and the two Swallow Plovers, *Glareola lactea* and *G. Orientalis*—are found both in the north and the south-east. *Dromas ardeola*—the Crab Plover—and *Cursorius coromandelicus*—the Indian Courser—are only found in the north. It may be noted that *C. coromandelicus* is rare on the Malabar coast. Our true Plovers, as a rule, are found over a large part of India. The remainder of the Waders call for little comment.

The same may be said of our Gulls, Terns, and Pelicans, and various sea birds.

Of the Storks and Herons, I may remark in passing a curious point about one species, *Gorsachius melanolophus*—the Malay Bittern. It is common in Malaya, but it is unknown west of the Bay of Bengal, except in Ceylon, where it is a rare migrant to the low-country, and in the hill forests of Malabar, where it appears to breed.

Nearly all our Ducks are migrants; the only common species resident in the Island are the Whistling Teal—*Dendrocygna javanica*—and the Quacky Duck—*Nettapus coromandelianus*—which are found nearly all over India.

Our list of birds is closed by the Dab-chick—*Podiceps albipennis*—which may also be met with all over India and Burma.

Now, what are the salient facts that appear as the result of the foregoing summary?

In the first place, it will be noted what a large proportion of our resident avifauna shows an affinity with that of Malabar. This affinity applies in special to the Kandyan Provinces and the wet zone of the low-country. Not only does the main element among the bird population of our hills closely correspond with that of the Indian Ghauts, but the birds of the damp low-country zone are as closely connected with those of the forests of the Malabar coast. A good many of the species and genera common to these two tracts are not met with in the Carnatic, and this peculiarity of distribution is most marked in the case of our short-flight birds.

On the other hand, in the extreme north and north-west of the Island the species are largely the same as in the Carnatic. These two regions possess several genera, and a larger number of species which are not found in the wetter parts of Ceylon or in the Malabar district.

Again, by far the larger number of peculiar species and genera belong to the Malabar type of fauna, and have their headquarters in the wet zone.

A few of our peculiar birds are of Himalayan or Malayan origin, but none of them are of the Carnatic type.

Lastly, our Himalayan species belong to the "Malabar" portion of Ceylon.

To sum up the situation in a few words, the Malabar affinity in the wet zone is shown by close correspondence of type; the Carnatic affinity in the dry zone by complete identity of species.

How are we to account for this dual distribution of birds?

I do not think it can easily be contended that the main Malabar element in the Kandyan districts invaded the Island across an intervening dry Carnatic zone. If this had been the case, there surely would have been more connecting links in the intervening region?

Nor, again, does it appear likely that the Malabar element in the Kandyan districts and the Carnatic element in the north of the Island developed side by side. In this case the separation of Ceylon from India would be a mere geological incident, without any serious zoo-geographical import. It would imply that Ceylon for some time had been a mere prolongation southwards of the Malabar and Carnatic tracts, and I do not think that this is a satisfactory explanation of the distribution of our birds.

If this supposition were correct, one would expect that the whole of Blanford's Northern Region of Ceylon—*i.e.*, the whole of the east of the Island from Jaffna to Tangalla—would have a more or less uniform Carnatic element; whereas, as a matter of fact, that element diminishes considerably as one travels southward. One would also expect that the species peculiar to the Island would be more equally distributed.

I venture to suggest as the most satisfactory solution of the problem the hypothesis that the distribution of our birds can be explained by assuming the Malabar and Himalayan elements to belong to an older period, when our fauna had an uninterrupted communication with the fauna of the Malabar coast, and when the Carnatic element, due to a later invasion, was as yet unrepresented.

This uninterrupted communication with the Malabar coast was afterwards broken, and almost all communication for birds of short flight between Ceylon and the mainland was cut off by a subsidence of the earth's surface, which would have submerged the north-west and south-east of our Island and a fairly wide strip of the opposite mainland. Quite a small

difference of level would let in the sea over a broad stretch of country on either side of Adam's Bridge.

Our birds of weak flight would then be isolated, and the isolation would give an impetus to the formation of local peculiar species.

A considerable period of depression would then have been followed by re-elevation and the connection of Ceylon with India by a possibly continuous land surface between the mainland, Rameswaram, and Mannar.

The argument for this elevation is supported by the evidence of recent marine deposits on the northern coast from Mannar round to Trincomalee, so it is by no means geologically unsound.

Ceylon being once more united to India, the more recent Carnatic invasion would find its way into our Island, and would naturally make its influence most felt at the point of entry.

Have we any evidence to date these successive movements ? Of course, it must be understood that I am arguing mainly, if not solely, from the distribution of our birds.

I think a possible clue may be found in the presence of the Himalayan element among our birds.

At the close of the tertiary ages we know that an arctic climate prevailed over the northern temperate regions to such an extent that the whole of the north of Europe and Asia was buried under a great sheet of ice, while beyond the limits of this northern ice sheet the Alps and Pyrenees were loaded with vast snow fields, from which enormous glaciers descended into the plains on either side.

Evidence of this glacial epoch is also found in the Himalayas. The great terminal moraines of the enormous glaciers of this period are found in Sikkim at an elevation of 7,000 feet, whereas at the present day no glacier in Sikkim descends below 14,000 feet.*

Thus, all over the Northern Hemisphere the temperature would have been considerably lower than at present, and during the coldest part of the great Ice Age a large portion of the Himalayan region must have been covered by snow and

* Blanford : " Phil. Trans.," *loc. cit.*, p 435.

ice. Many of the animals and birds would have been driven south to a warmer climate, and some of the temperate Himalayan types appear to have penetrated as far south as the hills of Southern India and Ceylon.

Our noticeable Himalayan birds number about a dozen, viz., *Cissa ornata* (the Ceylon Magpie), *Eulabes religiosa* and *E. ptilogenys* (the two Hill Mynahs), *Acmonorhyncus vincens* (Legge's Flower-pecker), *Cyanops flavifrons* (the Yellow-fronted Barbet), *Eurystomus orientalis* (the Broad-billed Roller), *Melittophagus swinhoii* (the Chestnut-headed Bee-eater), *Collocalia unicolor* (the Indian Edible-nest Swiftlet), *Batrachostomus moniliger* (the Frogmouth), *Loriculus indicus* (the Ceylon Parroquet), *Photodilus assimilis* (the Ceylon Bay Owl), *Huhua nepalensis* (the Forest Eagle Owl), and *Chalcophaps indica* (the Bronze-wing Pigeon).

It must be borne in mind that this " Himalayan dozen " represents the small band of survivors from a considerably larger immigration.

Now, over half of these surviving species are birds of weak powers of flight, to whom a wide arm of the sea would prove an exceedingly formidable barrier. It is quite possible, therefore, that when the onset of the glacial epoch drove the temperate Himalayan species southwards, Ceylon was connected with the Malabar coast, or not separated by any serious barrier.

What was the nature of this connection ?

The sea now lying between the Ceylonese " Malabar tract " and the Malabar coast is fairly wide and of a considerable depth. There is a shallow submerged plateau fringing the Ceylon coast off Colombo, and a similar plateau on the Indian side. But these plateaux are of no great width, and between them lies a deep sea basin. In fact, a few miles from each shore the water suddenly deepens from a few fathoms to 500 fathoms or more, and this depression reaches north to within a few miles of Adam's Bridge.

If we are to maintain that the connection during the glacial period was formed by a continuous land surface, say, from Colombo to Tuticorin, we must postulate that this sea floor was then over 3,000 feet higher than now ; and also to prevent

awkward complications on the "Carnatic" side of the Island, we must argue that the present connection *viâ* Adam's Bridge was then under the sea, or relatively more than 3,000 feet lower than at the present day.

Now, depressions and elevations of the earth's surface are not the result of sudden spasms, but are due to infinitely gradual processes of long duration, and although an earth movement of 3,000 feet is far surpassed by many on record, a change of such large vertical measurement would be spread over a wide area. Consequently, one cannot invoke at will a fairly sudden change of over 3,000 feet in level between Tuticorin and Colombo dying away to nothing along the axis of Adam's Bridge unless there is geological evidence to support it. In the present case there is no such evidence on record; in fact, the nature of the sea basin in the Gulf of Mannar is all against the assumption of such a large movement within such recent geological times.

If, however, the climatic conditions during the glacial epoch are considered, it is quite possible the connection required to bridge the gap may have lain along the present shallow belt of sea—which is nowhere more than seven fathoms deep—extending from Adam's Bridge for at least fifty miles to the north.

The present arid condition of our "northern maritime belt" and the opposite Indian coast is no doubt intensified by the sterile nature of the soil: a wide stretch of sand recently covered by a shallow sea, and incapable of supporting a growth of heavy forest. Before its temporary submersion this tract may well have been country much like the central forest portion of the North-Central Province. We must also remember that during glacial times our climate, besides being colder, was probably also damper, as the Himalayan snow fields were so much more extensive.

It is not so hard then to suppose that, given a lower temperature when evaporation would be diminished, and probably also given at the same time a heavier rainfall, there would be a continuous stretch of forest damp enough to allow free intercourse for a Malabar type of fauna between the Malabar coast and the south-west of Ceylon.

To account for the numerous peculiar species in Ceylon, we must now suppose a break in this intercourse lasting for some little time. It must, therefore, have begun soon after the close of the glacial epoch, and quite possibly its beginning was contemporaneous with the close of that period.

As the climate grew warmer, the Himalayan birds would retreat northwards again, or make for the higher elevations and the dampest forests.

When this northerly retreat began some of the species might have found themselves cut off, not only by a belt of low-country forest in which tropical conditions were again beginning to prevail, but also by the separation of Ceylon from the mainland. This would account for the presence among our birds of such isolated short-flight species as *Cyanops flavifrons* (the Yellow-fronted Barbet), *Cissa ornata* (the Ceylon Magpie), and *Acmonorhynchus vincens* (Legge's Flower-pecker), whereas these genera do not occur in the Malabar tract. Either their retreat was not cut off from the Malabar hills, or they have since died out there in the struggle for existence.

We then come to a period fairly long in time, though short geologically speaking, in which Ceylon was an island of curtailed dimensions. The low-lying "arid maritime belts" of the north-west and south-east would be under water. The rest of the Island would be populated with an indigenous fauna of the Malabar type. The climatic conditions would be much the same as those of the present day. Migrants and other birds which could cross the intervening sea would come to our shores, or be carried by the monsoons against their will, and if the conditions were to their liking would settle down here.

Within a measurable distance of historic times re-elevation set in, and continuous communication was again established with India across Adam's Bridge. The dry-country "Carnatic" type of birds, which heretofore had been wanting in Ceylon, would find in the newly elevated sandy tracts localities in which they could flourish, and, of course, the invasion would be accompanied by a good many birds common to Malabar and the Carnatic. This invasion would account for the fact that in so many of our families and genera you will find a

species peculiar to the south-western region side by side with a later-comer, distributed all over Ceylon, Malabar, and the Carnatic. The *Crateropodidæ*, or Babblers, afford an instance of this, and the two strata among our birds are exceedingly well shown by our Woodpeckers.

Chrysocolaptes stricklandi—Layard's Woodpecker—and *Brachypternus erythronotus*—the Red-backed Woodpecker—belong to the older contingent; *C. festivus*—the Black-backed Woodpecker—and *B. aurantius*—the Golden-backed Woodpecker—to the later invasion. *Liopicus mahrattensis*—the Yellow-fronted Pied Woodpecker—is a Carnatic invader, belonging to a genus unrepresented in the Island before.

The invasion, like all other invasions, shows a record of varying success. Some species have succeeded in overrunning the whole Island, others have only obtained a footing close to the point of entry. Similarly, with regard to the older inhabitants, some may have already retreated to the damper and cooler portions of Ceylon before the newcomers came over, others may have been driven to their strongholds by the invaders, and others again, like our Jungle Cock—*Gallus lafeyetti*—and *Acridotheres melanosternus*—the Ceylon Mynah—have maintained their position all over the Island.

The recency of the invasion can be argued from the absence of any peculiar species among our Carnatic birds, and still more from the fact that so many of them have not succeeded in penetrating to the south-east of the Island, where the conditions are suitable. One would expect to find in the dry Hambantota District such species as *Coracias indica*—the Indian Roller, *Turtur risorius*—the Indian Ring Dove, and more especially *Cursorius coromandelicus*—the Indian Courser—and *Francolinus pondicerianus*—the Gray Partridge. These and other omissions are all the more noticeable, as the type of fauna found in this south-eastern maritime belt is essentially the same as that of the similar belt in Mannar, and contains a very small proportion of the Malabar type of fauna.

Before leaving the question of earth movements, it may be remarked that geological indications point to the conclusion that the last movement of elevation, which united Ceylon to the Indian Continent, has ceased, and that there is now a

slow process of subsidence, which, if continued, will result in another period of zoological isolation. It may well be that Adam's Bridge was dry land until the dawn of historical times, and that the traditions of encroachments by the sea off Mannar and Colombo are founded on fact.

Such are the recent geological changes which I have assumed in order to account for the distribution of our birds.

But hypotheses which will suit admirably the distribution of one class of animals may not square at all with that of other orders. Further, as I said at the beginning of my Paper, birds are not nearly so sure a guide as mammals, while the differences between species are rather small distinctions upon which to form conclusions. As a counterbalance to these defects, the evidence regarding our Ceylon birds is fairly cumulative, and points persistently in one direction.

The earth movements which I have assumed need not exceed a vertical measurement of 50 feet in either direction from the present level, and the change in climatic conditions during the glacial period is by no means wildly improbable. So I have hopes that my assumptions may not prove to be wholly empty theories. Indeed, they are more or less confirmed by conclusions independently formed by Mr. Wayland, Assistant Mineral Surveyor, who has been investigating the river gravels in the valleys of the Kelani and Kalu-ganga. A few months ago, while the materials for my Paper were only half collected, and while my ideas were still rather nebulous, I sent him a short statement of the subsidence and re-elevation which I supposed might have taken place, and asked whether he knew of any geological evidence to support or disprove their existence. I received from him the following answer, of which he has permitted me to make use :—

> As far as I am aware, very little has been done with regard to the recent earth movements in the South of India and Ceylon.....
>
> Your letter came as a curiously unexpected confirmation of my own views with regard to the recent earth movements in this country. I have been paying some attention to the high level gravels of the Kelani Valley and of the Ratnapura District, and in order to explain the distribution, &c., of the gravels, I invoked a fairly large subsidence (something over 50 feet), which, according to my interpretation, probably increased in a N.N.W. direction.

Then came upheaval (possibly in two stages), which resulted in the land standing at a higher level, in relation to the sea, than it does to-day. Then subsidence again set in.

I have not sufficient evidence to enable me to state with certainty that this is the true explanation of the facts. It is the attitude which I feel justified in adopting at present.

It is only fair to state, however, that the Principal Mineral Surveyor does not agree with me in attributing the high level gravels to subsidence of the land. He believes that they have been left high and dry by the river, which has cut its way deeper since the days when the gravels were deposited.

Personally I believe that these movements have taken place within human times, as I have recently discovered what I maintain to be (and in this Mr. Hartley corroborates my view) artefacts of stone in some of the highest gravels.

I believe that Mr. Wayland intends to follow up the subject, and will in due course give us his conclusions formed on a more complete investigation. On the zoo-geographical side, the recent collection of mammals made in the Island by Major Mayor, on behalf of the Bombay Natural History Society, should afford most magnificent material for examination, especially as it will link up with similar work throughout India. Unfortunately Major Mayor has left the Island before visiting the Northern and North-Western Provinces, the very districts most vital to my theory. It is to be hoped that he will return and complete the work which has thus been left unfinished.

If the distribution of mammals agrees with that of the birds, I would suggest the following modification of Blanford's zoo-geographical tracts.

Instead of his Southern Hill tract and Northern Ceylon tract, I would divide the Island into—

(1) A division which would comprise the main hill region and the wet low-country zone lying between it and the western coast. The north-western boundary would cut the coast between Chilaw and Puttalam, and the south-eastern boundary between Matara and Tangalla.

This division, which might be called the Kandyan tract, would represent the stronghold of the Malabar element, and would correspond, more or less, with Blanford's Southern Hill tract.

(2) A division which would include Legge's Indo-Ceylonese district, *i.e.*, the arid maritime belts of the north-west, north,

and south-east, with, perhaps, the sea-borde of the Eastern Province as a connecting link. This might be called the Jaffnese tract, and would represent the districts in which the Carnatic invaders had made good their footing.

(3) The last division would comprise the drier forest region with a rainfall of from 50 to 75 inches. This is the country through which the Malabar and Carnatic contingents overlap, and might be called the Intermediate tract.

I would not distribute this tract between the other two, but keep it separate, owing to its relatively large area, and the fact that, on the whole, the character of its avifauna is fairly constant throughout, lacking many of the damp-loving "Malabar species" on the one hand, and of the dry-country "Carnatic species" on the other.

Until, however, the evidence both geological and zoogeographical is more complete, these divisions and reconstructions of the part must be, more or less, a matter of conjecture. The collection and examination of that evidence is a task in which members of our Society can render useful help, whatever branch of Natural History may be their hobby.

Perhaps some day Government will expand the present Mineralogical Survey into a full-blown Geological Survey, and thus provide officers, part of whose work will be to make a full scientific investigation and to give an authoritative pronouncement. Meanwhile I have started an interesting hare, and I hope that others will pursue it.

"THE INTERPRETATION OF NATURE"
AND
"THE NATURE OF INTERPRETATION."*

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A.—THE INTERPRETATION OF NATURE.

THE term "naturalist" is, in the popular acceptation, a very wide one; it includes all folk from the narrowest specialist with but one idea (his own) to the over-enthusiastic amateur with too many ideas for complete digestion (generally not his own); it includes investigators who think seriously about their work, and wonder-seekers whose sole quest of Nature is novelty. It includes those who hug detail and those who despise it, systematists who collect things for classification and collectors who gather specimens as a schoolboy gathers postage stamps. In fine, all sorts and conditions of people who think or read about Nature at all.

As the branches of natural knowledge constitute, more or less, separate departments of science, the various followers of Nature are best named from the department in which they work, *i.e.*, as mycologists, brachyopodists, &c., so that the name "naturalist" is more appropriately reserved for those fortunate people who are able to take a broad, intelligent, and comprehensive interest in the general problems of natural science. It is in that sense that the name is employed in this paper.

One of the facts which strongly impresses itself on the minds of those who study living Nature is that specialization carried beyond certain limits is a bad thing for the individual; good, as it may be, for the community.

* A lecture delivered to the Ceylon Natural History Society.

Specialization, however, is as cardinal a factor in natural history as it is in Nature, and in these days of rapid progress the professed scientific investigator is forced to confine the best of his attention within comparatively narrow limits. Thus, as the growth of knowledge accelerates, the specialists are driven into ever-narrowing fields of research. The result of this minute investigation is a most voluminous and highly technical literature, which functions as a barrier between what have been called "The man of science" and "The man in the street."

As a matter of fact, "men of science" taken as a whole do not constitute a special breed of humanity intended for the guidance of the rest, and at least as many good potential naturalists (not to speak of private investigators) are to be found outside the professional ranks as active scientists within them. Commonly enough the amateur has better right to the title of "naturalist" than the professional man.

Specialization tends to put the universe out of focus for the conscientious specialist, for he is generally so absorbed in his investigations that he has no time to thoughtfully consider in what relation his work stands to the work of all other naturalists. Indeed, that is a special line of investigation itself. As one's judgment of the whole is warped in proportion as one's knowledge of the whole is disproportionate, specialists view the facts of the world by the light of their special knowledge, and not their special knowledge by the light of the facts of the world. We all do this, of course, but, inasmuch as human life and intellect is limited, it must follow that the more special your knowledge, the greater its disproportion, and that, other things equal, one's right to the title of naturalist diminishes in proportion as one's knowledge of some branch of natural science increases. Specialization is an admirable thing, but its dangers should be recognized, and here it may be remarked that the vast accumulation of facts which has resulted from the patient labours of those engaged in special research opens a great field for general investigation, for philosophy, in fact, not for vaguely speculative and groundless guesses, which have so often masqueraded as the essence of wisdom, but for a philosophy based on a solid foundation of

facts, built up with the greatest care and the soundest of judgment by the adoption of those reliable methods of interrogation which form the foundations of science. This field of philosophy, then, is the domain of the true naturalist—perhaps one might almost say the super-naturalist.

It will not be easy to define Nature to everybody's satisfaction if we admit into the definition, as some may be inclined to do, some theory of the ultimate constitution of things. But we all know what we mean by "Nature," and for our present purposes we will say that "Nature" is the external world unaltered by man; that a natural thing is an apparent entity in this external world, while a naturalist is a person who endeavours to understand the relation of natural things to each other.

It is both customary and complimentary to assume that the object of the Nature student in familiarizing himself with the phenomena of natural things is the discovery of truth, and pertaining to some particular group of natural things in which he happens to be interested. Further, the belief that truth immutable underlies Nature is universal, and it is commonly supposed that this is the truth towards which the results of science tend with ever-increasing precision to approach.

It is not my intention to discuss the nature of ultimate truth at all, nor, indeed, in the first part of my Paper to show what the truths of natural history really are, for this cannot be profitably undertaken till we clearly understand what they are not.

The ultimate question which a naturalist asks of anything is, "How does it come to exist?" And this is the question which I propose we put to the truths of natural history. How do they come to exist? In other words, how do we interpret Nature?

There is no question, of course, that the object of science (and all science is natural history) should be to discover the most complete and adequate conception of the relation of different facts to each other, or, to use the less accurate and more popular phraseology, "the cause of things." All science has this object in view, and the philosophy which has

any other object than this, though it may be Nature-study, is not science. It is not enough that this object should be professed, it should be a very real and thorough principle with the observer, whose aim should always be to read his theories *out of* and not *into* Nature.

Such an inquirer will of necessity adopt the only method open to him, and it is the method rather than the object which has earned the name of science.

There are three stages in the process of elucidating phenomena : (i.) the collecting of facts ; (ii.) the correlation of facts ; and (iii.) the formation of theories to account for the facts. The first two are inseparable, and may be lumped together under the head of *Description*, while the third may be called *Interpretation*.

In practice description and interpretation go hand in hand, and while this association is advantageous and desirable for the progress of research, it is also a constant source of danger to that very progress which it serves to stimulate. Fortunately, in these days description is a recognized part of the routine of a pioneer's work ; it is the first step in his investigation. A few centuries ago, however, its contribution to the interpretation of things was, by comparison, trifling, as a study of the cosmologies, or of the beliefs of the middle ages, will serve to show. More than one right-minded student, who in the good old days dared to relegate observation to its rightful place, paid for his boldness with considerable discomfiture, and in some cases with his life. We recognize this as deplorable indeed, yet still we are not quite so apt in separating description and interpretation as we should be.

Description in earlier days was less indulged in than it is at present, because natural knowledge was the monopoly of a few educated people, whose authority, as naturalists, was considered infallible.

Amusing illustrations of the situation were abundant, as when in the middle ages the question of the number of teeth in the horse was debated with great heat in many contentious writings. Apparently none of the contestants thought of the simple expedient of counting them, but tried to sustain their position by reference to authority.

Again, one who noticed spots on the sun became convinced of the error of his eyes, because Aristotle had somewhere written "the face of the sun is immaculate."

This childlike faith in authority not only excused people from personal experiment, but led to the curious idea that practical investigation was unworthy of the philosopher, and even up to the first half of the nineteenth century a knowledge of such things as physiology and anatomy was regarded as the private property of medical men. It was thought a little coarse for any but a doctor to know a few simple facts about the circulation of the blood, and such like.

The cosmologists despised description; we are wont to confuse it with interpretation. We are still cosmologists at heart, but with the difference that if the older naturalists might be said to solve the universe from the depths of the armchairs in the parlour, we, on the other hand, may be often accused of taking our armchairs into the field.

To-day, of course, there are several departments of natural history which deal almost exclusively with description, as, for instance, pure geography and petrography, and the systematic sides of botany, zoology, and paleontology. Philosophy, on the other hand, concerns itself entirely with interpretation, but scientific, or, as we say, "natural philosophy," works from a basis of observed facts.

The intelligent worker in the field of natural history combines description and interpretation, thereby proving himself a natural philosopher, and if when stepping beyond the realm of description he is entering dangerous territory where guides are few and mistakes are easy, he may console himself with the knowledge that many mistakes are avoidable if only one will tread warily and look before leaping; and that if he stands to take the wrong path, he also stands to get somewhere interesting in the end. It has been wisely said that if you confine yourself to description you cannot go far wrong, but, then, you cannot go far.

The error one invariably makes when entering the field of natural philosophy is the one already alluded to, of confusing description with interpretation. One is generally led into this mistake by the influence of some theory at the back of

one's mind, which unconsciously causes one to describe things in its own terms. There is, for instance, a general tendency among naturalists to make every peculiarity of living things fall in line with the theory of natural selection, and when such and such an animal or plant is found to possess such and such a puzzling feature, then we immediately invent a use for the said puzzling feature, and declare that its use is the cause of its existence. When we cannot invent a use, we assume that it once had one, and call it rudimentary, or that its full function is yet to be, and say the feature is elementary. Failing these, we say we have not discovered its use, but we firmly believe that sooner or later we shall find a use for it. In adopting this position we fail to realize the unwarrantable nature of the assumption we make in doing so, *i.e.*, that everything that survives in Nature has some selective value. Again, if any organ can be shown to have a use, we never fail to assume that that organ has played a very significant part in the evolution of its possessor, and this on account of a preconceived idea of what evolution means.

Theory, you will observe, is guiding description. The temptation to read one's pet ideas into Nature has always been a great failing with the naturalist, and is probably no less common to-day than it was centuries ago. It is this process of "reading in" which has been dignified by the name of reasoning from analogy—a title which it unquestionably deserves, for, whereas the common sense interpretation of Nature depends upon the *likeness of things*, the scientific conception is founded on differences. For example, the sameness of the signs of life as exhibited in both the plant and animal kingdoms has lead to the idea that any general principle in the one will be found to have its equivalent in the other. Consequently, it was thought that the phenomenon of circulation as seen in the arterial and venal systems of animals was to be paralleled by the passage of the sap in the xylem and phloem tissues of plants, and when Mr. Ruskin (after turning up all the indexes of the best botanical authorities of his day) found occasion to grumble at those gentlemen because he could find no reference to the "circulation of the sap," he had to be told that the botanists had discovered their mistake.

The confusion of theory and fact is a fault too commonly seen, especially, one regrets to say, among those whose business it is to teach the principles of science.

For example. Everybody knows that many plants, when kept from the influence of light, turn pale, and by lengthening their internodes grow long. It is commonly taught that this is the plant's adaptation for finding light. That the plant is devoting its energies to the production of extra long shoots, because by doing so it stands a better chance of thrusting some part of its person out of the darkness than if it grew normally. More than once I have heard it said, by people who ought to know better, that this groping for daylight is a fact. But is it? *Of course not.*

Many plants become etiolated (lose their green colour) and lengthen out their members when the stimulus of light is withheld. *This* is the fact. It is obvious that by this abnormal growth their chances of reaching daylight are enhanced. This is also a fact. But the statement that *they enhance their chances* or any parallel statement is not a fact, and is probably (but not necessarily) untrue.

The point is that because the chances of good fortune are increased by the plant's behaviour, it has been inferred that the behaviour is a direct response to the existence of those chances, which inference is a *theory* accounting for the plant's behaviour, and must not be confused with the fact of behaviour itself.

Again, the study of cytological phenomena led to the prediction by Rabl of a remarkable form of conjugation of centrosomes. Fol, in 1891, a year after Rabl's prediction, actually described such a conjugation in the growing cells of sea urchins under the picturesque name of "The quadrille of centres." Later in the same year Guiguard discovered the same phenomenon in a member of the plant world (in a lily in fact). Between 1891 and 1895 various workers adduced additional examples from a snail, a trout, and a lancelet. It is now known that no such phenomenon exists.

Many examples like the foregoing will occur to you, in which one clearly sees the influence of the preconceived idea.

The tendency is to observe what theory predicts. Most of us have a theoretical axe or two to grind, and the difficulty

arises, not in the finding of facts which controvert our theory, but in the perception of them. Once convince yourself of the truth of any hypothesis and you receive a mental bias, by means of which, albeit unconsciously, you correlate your observations with the inevitable result that they are made to fall in line with your preconceived ideas. You are led to confuse theory with observation, and fact with inference.

A notable example of this curious visual distortion is to be seen in the predelineation (or *evolutio*) theory. This theory maintained that the development of animal life was much the same as the unfolding of a bud. The immature animal was considered to exist *in toto* within the reproductive cell, which merely required a certain stimulus to start its growth. This theory was a product of the seventeenth century, and is associated with the great names of Swammerdam, Malpighi, and Leeuwenhoek.

Malpighi observed evidence of organization in an unincubated egg in 1672 (during an Italian summer, be it noted). Swammerdam had made observations of insects in a chrysalis stage and of caterpillars about to enter the pupa condition, in which he discerned the outlines of the organs of a future state. Leeuwenhoek made the discovery (often wrongly attributed to Hartsoeker) about 1676 of fertilizing filaments in eggs. This led to a controversy as to whether the embryo pre-existed in the egg or in the sperm. The egg was regarded by some as a nidus, within which the sperm developed; others declared the ovum to carry the embryo, and regarded the sperm as a stimulant for growth. Thus arose the rival schools of animalculists and ovulists. The debate over the details of the preformation theory gave way to the wildest speculations, and some ingenious persons computed the number of eggs, which must have been encased one within the other (like a Japanese juggler's boxes), within the ovary of Mother Eve. The astonishing answer to this remarkable problem in biometrics was two hundred millions. Meanwhile Hartsoeker, who was a confirmed animalculist, gave the world a drawing of a spermatozoon, in which a little man was to be seen crouching with his knees tucked up under his chin, and Hartsoeker seems actually to have believed that he had seen the little man.

A friend of mine was undertaking some research on a group of sponges some years ago. During this work he found it necessary to dissolve the spicules in an acid, which at the same time stained the thin film of animal matter coating them. As the little calcareous rods finally disappeared in solution, a black streak made its appearance on the microscope slide. My friend deduced from this an axial canal lined with animal matter—a common enough thing in the sponge world. It was by little more than chance that he eventually arrived at the true explanation, *i.e.*, that the outer film of animal matter was elastic, and the black line left by the spicule when it passed away was the contracted film. The spicule had, in fact, no axial canal at all.

Columbus had no ideas of a new continent when he sailed westwards, and although he visited the West Indies on four occasions, he died in the belief that he had discovered the eastern coast of Asia.

The preconceived idea about evolution often blinds the observer to another quite as logical interpretation of the facts. To quote an example. You will recall how Lamarck and his followers explained the lengthy neck of the giraffe on the supposition—since substantiated by evidence—that the early giraffes were short-necked, like other creatures, but circumstances necessitated their stretching for food, and the constant straining of the neck resulted in the permanent lengthening of that member, which, as it chanced to be hereditary, was handed down and added to by succeeding generations.

The followers of Darwin, of course, believed this interpretation to be wrong, in so far as the starting of the variation in length of neck from that of the normal was assumed by Lamarck to be due to the mere process of stretching. The Darwinians, as we all know, believed that the variation arose somehow in the germ cells, from which the longer necked giraffes originally sprang. But both the later Lamarckians and Darwinians seem to have believed that the long neck of the giraffe was a necessary condition of the creature's existence. That if the necks had not been lengthened, the whole race of giraffes would have become extinct by reason of starvation.

Surely in this we see the influence of the preconceived idea. Evolution was a new principle to science, and every one was imbued with it one way or another. Here was an extraordinary phenomenon in necks which called for explanation, and the two alternatives were suggested as we have already seen. Now, whether the original variation was due to the acquirement of changes set up in the animals, or to some spontaneous adventure of the germ cells, we need not discuss here. Our point is that both parties agreed that the giraffe's long neck had a selective value of paramount importance to its possessor, a belief which is strongly maintained to-day.

Subsequent discovery may show this theory to be right, but that is quite beside the point, for, meanwhile, who will dare to say that the giraffe's long neck is not an hereditary variation of no particular selective value at all? For, let us remember, the very exceptional nature of this organ should warn us that we may be dealing with something which does not rightly fall in line with our general interpretation of things. Again, consider the consequences of the accepted theory. Inasmuch as the necessity has been correlated with the want of vegetation on lower branches, it must follow that the once leafy district, rendered leafless by the overcrowded population (or some other condition), which caused the gradual destruction of the lower plants, must have witnessed the extinction of all the larger members of the mammalian fauna save the wily giraffe. We may, if we like, invent a story about the migration of other forms of life to other parts on the encroachment of desert conditions, but then we have to explain why the short-necked giraffes did not migrate as well, and we must invent some cause, more potent for effect than starvation itself, to satisfy us that the giraffes really did stay behind, and when we have done this, what have we achieved? Nothing but pure invention. Interesting, I grant you, and justifiable enough as a speculation, and as such it should take its rightful place in our scheme of the interpretation of things. It is quite unjustified as a final conclusion. Is it not possible that the length of neck of giraffe is a germinal variation of no particular selective value, which may have become of value to its possessor at a more defined period of its development?

What I mean is that, having grown a long neck in the forests, the giraffe would then be able to wander off and to feed in places barren of undergrowth, and, indeed, might take unrivalled possession of the district. So, too, is it not possible that our xerophytic plants which grow in dry (or very boggy) places do so, not by reason of a vigorous eradication of the thirsty ones, with the consequent survival of those whose wants were small, but because requiring less they were able to migrate to situations where competition was not so rife ?

In a word, does environment always select individuals, and do not individuals sometimes select their environment ? Does every persistent variation necessarily have a selected value, or, indeed, a use ? Is there a reason why any hereditary variation (saving a detrimental one) should not persist ? Once we admit the probability of such persistence, we must greatly modify our conception of the genesis of species, as, no doubt, many have already done.

But this preconception, of which we are all guilty, warps our observation in another way. It often blinds us to exceptions, and the progress of science depends nowadays, not so much on the propounding of great laws, as on the discovery of exceptions to the rule. One tends, in the light of some absorbing theory, to pass exceptions by, or to put off their discussion till they can be made to fall in line with our pet ideas. Indeed, we are often so bent on the discovery of facts, which substantiate our views, that the small exceptions pass unobserved by us, and need to be repeated many times before their significance can be realized. In this connection let me pass on to you Professor Bateson's words of counsel : " Treasure your exceptions ; when there are none the work gets so dull that no one cares to carry it further ; keep them always uncovered and in sight. Exceptions are like the rough brickwork of a growing building, which tells that there is more to come, and shows where the next construction is to be."

You have only to look back on the history of any branch of science to see how valuable exceptions have been, and if you think of it, perhaps, you will agree that the rule which has most exceptions is, on the whole, likely to be the truest, and nearly always has references to the most facts. The fewer the facts

the easier it is to make a rule about them, or, to use an analogy invented by the late Professor W. K. Clifford, it is simpler to put a room in order when it contains little furniture than when it contains much furniture. Or, again, if you have only ten books you may classify them without trouble, but to adequately arrange a library of 10,000 books is a very different matter. We should, therefore, not be content to accept the perfect all-explaining theory without a thorough investigation of the facts to which it pertains ; in other words, be wary of the obvious. Nothing could be more obvious than that the sun goes round the earth, but for all that it does not.

There is still another pitfall in the path of natural history, and that is the want of precise definition of scientific terms. Thus, for example, the voluminous literature which has appeared dealing with the inheritance of acquired characters is to a large extent the result of the elasticity of the single term "acquired."

Herbert Spenser's admirable phrase "functionally produced modifications" had been, it would seem, lost sight of.

Then, again, much confusion has existed among biologists whose interests were with questions of inheritance, owing to the inability to perceive the difference between a statement which applies to masses and a statement which applies to individuals, and also to the want of distinction between a statistical and a physiological law.

Progress has more than once been hindered by the want of investigation of the common sense interpretation of things. Thus, for a lengthy period every one was quite sure that bodies of different weight, if dropped, would fall at different rates. It stands to reason, of course, that if you drop a ball of iron and a wooden door handle at the same moment from a point of some elevation, the ball of iron will reach the bottom first ; and that is what everybody thought till Galileo took the trouble to drop a few articles from the top of the leaning tower of Pisa, thereby proving everybody to be wrong.

Perhaps I cannot do better in this connection than to quote that brilliant investigator, Mr. A. D. Darbishire. He says, in conclusion to an argument, " The difference between expectation based on this law (he is referring to a certain law

of hereditary) and the accurate knowledge of what actually takes place ..... is the same as the difference between common sense and science, and the same as the difference between that which stands to reason and that which rests on evidence."

The progressive attitude in natural science is that of scepticism, and most particularly should we guard against the misuse of the preconceived idea. As a stimulus to further work it is useful; as a line of tentative investigation it is invaluable; but as a guiding principle in inquiry it is to be heartily condemned.

Generally, I think, we are more interested in proving our theory right than in proving it wrong. Or, to state this differently, our real object in studying natural phenomena is often enough the pleasure of seeing how beautifully they fit in to our interpretation of them, rather than the knowledge of how our interpretation fits the facts.

Having made as good a theory as we can, we should endeavour to disprove it, for then, indeed, are we aiming at truth and not at romance.

B.—THE NATURE OF INTERPRETATION.

In the first part of my Paper I attempted to how that our methods of studying Nature are sometimes open to the objection that, inasmuch as we may confuse description with interpretation, we are liable to draw very wrong conclusions: that this is the result of the very human desire to prove our point of view. Ideally, theory should not be trusted till all the facts bearing upon it have been collected, and all the exceptions to the apparent rule appreciated. We should always be careful to see that we are not led into any looseness of statement or ambiguity where technical terms are concerned. We should always approach the problems of Nature with a perfectly open mind, being ready at any moment to throw over our most treasured theory in favour of another, or to adapt it as may be necessary when occasion requires.

In this part of my Paper we shall endeavour to understand what we are actually doing when we interpret Nature, and

to what extent our methods and results justify the common sense conclusion that we are gradually building up a true and lasting picture of the universe to which we belong.

We have seen that description is often in error and theory inadequate, and as even the great empirical laws of Nature constantly require revision as knowledge advances, we cannot, I think, escape from the conclusion that much of our interpretation is probably not right, and some of it certainly wrong; that none of it is final. We have not yet touched the absolute.

The question as to whether we ever can touch the absolute is, perhaps, a metaphysical rather than a merely scientific one, and we shall not deal with it at any length here; but it is a matter of importance for every student of Nature to inquire whether or no his work is tending towards this ideal end. The question arises, Does our work as naturalists help us to see deeper into Nature, or not?

If you think of it you will see that a complete description is an explanation, that when you have described everything there is to describe about an object or a phenomenon there is nothing more to be said about it. Interpretation, therefore, is theoretical description. Now, the completeness of our description of an object varies directly as what may be called our "closeness" to the object concerned. You cannot describe the texture of a rock from a distance of half a mile; indeed, a petrologist will seldom allow you to name a rock until you have peered into and through its component grains with a microscope. That description really does mean the coming into closer contact is to be seen in the fact that all descriptions hark back to the ultra-microscopic, about which, unfortunately, we can only reason and never see. If you attempt to explain the formation of worlds, you are driven back to the contemplation of chemical atoms and ultimately to electrons, or whatever is considered as the most primitive step in the series at the time. The explanation of inheritance turns upon the presence or absence of unit characters supposed to be stored up in the chromosomes in some unknown way. Even the investigations of psychological phenomena when carried out to their legitimate lengths send you back to the minutiæ of things, and so with all explanation. We describe till we

can see no more, and then, according to certain rules, we invent. It is because of the necessity of invention that the very useful little interrogative "Why" comes into being. Strictly speaking, there is no such question as *Why;* the only question to science is *How.* And I venture to think that were complete description a possibility to us, the question *Why* would appear as meaningless as it really is. True interpretation, then, is complete description, and the completeness of description is dependent on the closeness of contact. Now, the more we interpret Nature on the true lines, the deeper may we be said to see into phenomena. But to what extent can we interpret on the true lines? Consider that clock for one moment. You can describe its actions from where you sit with considerable ease; you may calculate that the bigger hand moves twelve times as fast as the smaller; further investigations may show you that this 12 : 1 ratio is only approximate, and that the clock is running slow, or fast, compared with another clock, as the case may be. Then you might theorize about the works of the clock, and attempt to decide why it is that one hand moves faster than the other, but if you really wanted to discover *how* it worked, you would wait till the librarian had gone out to lunch and take the clock to pieces; with luck you might succeed in reconstructing the clock before the librarian returned; in any case you would have handled the various wheels and springs, and would be able after your careful study to describe just how the clock works, and considered as a piece of mechanism you could describe it perfectly. Now, this is because the mechanism of the clock bears a certain definite relation to yourself in point of size, for the reason that it is of human manufacture. But do we ever see the mechanism of Nature? Surely there is but one answer to this question, and that is *No;* most decidedly *No.*

In the case of the library clock we need not bother with interpretation, for under favourable circumstances we can examine its works and describe its workings in detail. Not so with Nature. Nature has a special watcher for her clock, who never by any chance goes out to tiffin. He sits under the greater chronometer of the Universe, which was wound up at the beginning of time, and goes on merrily ticking off the

æons of eternity, and displaying on its wonderful dial all that ever was and is. But nobody can read all the strange figures and signs of the great chronometer face, and a great deal of study is required to understand any of them. If we would know whether Mars is inhabited, or to what extent the principle of relativity is applicable to gravitation, or anything else about the Universe, we are answered by the rooted watcher in those ominous words of Winifred Pryce, "Just look at the clock."

All that we can see, and hear, and feel constitute the great dial of Nature. The limit of human sensation is the ever-present watcher, who prevents us from meddling with the works. Improved instruments enable us to observe the dial with greater ease than was formerly the case, and have, indeed, revealed hordes of previously unsuspected hieroglyphs upon it. We are getting to know and read the clock more accurately as days go on, and we are better able as time proceeds to formulate theories about the works. But, of course, formulating theories about works is one thing, seeing and handling works is quite another.

I would like at this point to call your attention to a diagram invented by Mr. Darbishire to illustrate this position :—

I E P

Let E P represent the distance between the eye and the phenomenon, when the latter is just so far away that it can be merely perceived and nothing more, as 10 units of linear measurement ; and E I between the eye and that part of the brain which imagines (whatever it may be) 2 units. The interpretation of the clock (the real one in the library) consists in decreasing the line E P by dividing it by 1,000, say. But what about the interpretation of a natural phenomenon ? Does it consist in the decrease of the length E P ? No ; it consists in increasing it by the length of the line E I. So that whilst we think that the more we interpret a phenomenon the more we are getting at close quarters with it, as a matter of fact, the inverse relation is what really obtains. If we admit that interpretation consists in going beyond the limits of our vision, we have to admit that what we do on the other side of

that limit is not seeing, but imagining. And really it is tacitly conceded that this is so. For when a particularly ingenious theory which, we think, enables us to come into close quarters with a phenomenon is brought forward, our praise is not for the marvellousness of the mechanism discovered, but for the ingenuity of the brain which conceived it. We praise Mendel, not for the mechanism of segregation; how could we? We have never seen it. We say, "What intellect!" and not "What works!" Moreover, it is easily proved that this is so, for if interpretation really meant a making out of works, there should be greater unanimity in the sphere of interpretation than in that of description, because the closer we can look, the more easily can we see. Thus, I think, we must admit that there is all the difference in the world between discovery of the mechanism of a human invention and the propounding of a theory to account for a mechanism of Nature.

Inasmuch as our interpretation of Nature consists in increasing the length of the line E P by the length of the line E I, instead of *shortening* the line E P as in the case of our clock, it follows that there must always be a theoretical doubt concerning the correctness of our ultimate conclusions about Nature. So long as we stick to observation we are safe enough, but the moment we begin to explain things we find ourselves on treacherous ground, and the most we can say about any bit of Nature's mechanism is, "*This is how it might work, and possibly how it does.*"

It may be objected, of course, that although we never see into Nature because the mechanism of phenomena is invisible to us, yet we can deduce the mechanism from its effects with considerable accuracy, and the proof of our accuracy lies in the fact that the application of our deductions to untried circumstances has often proved satisfactory in every way. Thus, Adams and Leverrier independently predicted the existence of a new planet, and on pointing their telescopes to that particular part of the heavens where the planet was calculated to be, they were rewarded, as we all know, by the discovery of Neptune. Graham, reflecting on the consequences of the theory of the polarization of light waves, predicted the occurrence of certain optical effects within a crystal, and these

on investigation were found to exist. The observation of a certain dark line in the sun's spectrum led Sir Norman (then Mr.) Lockyer to predict the existence of a new element in the sun's atmosphere; many years later another investigator discovered that element (helium) on earth. These are among the classical examples of scientific deduction.

First, it must be recollected that a wrong theory is often capable of extended application, and predicted consequences of that theory may be found to coincide with experience. The theory of diminishing ancestral contributions is as old as the human race itself, and has worked so well that no one thought it necessary to call attention to the theory at all till the twentieth century. It is now held by competent authorities to be totally inadequate. Again, predictions were based on Newton's corpuscular theory of light, and the truth of the theory was held to be proved when these predictions were verified. Nowadays the corpuscular theory is only of historical interest.

There can be no kind of a question, of course, that the more we investigate and theorize about Nature the more utilitarian do our theories become, and the larger grows the field of fact which they are capable of explaining.

In a word, the truer do they become from our own standpoint. Thus, a theory is true in proportion as it is applicable. So that if we say that the electro-magnetic theory of light is the true interpretation of certain manifestations, all we can logically mean is that it is the most capable and comprehensive guess at the mechanism of those manifestations which has, up to the present, been put forward. Whether there is or is not anything behind visible Nature corresponding to our conception of ether waves is quite another question, and one to which we cannot possibly give an absolutely definite answer. We may think there is, or we may think there is not; or, again, we may express a philosophical doubt about it. At the best we can only guess at the mechanism of Nature: we can never look into Nature and see its works.

It might be difficult to prove that there is anything behind phenomena at all, but there is surely a very strong presumption that there is something there; indeed, in the absence of evidence

to the contrary, this presumption amounts almost to a certainty ; no one in practice doubts it for a moment. It does not fall within the limits of this Paper, or within the ability of the author, to discuss the supposed nature of things in the back of beyond. Seeing, however, that there is at present no logical escape from the conclusion that there is a " back of beyond " in which things happen, and that some at least of those happenings correspond in some sort of way with our interpretation of them, we are tempted to ask whether there are any grounds for supposing that all the happenings in the unknown find expression in the material world, and if not, can we conceive of any reason why they should not ?

To go back for a moment to the theory of light. Physicists interpret light as a certain kind of wave motion in a hypothetical ether, while physiologists tell us that light is sensation of which we are capable under certain conditions. Compounding these two statements together we arrive at the important conclusion that there is a something which transmits vibratory motion, that this motion excites the sensitive layer of the retina, and is transmitted by the optic nerve to the brain, whereon the sensation of light is experienced. Investigations go to show that only a very limited number of these vibrations are capable of exciting the retina, and that the differences of velocity, &c., which exist within those small limits, produce in the brain the different colour sensations known to us. But on the authority of evidence it is asserted that there are wave vibrations of too high and too low a velocity to give us the sensations of light, that the number of them is in all probability enormous, as compared with the very few vibrations which affect our eyes. A very similar case is made out for the sensation of sound, only here the wave vibrations are transmitted through matter, not through ether, and are of a somewhat different nature. Further, we are told, again upon evidence, that all our sensations reach us through the medium of the nerves, and that the cause of sensation is in all cases primarily wave motion of one kind or another, always very limited in its range. Thus, to speak rather inaccurately, but in a way which will be readily understood, it may be said that there are sounds we never hear, tastes we never experience,

touch sensations we never know, and sights we never see. And this because our susceptibility to wave vibrations are so excessively limited. Suppose now our susceptibility be suddenly increased ten-fold, the material world would be instantly and miraculously changed beyond all recognition : one cannot even guess what the new world would be like ; we have not the faintest idea ; all that we do know is that the universe would be grander and fuller in every sense of the words than it is even now, and our conceptions of Nature's mechanism would be absolutely changed. But there is no reason to suppose that the limit of the theoretically knowable is to be reached by multiplying all that is known by so low a number as 10 ; indeed, I think most of us feel that the theoretically knowable is out of all proportion to the known. The relation of a pimple to a mountain is probably a very inadequate comparison in this connection.

What, then, is the conclusion we must draw from the accepted facts of natural science ? Why, surely, this. Our universe exists by virtue of the limits of our senses. The world, as we know it, is the world of man created by man, not of his own desire, but in response to some other power than the human will. But it will be objected : you first set out to show that our scientific theories are at best guesses at the truth, and yet you do not hesitate to found a very vital conclusion upon them. My answer is that we have arrived at this conclusion from a perusal of the wave theory, and, so far as our ultimate conclusion is concerned, it does not matter one jot whether the wave theory is the true interpretation of phenomena or not. The point is that if we believe, as I think we are justified in believing, that there is something in the back of beyond which somehow corresponds to our interpretation of it, then we see that, whatever that something is, it is the starting point of our sensations ; and our want of receptibility to this same something defines a limit to our experience. We have arrived, then, at the assumption that there is some definite correspondence between the phenomena of Nature as observed by us, and the mechanism of Nature which is supposed to lie behind those phenomena. We shall be agreed, I think, that this assumption is not illogical or unjustified, and that working out the

consequences of this assumption in a logical manner we may arrive at a theory about the natural world which, if somewhat astonishing, is capable of abolishing many difficulties; for instance, in the light of it, we need not ask where is reality, what is truth? We need not be sceptical, as some of our contemporaries are, concerning the existence of other things than mind, and if we follow its consequences still further, we may find this theory still more adequate. But, as I said in the first part of my Paper, we should not accept the perfect all-explaining theory without a thorough investigation of the facts to which it pertains. These are the facts which we as members of the Ceylon Natural History Society are particularly interested. It has not been my object to construct from these a pretty conclusion for your amusement, but to suggest what appear to me reasonable lines of procedure, and to point out where these same lines may possibly lead you.

ON THE OCCURRENCE OF PIGMY IMPLEMENTS IN CEYLON.

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In a Paper read before the Ceylon Natural History Society in May, 1913, I gave a brief account of the stone implements of Ceylon, in which I reserved consideration of the so-called pigmy implements for a later occasion. The study of the Stone Age in this country is itself of recent date, and the identification of pigmies was not completed until the year 1912. Before that date however the Doctors Sarasin in their excellent work "Die Steinzeit auf Ceylon," published in 1908, had illustrated several stones for which they suggested tentatively a pigmy or (as named on the Continent) a Tardénoisian origin; and the late Mr. John Pole had in his collection some sixty specimens, now in the Colombo Museum, which he was unfortunately unable to identify.

My own acquaintance with pigmy implements was until recently almost non-existent; but having found a few stones in Ceylon which strongly reminded me of what I had seen in England, I sent a few in 1912 to the Rev. R. A. Gatty, who has collected very large numbers of them in Lincolnshire, and who, until his lamented death in March of this year, was one of the authorities on the subject. He replied that my specimens were undoubtedly pigmies, and prophesied that they would shortly be discovered in considerable quantities, a prediction which was abundantly verified the next year.

To begin with a short survey of the pigmy question in other lands, I may say that there is no division of the stone-age manufacture which presents so many problems still unsolved. It is only in comparatively recent years that attention has been directed to these minute and puzzling objects, which had previously escaped notice by reason of their insignificant

dimensions. In the course however of the last thirty years a number of spots have been discovered in widely separated lands where these implements occur, sometimes in very large numbers and in almost precisely similar forms and sizes. From a recent publication by the Lancashire and Cheshire Antiquarian Society I learn that pigmies have been discovered at ten places at least in the British Isles, at several in France and Belgium, in Southern Spain, in North and South Africa, and in two localities in India, namely, Banda District and the Vindhya Hills. I have also seen illustrations of them as occurring in Australia, and I have in my own collection about sixty specimens which were sent to me by a friend from Uganda. It is probable that, as the eyes of antiquaries grow more accustomed to these minute objects, they will be found all over the world, though possibly in stations widely separated from each other. As regards the localities where they occur, in Great Britain they are often discovered in sandy and desolate spots, but have also been found on high ground in Lancashire under ten feet of peat and on the sea-shore at Hastings in heaps of prehistoric refuse known as kitchen middens. In France and Belgium, besides being found on the surface, they have been brought to light in caves ; and by their position it has been proved that they belong to the end of the palæolithic or the beginning of the neolithic period.

It must not however be too hastily assumed that all pigmy implements are to be assigned to the same date. They probably represent a stage of progress which most or all races passed through ; and it is almost self-evident that the more backward nations were living under palæolithic conditions for long periods after the more intelligent had attained to the neolithic stage ; and I would remind you that even to-day the Australian savage breaks up beer bottles and telegraph insulators to manufacture his primitive spear heads.

Nor is it at all necessary to assume that pigmy implements imply a diminutive race. If ever we reach a complete understanding of the uses to which these singular instruments were put, we shall probably find that they were capable of employment by full-sized human beings. Lastly, it is unnecessary to

suppose that similarity of implements proves identity of race. Stone tools from all parts of the world offer a general similarity of types ; and it is likely that the invention of a new and serviceable implement would be communicated gradually to all accessible quarters of the world, or that the same type would be independently evolved to meet a similar need.

With regard to the types of the pigmy tools discovered in so many and distant parts of the world, it is remarkable how closely they resemble each other both in size and in form, whether the material be flint as in Europe, jasper and chalcedony as in India, obsidian as in Uganda, or quartz as in Ceylon. In all lands there are four main types of them :—

(1) The crescentic, which is curved and moon-shaped.
(2) The angular, which takes the form of an equilateral or scalene triangle.
(3) The pointed, which is generally long and slightly curved.
(4) The rhomboidal, or four-sided, which seems to be almost unknown in Ceylon, and which I believe to be a variation of the crescentic.

In addition, there are found other and universally known types, such as the round and hollow scraper, the blade, the chisel, and the arrowhead ; but these are almost invariably to be distinguished from the parallel neolithic series by their extreme smallness.

A very large number of guesses have been made at the uses to which the so-called geometric patterns may have been applied.

It has been suggested that they are arrowheads ; single barbs of spears, harpoons, and arrows ; fishhooks ; tattooing and surgical instruments ; teeth of multiple scrapers, carders, saws, or sickles ; scrapers ; borers ; blades, and even ornaments. I may confess at once that I for my part have not penetrated the mystery. I can see many uses to which some of them may have been put. I thought at one time that the crescentic or lunate type might have been used as an arrowhead mounted obliquely and presenting a single barb ; but I cannot solve the problem how they should be fixed in

the arrow shaft. I have numerous lunates which could not possibly be so mounted; and I have found a number of normal arrowheads, exceedingly small, mingled with the pigmy specimens below the surface. I think that several types, including the lunate, may have been used as hooks, not for fish only, but for birds. In Bandarawela, where the great bulk of my specimens were found, it is well known that fish are scarce and small. In England at the present day it is a common poacher's trick to take pheasants on a hook baited with beans; and I have seen a statement in Charles Kingsley's works that deer used once to be caught in the New Forest with an apple suspended on a hook. I believe that no certainty will be attained until either we find some backward race using similar tools, or until more or less complete sets are found in caves with their shafts or mountings intact. I do not despair of such a discovery being made in Ceylon, where there are innumerable caves awaiting exploration.

I proceed now to give an account of my own researches. At the beginning of 1913 I had accumulated about a dozen pigmies from various widely separated hill districts. In April of that year I rented a house on the top of the main ridge overlooking Bandarawela, which for want of a better name I have called Bungalow Hill. As all my Ceylon readers know, Bandarawela is a small inland town at an elevation of 4,000 feet, situated in a grassy, undulating country, entirely free from continuous jungle, with a soil composed of gneiss, quartz, and felspar, generally decomposed. Outcrops of hard rock are scarce, and it is certain from my investigations that the bulk of the material used for implements, whether of pigmy or neolithic type, consisted of brook pebbles, which were carried to the hilltops and there broken up. On examining the hill on which I lived, I found at once a large number of pigmy implements scattered on the surface; and in the course of a few weeks I visited every hilltop within a radius of several miles, finding plentiful neolithic remains on the surface and occasional pigmies. It was however only on four hills, all in the immediate neighbourhood of the town, that I discovered pigmies in profusion. On three of the four

pigmies of all types and sizes have been found ; on the fourth none but large and massive specimens, usually lunate. The material of all the specimens but three was quartz, generally white or clouded for the larger, transparent for the smaller. The three exceptions were of chert, one lunate, one angular, (apparently an arrowhead), one pointed. Having collected several hundred specimens from the surface, I procured a " mamoty " and a quarter-inch sieve and proceeded to dig. After a few trials I found that the hill which I have named Church Hill was incomparably the richest. It is a ridge some 300 yards long, rising steeply on all sides, branching into several minor spurs, and separated from Bungalow Hill by a deep and narrow valley. The Doctors Sarasin examined this spot, illustrated it with a photograph, and alluded to the great quantity of neolithic remains on its surface ; but they unluckily overlooked the numerous pigmy specimens which abounded on it when I first examined it. I have found pigmies on all parts of its topmost ridge, but the only portion which yielded good results to digging was a level saddle between the two highest points running roughly from south-west to north-east. It is certain that a considerable manufactory of pigmies existed here, although there is no material available near the spot ; and the whole remains were most fortunately covered with a capping of earth varying in thickness from an inch or two in the centre to six or eight inches a few yards away. Mr. E. J. Wayland, of the Mineralogical Survey, has kindly reported on this earth cap, and he informs me that without any doubt it is composed of the rocks decaying *in situ*, and has been deposited over the remains by the labours of worms, ants, and other insects. In the course of the months of April, 1913 and 1914, I excavated an area ninety-three feet long, with an average of about fifteen feet in width to a depth of six or eight inches, passed it all through the sieve and afterwards through my fingers. The work was extremely severe, but my gains were in proportion ; in 1913, with the invaluable assistance of two Tamil servants, I secured from all quarters 3,687 specimens ; in 1914, when the richest area had already been denuded, I had to be content with 1,081. These figures constitute easily a world's record in

quantity, and the implements, I believe, furnish another in quality; for I have in my collection stones of a beauty of workmanship and material such as I have never heard of elsewhere.

It was a disappointment to me that no remains were discoverable except the imperishable quartz and chert. I found no pottery, bone, horn, ivory, or wood, except innumerable fragments of charcoal from ancient camp fires. The last has however some significance, as proving that these ancient hunters, who were almost certainly the ancestors of our Veddas, were acquainted with fire; and in addition it seems to me to indicate that their remains are not of a very remote date, for otherwise the charcoal embedded in porous soil would have been absorbed and have left no trace behind. The freshness of the material and workmanship also points to a period which may be described as neolithic rather than palæolithic, in so far as these words have any meaning in Ceylon. The cap of earth overlying the remains was a stiff, reddish, sandy loam, retentive of moisture and free from stones; very occasionally it contained a chip of quartz or a fragment of charcoal. Beneath it extended the layer of chips, implements, and charcoal, rarely exceeding two inches in thickness and mixed with coarser grit and gravel which the insects and worms had failed to eject. The fragments of quartz are frequently spotted with a deposit of iron oxide, which can only be removed by scraping with a knife. Under the chips came undisturbed yellowish decayed gneiss of which the body of the hill is composed. The richest deposits of implements were always nearest the top, where I have recovered as many as eighty in a day, though the thickest layer of chips was generally a little way down the hill. Of the two slopes, the eastward was very much more prolific than the westward, and had a thicker coating of earth. The deposit was terminated on the ridge at the north-eastern end by an outcrop of gneiss, at the south-western by a gradual rise, where the layer became thinner and ran out in bands till it ended altogether.

I have dealt at some length with the Church Hill, because it was by far the richest ground examined; but the other

three elevations yielded their hundreds, where the Church Hill gave its thousands. The most important of these is the Bungalow Hill, a ridge of about half a mile in length, somewhat higher than Church Hill, which it overlooks at its western end, and embracing several rounded eminences and spurs. I found specimens both on and below the surface on all the crests and ridges, but in greatest number on a gently rounded elevation about a hundred yards south-east of the highest point. There is unluckily no earth cap at this spot, though the two highest crests are well covered.

The third hill, which I have named Dhoby Hillock, is an almost imperceptible knoll, overlooked by Church Hill, on the Ettampitiya path. It is not above fifty yards long, but has yielded a very large quantity of pigmies, all from the surface, as it has no earth cap.

The fourth and last, which I have named Ambalam Hill, lies on the eastern side of the path leading from the "ambalam," or travellers' shelter, on the Welimada road, and is parallel to the burial ground close to the western flank of Church Hill. It has no earth cap, but I recovered a number of pigmies from pockets of detritus along its eastern side. The specimens were not numerous, and were all large and solid.

I am quite unable to suggest reasons for these four hills being selected as manufactories in preference to any others in the neighbourhood. None of them contain material in any shape. All have access to water, but are at least two miles from, and at a considerable height above, a fishable stream. The first two are large, commanding, and defensible; the last two are insignificant in size and overlooked by higher elevations. The conditions of the four are so mutually contradictory, that I incline to believe that the occupants changed their ground according to seasonal or other vicissitudes.

As regards the remains discovered by me, I have divided them into eighteen types, of which I annex a table later giving the numbers of each found by me in 1914. In the case of the much more numerous finds of 1913, I regret that I omitted to keep a census. Before discussing the types in detail, I desire to call attention to the very important difference

which exists between the chipping of the pigmies and that of other implements. In the case of the latter, the object of chipping is to shape the tool and to give it a sharp edge or point ; in the case of the former the object is, after shaping the tool, to blunt the part so treated and to do away with its sharpness. With pigmies, in fact, the sharp edge or point is the part left untrimmed, and the chipping on the back is at right angles to the plane of the implement and so totally destructive of an edge. I have however noted in the table that ten per cent. of the total of pigmies from Bandarawela have had their cutting edges trimmed, sometimes to secure a symmetrical shape, sometimes apparently to obviate sharpness on both sides alike. This work occurs only in seven of the types, and is far the commonest in the case of curved and straight points. I have also noted that in six types there is no edge at all, what corresponds to the edge in similar tools being square and solid. Again, it will be observed that the proportion of square-edged implements is high in curved points. I regard this as significant, because the curved points are very suitable for use as hooks or throttles ; and it is obvious that a hook without a cutting edge is less likely to be torn out than a sharp one. I may mention incidentally that throttles of wood are used in Ceylon to the present day for catching crocodiles.

I divide my finds into the following types :—

(1) Crescentic or Lunate vary in length from one inch and a quarter to five-sixteenths of an inch, in breadth from half an inch to less than one-eighth, and in thickness from seven to little more than one-sixteenth. They present an infinity of sub-types, long and short, broad and narrow, thin and thick. They are carefully trimmed the whole way along the back.

(2) Semi-Lunate resemble the above in all particulars of length, breadth, and thickness, except that their butts are left untrimmed, possibly with a view to hafting. They very frequently contain the bulb of percussion.

(3) Irregular have general affinities with lunates, but show extraordinary diversities of outline. The sharp edges are often concave.

(4) Rhomboidal appear to be lunates with the curved back truncated. I possess only three: two from Bandarawela, one from Dolosbage.

(5) Angular are often equilateral, but are sometimes constituted by a straight sharp edge and two curves meeting at a point. The scalene form, which is so common in Europe, appears to be entirely wanting in Ceylon.

(6) D-shaped vary in length from seven-eighths to little more than a quarter of an inch. They are akin to semilunate, but are broad and squat and solid. They often contain the bulb.

(7) Beaked are of two types: the one for upward movements, the other for downward. In some cases the butt appears to have been trimmed for hafting.

(8) Curved Points, the most numerous of all types, vary in length from three-quarters to five-sixteenths of an inch. They are generally solid and are fashioned with exquisite skill. The butt is generally neglected.

(9) Straight Points seem to be a variety of the preceding.

(10) Drill Points (figures 890, 891, 892, 893, 900, 901, 1503); Professor Henry Balfour, of the Pitt Rivers Museum, Oxford, has suggested to me the identification of these implements. They are straight and roughly rectangular in section. None were brought to light in 1914. The first six were found in 1913, four below and two on the surface; the seventh was found on the surface at Hatton.

(11) Borers are generally triangular and thin. The work in which they were employed must have been very delicate. Almost every one which I possess would infallibly splinter if applied to wood or bone.

(12) Arrowheads are generally of irregular lozenge shape with truncated base. They vary in length between eleven-sixteenths and three-eighths of an inch. Their diminution in breadth towards the butt does not amount to notching, but was intended no doubt to facilitate their insertion in the shaft. No. 1,386 is so far unique in Ceylon, displaying one well-developed barb, but no stem.

(13) Blades are flakes of crystal blunted by characteristic chipping along the back and with untrimmed convex edge.

(14) Chisels differ only in size from neolithic patterns.

(15) Hollow Scrapers are scarce, and some show very small apertures.

(16) Round Scrapers are plentiful, as always. They are generally smaller than neolithic patterns, my minutest specimen measuring three-eighths by one-quarter of an inch. This year however I recovered one from below the surface measuring one inch and three-quarters by one inch and five-sixteenths. This is an unusually large scraper for Ceylon, even among neoliths.

(17) Rounded Pebbles of Quartz, used as hammer stones, are smaller than those usually found among neolithic remains, where they are exceptionally plentiful in many sizes.

(18) Rounded Pebbles of Gneiss are found not uncommonly in all sizes among neolithic remains on hilltops, where they could not possibly have been deposited by natural causes. They are often in an advanced stage of disintegration and rarely show signs of use. Besides the five recovered in Bandarawela this year, I have previously found three specimens in a cave many feet below the surface associated with neolithic remains. Two were large and showed no traces of use; the other was small and had lost both ends either by hammering or by attrition. I think that either they were used as rubbers, or that their softer material recommended them as hammers for delicate work. The five recovered this year were all small and two of them were lying side by side.

In completion of my statement I must make mention of the immense quantities of chert fragments which are associated with the pigmies, sometimes in the form of rude blocks, sometimes in delicate chips and splinters. The material is not known to exist *in situ*, but isolated boulders are found in many parts of the Island, and rounded pebbles of chert occur not uncommonly in streams. In view however of the extreme rarity of chert implements of all patterns, it is impossible at present to account for the abundance of this rock among remains both of pigmy and neolithic type. It is conceivable that it was used for striking sparks from iron pyrites, which is found in parts of Ceylon, though I have not met with it in stone-age stations. The modern Veddas are

acquainted with the mode of producing sparks from chert and steel, but their usual method of procuring fire is by means of the bow drill.

It will be observed that the list of implements discloses some remarkable omissions. Nothing resembling an axe has ever been found in Ceylon. There was besides no chopper or heavy blade, no spearhead, saw, punch, or fabricator, though the two last may have once existed in bone or horn. There were no sling stones or throwing disks, nor any sign of potboilers. It is probable that the earth cap has preserved for us the complete armoury of this ancient race in so far as it was composed of imperishable materials ; and it is surprising to find so total an absence of formidable weapons in a land which must have abounded with elephants, bears, leopards, and buffaloes, and in an age when these had probably little terror of man. It may be conjectured either that the insignificant pigmies are the *disjecta membra* of some weapon of power, or that their makers maintained an inglorious existence by preying upon the lesser creatures and trusting to flight from the formidable. The latter supposition receives some support from the researches of the Doctors Sarasin in the Nilgala cave, in which they found only the scantiest remains of buffalo, pig, and bear, nothing of elephant or leopard, very abundant snail shells, and a moderate quantity of deer and monkey. In my own excavation of a cave near Balangoda, besides innumerable snail shells, I could only identify bones of monkey and mouse deer. In neither cave were remains found of snakes, fishes, or birds, although the Veddas eat the two last, while they are said to reject the first. The same absence of large and aggressive weapons was noticeable in the caves so far explored. The few bone and horn implements recovered pointed to peaceful rather than destructive uses, and give no warrant for believing that an armoury of lethal weapons of perishable material has been absorbed in the soil of Bandarawela. The situation must therefore be faced that this race relied for their existence, in the midst of powerful and ferocious beasts, on a handful of pointed fragments of quartz, whose purpose is still an enigma to all inquirers. Fire was no doubt a great protection, and the poisons with

which Ceylon abounds may have contributed their share to human security; but the leopard, the bear, the wild boar, and the buffalo even at the present day demand short and sharp measures instantly and forcefully applied, nor can immunity be obtained by flight, concealment, or avoidance. The Vedda of to-day, in spite of occasional catastrophes, relies with good reason for his safety upon his powerful bow and steel axe. His predecessors could hardly have maintained themselves without a weapon for combats at close quarters in addition to the light arrows evidenced by the absurdly diminutive arrowheads discovered beneath the soil; and in my opinion circumstances demand the supposition of spears and perhaps weightier arrow shafts, of which some pigmy types may have formed the barbs.

In conclusion I will add a few remarks on the question whether pigmy and neolithic types were simultaneously used by the same race, a theory which was strongly combated by the late Mr. Gatty. In Ceylon, wherever I have found pigmy specimens on the surface, I have also found neoliths, though the converse by no means holds. On certain hills however near Nawalapitiya, where both types are found associated, I noted several specimens of pigmies, which by their worn and frosted appearance seemed to postulate a greater antiquity than the neoliths. I have not observed this contrast elsewhere, and as an isolated fact it may be accidental. I held till recently the opinion that the two types were coeval, and in digging at Bandarawela below surfaces richly strewn with pigmies and neoliths, I expected to find confirmation of my view. I am obliged to confess that I have not done so. In all cases where identical types of implements from above and below the surface can be compared, there is no question that the former is on an average considerably larger than the latter. The only marked exception is the large round scraper from the pigmy layer already alluded to. I also picked up on the surface of Bungalow Hill a single arrowhead; it is significant that this differs, not only in size, but in type from any recovered from below ground. I do not attempt at present to draw any hard and fast conclusion; but the evidence before me inclines me now to believe that the two

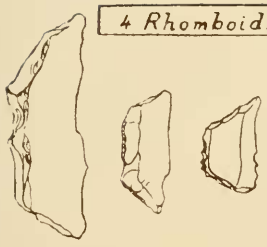
types are separated in time. If ever this supposition proves to be correct, it will be time to consider whether their makers were or were not of the same race, for which there is at present no evidence available.

Besides the great deposits at Bandarawela, pigmies have now been found sparingly in the following localities, all of which are in the hill country :—Diyatalawa ; Haputale ; Pattipola ; the Horton Plains ; Rillamulle and Kurundu-oya estates in Maturata ; Strathdon and Vellai-oya estates in Hatton ; several estates in Maskeliya by Mr. Pole ; Donside, Hindford, and St. Clive estates in Nawalapitiya ; Kellie Group in Dolosbage ; Ulapane estate ; Kalugama estate in Peradeniya ; Gampolawatta estate in Gampola ; Katugastota river bank ; Wiltshire estate in Matale. I anticipate that with a little search they will come to light in all parts of the Island, and that here and there great manufactories will be discovered, similar to the one at Bandarawela. I suspect the existence of one such close to the resthouse on the Horton Plains (7,200 feet), where Mr. Cassie has already picked up several pigmies on the surface, but which I have not had time to explore. The most important work to be done now is the excavation of caves, to which I hope to turn my attention before long.

I annex a table of pigmy types found by me at Bandarawela in 1914 :—

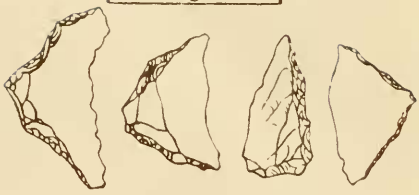
	Types.	Sharp-edged.	Square-edged.	Trimmed-edged.	Total.
1.	Lunate	246	6	12	264
2.	Semi-lunate	167	9	12	188
3.	Irregular	11	0	0	11
4.	Rhomboidal	1	0	0	1
5.	Angular	47	0	5	52
6.	D-shaped	60	7	11	78
7.	Beaked	13	3	1	17
8.	Curved Points	257	25	40	322
9.	Straight Points	18	1	14	33
10.	Drill Points	0	0	0	0
	Blanks	6	0	0	6
	Uncertain	32	7	6	45
		858	59	101	1,017

4 Rhomboidal



200 1357 1264

5. Angular



527 1367 1368 528

500 403 524 523 237 217 1359 515 516 1358

6 D-shaped

1387 1388 1390 1394 1397 1405 1407 1392 1400 1416 1419 1410

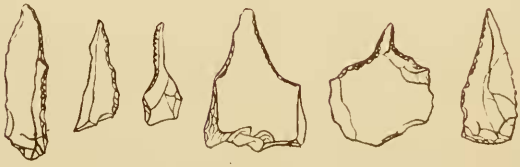
7 Beaked

598 610 617 624 603 604 660 650 648

9 Straight Points

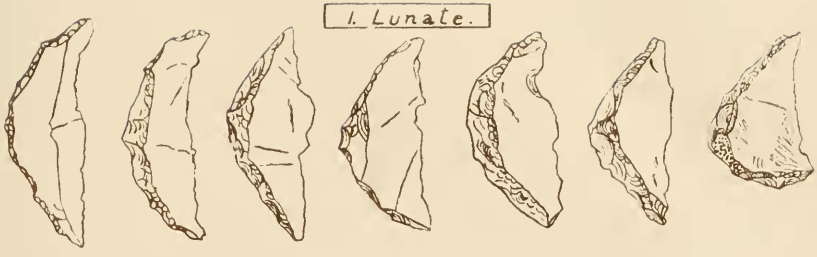
959 961 962 1493

11. Borers



1477 937 942 963 964 1270

1. Lunate.



376 375 205 204 202 203 352

244 354 355 1340 1335 371 373 372 209 210

3. Irregular.

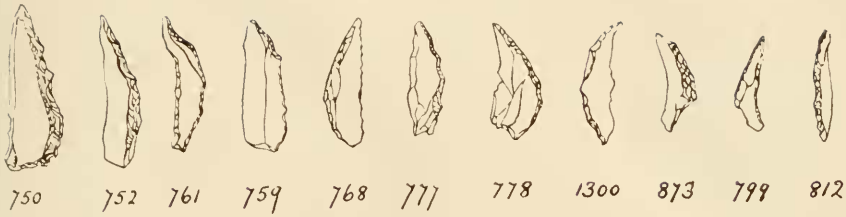
460 434 478 440 441 458

2. Semi-Lunate

670 671 672 682 .1455 676

680 686 690 687 734 1434 1432 1450 1449 1440

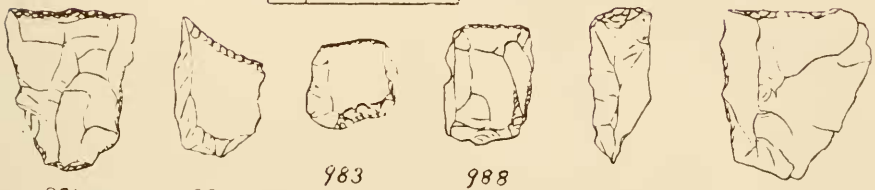
8. Curved Points



750 752 761 759 768 771 778 1300 873 799 812

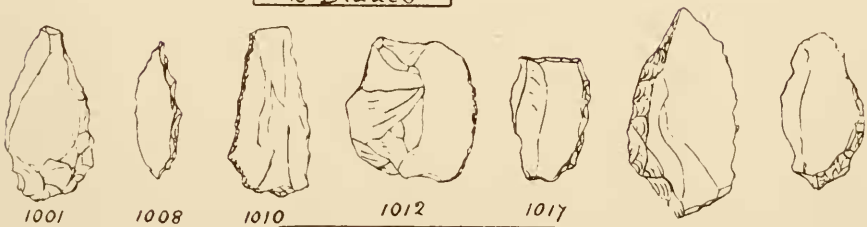
814 815 822 823 826 838 846 853 863 867 868 1461 913

14. Chisels



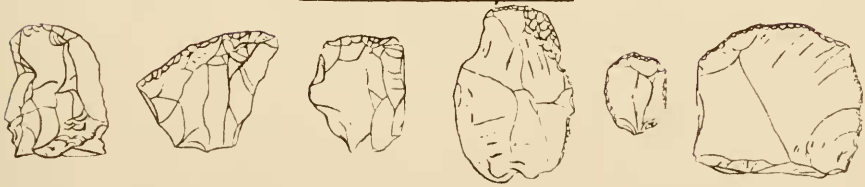
981 982 983 988 989 1495

13 Blades



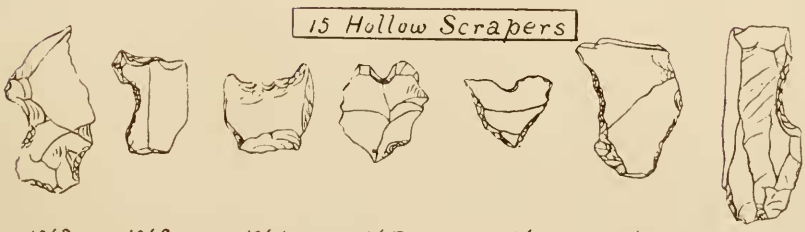
1001 1008 1010 1012 1017 1014 1015

16 Round Scrapers



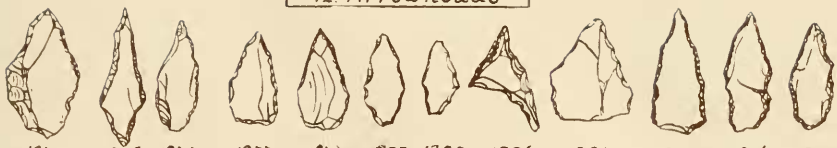
1023 1024 1034 1037 1039 1013

15 Hollow Scrapers



1062 1063 1064 1065 1066 1067 1071

12. Arrowheads

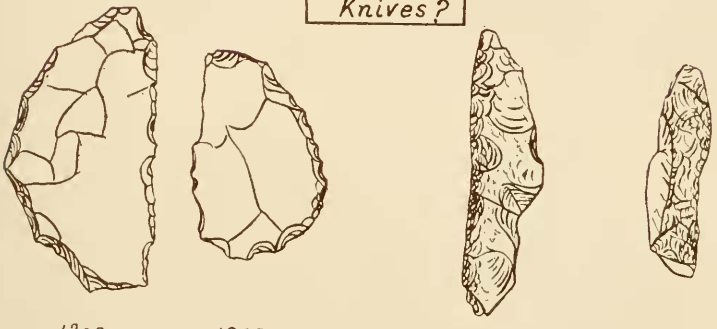


1370 1373 1374 1377 1379 1382 1385 1386 931 902 1316 1277

10. Drill Points

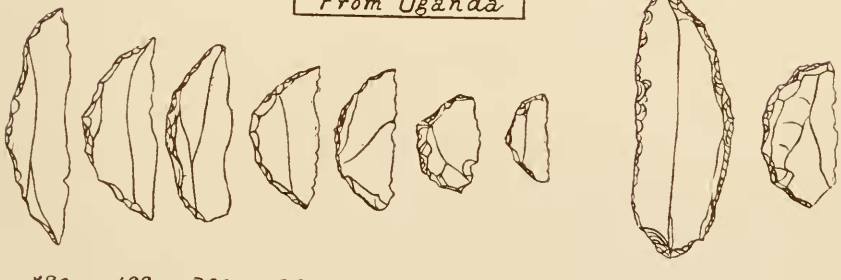
1503 891 890 892 893 900 901

Knives?

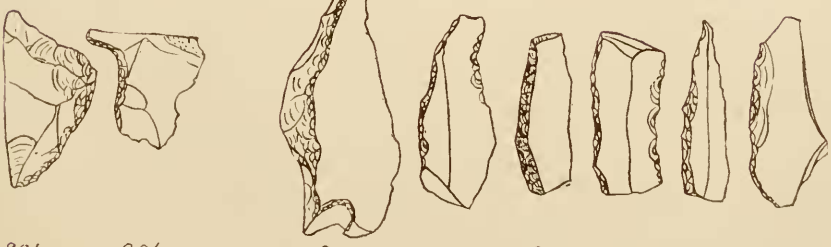


1208 1209 1208 1209

From Uganda



880 188 882 883 884 885 886 783 899



891 896 902 903 904 911 915 922

	Types.	Sharp-edged.	Square-edged.	Trimmed-edged.	Total.
11.	Borers	—	—	—	3
12.	Arrowheads	—	—	—	8
13.	Blades	—	—	—	4
14.	Chisels	—	—	—	2
15.	Hollow Scrapers	—	—	—	2
16.	Round Scrapers	—	—	—	38
17.	Quartz Pebbles	—	—	—	2
18.	Gneiss Pebbles	—	—	—	5
	Total	—	—	—	1,081

N.B.—Bevelled edges, which are fairly common, are reckoned as sharp.

Notes to the Illustrations.

1. I have rejected photographic reproduction, because I have seen that this process applied to quartz specimens is inadequate to render detail. For confirmation see Dr. Sarasin's "Steinzeit auf Ceylon."

2. The figures attached to my Paper have been drawn with the utmost care by Mr. G. M. Henry of the Colombo Museum, to whom my best thanks are due. The stones are so far accurately reproduced in their natural size that an implement laid upon the drawing exactly covers it. It will be at once perceived that this system implies an unavoidable incorrectness, inasmuch as the thickness of the stone, sketched in by eye, encroaches upon and so diminishes its actual breadth. I have thought it better to put up with this designed inaccuracy than to conceal the back from view altogether. Considerations of space and labour preclude us from presenting each stone under four aspects.

3. The last specimens figured, viz., Nos. 880 to 922, are not from Ceylon, nor are they of quartz, but are of obsidian from Uganda. They are inserted here partly for purposes of comparison, partly because, as far as I am aware, no similar specimens have yet been described.

C. H.

REVIEW.

Some South Indian Insects.*

We have just received from Mr. T. D. Chadwick, Director of the Madras Agricultural Department, a copy of an interesting volume by Mr. T. Bainbrigge Fletcher, R.N. (late of H. M. Survey Ship "Sealark"), F.L.S., F.E.S., F.Z.S., Imperial Entomologist to the Government of India, and formerly Government Entomologist, Madras, entitled "Some South Indian Insects and other Animals of importance considered especially from an economic point of view," which has been issued by the Madras Government Press. The author distinctly states that the volume has no pretensions to the assumption of any status as a text book, and does not pretend to do much more than provide a narrow and tortuous entrance into the vast and almost untrodden field of insect life in South India. However modest the writer himself may be in this direction, we are sure that any one who peruses even casually the 564 pages of the work will agree that it is much more than the retiring author would have us believe. In addition to a large amount of information, no less than fifty splendidly coloured plates are provided, which have been prepared from the original drawings at the Agricultural Research Institute, Pusa. Most of these have been published before, and it is to this fact that so large a number of coloured plates are included in a book costing only six rupees, which figure is not the least of the surprises in the way of good value provided. The preliminary chapters give a general account of the structure, habits, &c., of insects and insect pests, which are necessarily brief, and, as the author says, incomplete, as any one of these might be expanded into a

* "Some South Indian Insects," by T. Bainbrigge Fletcher, R.N., F.L.S., F.E.S., F.Z.S., Imperial Entomologist to the Government of India; 8vo., Superintendent of the Government Press, Madras, 1914.

whole volume by itself; while the various aspects of entomology that have been omitted would form a companion series of tomes. The arrangement and information given, however, is such as will commend itself to a large number of readers who delve into such works for the purpose of gaining concise knowledge on the subjects in which they are interested, and knowledge which can readily be assimilated. In the succeeding and main portion of the book some of the more important insects are considered, each being treated under the head of references, distribution in South India, life history, food plants, status from an economic point of view, and control. Under the first heading the synonyms, which will generally appeal only to entomologists, are limited to the original description and the more important or accessible references. Under the last heading only such control methods are usually given as are generally efficacious, special methods being often applicable to local conditions. In some cases where no effective method has yet been found, the information under this head is left blank or represented by a query mark. Turning to the list of crop pests, Mr. Fletcher says that it is not complete, and it must be understood that it cannot be complete for very many years, if ever. Every month new pests come to light, many of them altogether unknown by name, and our knowledge of old pests is augmented. In addition to the fine coloured plates already mentioned, no less than 440 text figures are included, while the indexing is also very complete. Nothing but praise can be found for the work. As Mr. Fletcher says in his Preface, to any in search of a distraction or a hobby, either to fill an idle hour or to provide a welcome change of thought and occupation, the study of insects may well be commended. Insects are always with us, day and night, in the bungalow, at the office, or in camp, and the field for observation of life histories and habit, even of the commonest species, is absolutely boundless. If this book, he remarks, lends aid to any whose tastes lie in this direction, its aim will have been achieved. A brief glance at the book is sufficient to prove the attractiveness of the study, and the work itself follows just the right lines to attract attention to this absorbing subject, giving, as it does,

just what is wanted, leaving alone much befogging matter and detail, and allowing the amateur entomologist that scope for individual effort and investigation which is necessary to promote increasing interest in any study.

The cover bears a representation of one of the most striking of South Indian Mantids, the *Gongylus*, often seen in Ceylon, with its attenuated thorax and vivid green or brown colouring, in characteristic attitude when at rest among foliage. The volume contains much that is of interest and applicable to Ceylon, and its fine get-up makes it a most desirable acquisition, while its cheap price—it is only six rupees—brings it within the reach of all who are likely to be attracted to Entomology. Mr. Bainbrigge Fletcher deserves the sincerest congratulations on the excellent volume he has produced. Messrs. A. M. & J. Ferguson act as agents in Colombo for the Madras Government Press, and orders can be received at the *Ceylon Observer* office for copies.—*Ceylon Observer*, October 10, 1914.

NOTES.

Microdon, sp.—Several larvæ of this genus of Syrphidæ were found on *Eugenia* sp., in a nest of the ant *Cremastogaster* sp., along with a colony of *Lecanium psidii*, Gr. Except for their peculiar colour—they are bluish-green—and for the fact that they may be seen moving about, one might mistake them for a species of Lecanium. They are slightly convex, are surrounded by a fringe, and in a position corresponding to that of the anal plates of a Lecanium is a dark brown, conical process. Each larva is about 5 mm. by 4 mm., oval, broadly rounded posteriorly, and narrower anteriorly. The head is usually retracted underneath the prothorax. When protruded it is seen to bear a forked process, each fork bearing two or three stout setæ at the apex. When treated with KOH and mounted in Canada balsam the following details can be made out. The body is studded with circular glands. The fringe is seen to consist of a series of long feather-like processes, and shorter, more hyaline processes arranged alternately; these arise from the crenulated margin of the body. The margin of the (stigmatic ?) process that corresponds in position to the anal plates of a Lecaniid is crenulate, the convexities of the crenulations being towards the centre of the process. The cephalic process ends in two finger-like bodies, one of which suddenly narrows about its middle length and bears a small spine at that point. The mandibles are large. Each is oval, and bears on its proximal half large, triangular, backwardly-pointing teeth, and on its distal half much smaller teeth.

I am unable to say on what they were feeding. The character of the mandibles suggests that it might be the scales. One cannot imagine them catching the ants ! In confinement they refused to feed, and died.

In the *Records of the Indian Museum*, Vol. II., Pt. I., Brunetti describes under the name of *Microdon auricinctus* an insect taken in Kandy in October, 1907.

Ceroplatus quadripunctatus, Brun. (*Mycetophilidæ*).—The larva of this fly was found feeding on the hymenium of a

fungus at Peradeniya. It looks more like a worm than a Dipterous larva, and it flows along with a motion resembling that of a snake. It spins silk wherever it goes. It is unicolorous, shining, covered with mucus, and it leaves an iridescent mucus wherever it has been feeding.

The anterior end of the body can be expanded and contracted, and when expanded shows two distinct, dark, longitudinal bands one on each side of a light-coloured area. When the larva is moving, a wave is to be seen passing rhythmically along its body towards the posterior end. The puparium, which is of much the same colour as the larva, is suspended in a thin, mist-like web of silk. It is about 6 mm. long, and has a prominent hump in the thoracic region.

From the puparium, which was formed on May 15th, the imago emerged on the 18th.

Anisodes nebulosata, Walk. (*Geometridæ*).—The caterpillar was feeding on *Ficus* sp.

It is about $\frac{3}{4}$ inch long, and tapers towards the anterior end. The head, thorax, and first segment of the abdomen are yellowish-brown, the rest of the abdomen grayish-purple. Four lateral oblique, reddish-purple bands occur on segments two to five, the three most anterior being edged ventrally with yellow. Two narrow, yellowish, longitudinal stripes are situated on the dorsum of the head. The anal prolegs have a whitish band on the lateral side.

The pupa is about $\frac{1}{2}$ inch long, and squarely truncate at the anterior end. The wing cases, head, and thorax are of a dark purple colour, the rest of the body being greenish-purple. There is a yellow, transverse stripe at the anterior extremity, and this is continued along the wing cases. The pupa is suspended by a loop of silk and by silk at the anal region.

From a pupa formed on October 4th the moth emerged on October 11th. In wing expanse it is about 25 mm. The body is grayish-white, the wings grayish-white, with large, bluish-black blotches and smaller purplish dots.

Dioptoma adamsi, Pase.—On the night of July 1st I took what proved to be the female of this species of Lampyrid. It was underneath a hedge, and my attention was attracted to it by its very bright, steady light. The luminous organ is a

large oval area occupying most of the ventral area of the seventh abdominal segment. When the insect is calling for the male, she curves up the posterior end of the body until the luminous area is fully exposed. She seems to move about so as to turn the luminous area in another direction, if one has not proved successful. While I watched her, three specimens of *Lamprophorus tenebrosus* came down, but they did not stay long. No males of her own species came on the first night.

The female is larva-like, softly hairy, slightly flattened dorso-ventrally, and tapering from the posterior end of the thorax towards the head, which is small and black. There are nine broad, dark brown, transverse plates of chitin, one on each segment from the metathorax backwards. There is a faint, mid-dorsal, longitudinal brown band on the first two thoracic segments. The mandibles are narrow, curved, and sharply pointed, suggesting an animal diet. The antennæ are short, and consist of nine segments. The thoracic legs are well developed.

Later in the evening of the 1st, when I looked at the tube in which I had placed her, I was astonished to see that she was luminous at many points. It is very difficult to make an accurate count of the number, as all the points may not be luminous at the same time, but there seem to be ten transverse rows of four each, two of the four being on the dorsal aspect, and two low down on the sides. In the third row from the anterior end, that on the first abdominal segment, the ventral spot was wanting on one side, and the penultimate segment bore three on the dorsum in place of the normal two. When the spots are luminous, the large ventral area is only faintly so, but there are a few bright points situated round its margin. So far as I could make out the spots were situated on the segments, the lateral ones being ventrad of the spiracles. No males came on the night of the 2nd.

I exposed the insect on the night of July 3rd towards 7 P.M., and she had hardly begun to expose her light when I had secured six males. The males are very much smaller than the female. They did not show any light, and came running along the ground. Later in the evening, in confinement, they,

too, showed a series of luminous points, which, so far as I could make out, had much the same arrangement as in the case of the female. The male, however, possesses prothoracic luminous areas, which are absent in the case of the female. The spots are even more difficult to count in the case of the male than in that of the female, owing to the small size of the insect and its restlessness in confinement. The meso- and metathoracic ones are weaker than the rest. The dorsal series can be plainly seen at the posterior end, and also in favourable circumstances shining faintly through the elytra. The whole ventral surface of the abdomen of the male glows softly.

The male has eight ventral abdominal segments, the seventh of which is narrow, and is seen clearly only towards the sides, and the eighth small and somewhat triangular in shape. As to what may be the significance of this double set of luminous organs I am unable even to offer a suggestion. The large one is evidently sexual, but what function has the series of lights? And what part in the economy of the species do the lights in the case of the male play? If they are rudimentary organs, it is astonishing to find them emitting the strong, clear light that they do emit.

I nearly lost the female on two occasions. On one occasion I had left her for a few seconds, and on my return I found a toad dangerously near her! On the second occasion I found her in the course of the night wandering about on the floor, she having made her escape, and the interesting thing was that she was then showing not the large luminous organ, but the series of luminous points; this was on the night of the 3rd.

I exposed her again on the night of the 4th about 7 P.M., and soon had captured four males. She laid eggs during the night of the 5th. On the night of the 6th, though I waited for a long time, she did not show her strong light, but the luminous points glowed faintly. She laid a further lot of eggs on the night of the 6th.

The eggs are whitish, oval-cylindrical, about 1·25 mm. long, and a little longer than broad. They were laid in a loose mass in the tube.

Peradeniya. A. RUTHERFORD.

Heortia vitessoides, Moore.—The caterpillars of this pretty Pyralid moth defoliated a plant of *Lagetta lintearia*, the Lace Bark Tree of the West Indies, growing in the Royal Botanic Gardens, Peradeniya, in July, and again in September, 1913.

When feeding the caterpillars spin a fine webbing over the tree, and they are able to lower themselves to the ground by spinning a thread of silk.

The caterpillars are yellowish-green in colour and shining. The body-tubercles bear long white hairs. The head is glossy black. Along each side of the body are two rows of circular, metallic-blue spots. These are in groups of three above the spiracles, the two upper being the largest and situated close together, the lower one just dorsad of the spiracle. These spots are enclosed in the area between two longitudinal yellowish stripes. Faint yellow transverse stripes occur on the dorsum.

The first thoracic segment and the anal segment are orange-yellow in colour. Just cephalad of the anal plate is a large, median, metallic-blue spot.

In confinement the larvæ pupated in the soil in a cocoon formed of particles of earth and small stones.

The pupa is at first shining reddish-brown in colour, and bears two rows of dorso-lateral black spots. The apex of the abdomen is somewhat darker in colour.

Later the pupa as a whole becomes darker, and the dorso-lateral spots are less distinct. The wing cases are yellowish-brown at the base, this area being crossed by two dark brown bands. The apex of the wing case is traversed by numerous fine, dark, longitudinal lines.

The abdominal region is in general lighter in colour than the head and thorax.

The cremaster consists of a few (3) hooks situated on a small tubercle.

From caterpillars that went into the soil on September 25 moths began to emerge on October 9.

They agree with Hampson's description of *Heortia vitessoides*, Moore, in the *Fauna of British India*, Vol. IV., p. 363, except that, while Hampson gives the wing expanse as 40 mm., these range from 25 to 30 mm.

Boarmia crepuscularia, Hub.—This Geometrid moth has been reared from a caterpillar feeding on the leaves of *Tecoma stans* at Peradeniya.

The twigs of this plant have a silvery-gray bark, and the caterpillar is of much the same colour. When not feeding it holds on to the twig by the two pairs of prolegs and projects at an angle, so that, by the human at least, its presence is very difficult to detect.

The presence of a head is masked by the fact that the caterpillar has the power of crinkling up the thorax, so that over the thoracic region there is a conspicuous hump.

The bark of this plant is minutely grooved, and on the caterpillar there are faint dark lines corresponding to the grooves.

Along the dorsum and the exposed part of the venter are blackish spots.

On the particular twig on which the caterpillar was resting there was nothing to correspond to these dark areas, but they bear a strong resemblance to patches of lichen.

The spiracles are oval, and brown in colour, with black margins. The moth is one of those which rest by day on bark, to which their colour-scheme gives them a strong resemblance.

In a shallow, stony-bedded stream running down a hill-side I encountered a flattish bug clinging to the stones under the surface of the water. I picked one up to drop it almost immediately again, for it pierced my finger, causing a pain not unlike that of a wasp's sting, and which did not pass away for several minutes. I secured the bug, however, and it proved to be *Heleocoris vicinus*, Mtd. (Naucoridæ). There were no after-effects.

There is a Reduviid bug that comes to the lights at night that should not be handled. It is *Ectomocoris atrox*. One flew into the writer's mouth while he was speaking, and before he could eject it, it had pierced his tongue, causing a distressing

pain. Reduviids are predaceous on other insects, and the action of this one was no doubt reflex on finding itself confined.

An immature tick, genus *Rhipicephalus*, had attached itself in the writer's armpit. The point of attachment remained sore to the touch for several weeks after the removal of the tick, but this was no doubt due to a piece of flesh having been removed with the tick.

A nymphal Locustid of the family Stenopelmatinæ lives within a retreat formed at the apex of a tea leaf. Four cuts divide the tip of the leaf into three sections, and the lateral pieces are folded together to form the retreat. In the average case the cuts are more or less symmetrically arranged with regard to the midrib, but specimens in which the insect has evidently lost its bearings are not uncommon.

The tenant is of a shining dark brown colour dorsally, yellowish-white ventrally. They are splendid jumpers, and one has to be very quick to capture them.

Many of such leaves bear small punctures usually arranged in two, more or less, parallel rows.

Of Dynastides, Sharp says (*Insects*, Pt. II., p. 199): "Many Dynastides possess organs of stridulation, consisting of lines of sculpture placed so as to form one or two bands on the middle of the propygidium, and brought into play by being rubbed by the extremities of the wing cases."

In the writer's opinion there does not seem to be any such arrangement in *Xylotrupes gideon*. On the other hand, there is a row of small teeth on the under side of the proximal half of the costa of the wing, and this is probably part of the sound-producing structure, resting as it does on the abdomen.

The production of sound by the Hawk moths seems to the writer to require further investigation.

Recently I took resting on the stem of a palm what was probably a species of Acherontia; it was too much rubbed for detailed comparison with named specimens.

When handled it emitted a loud continuous note. Speaking of this subject, Sharp says (*Insects*, Pt. II., p. 382): "Sphingidæ have been recorded as capable of producing sounds in the larval and pupal, as well as in the perfect, instars; but the method in which this is done has not been ascertained, except in the case of the imago of the Death's-head moth, which is well known to emit a very audible cry when not on the wing; in this case it is highly probable that the method is the friction of the palpi against the proboscis, as stated by Réaumur and Landois; the inner face of the palp is said to be marked in this case with fine ridges or striæ."

The above was not the method in the case of the insect which came under my observation. It continued to produce the noise when the proboscis was held away from the palps, and when the palps had been removed. Just where the seat of sound production is located I am not prepared to say. It seemed to me possible that the source was located in the thorax, perhaps internally.

Some recent Peradeniya Records.

Legnatia concinna, Morl. M. S. (Ichneumonidæ). Reared from Lepidopterous pupa. Previously recorded only from Dehra Dun, India.

Pammene isocampta, Meyr. (Tortricidæ). New species.

Limnœcia metacypha, Meyr. (Tineidæ). New species.

Idiophantis chiridota, Meyr. (Tineidæ). Larva feeds on galls of *Trioza* sp. (Psyllidæ), on Eugenia.

Argyroploce erotias, Meyr. (Tortricidæ). Larva feeds on galls of *Trioza* sp., on leaves of Eugenia.

Tinissa torvella, Walk. (Tineidæ). Larva feeds on fungus on bamboo.

Batrachedra psilopa, Meyr. (Tineidæ). Larva feeds in interior of galls on the leaves of *Heptapleurum stellatum*. These galls are probably caused by a species of Thrips.

Cryptoblabes proleucella, Hmp. (Pyralidæ). Caterpillar feeds underneath a web on *Coccus viridis*, Gr.

A. RUTHERFORD.

Insect Food Plants.—The larva of *Danais fumata* feeds on *Allœophania decipiens*, Thw., a shrub growing in chenas at the higher elevations. Observer: Mr. F. G. Saunder, Nuwara Eliya.

Cyaniris lanka feeds on *Smithia blanda*, Wall., which grows in damper portions of patanas. The egg is deposited on stem at foot of flower bud.

February 9, 1914. F. M. MACKWOOD.

Extension of the Range of the Common Leech.—To the field naturalist one of the charms of up-country jungles lies in their freedom from leeches. One may wander at will, without taking any thought of the pests which drive him out of the jungles of (say) the Ratnapura District. But a close acquaintance with the country round Hakgala during the last nine years leads me to suppose that the leech is gradually extending its range upwards. I may say that the same ground has been traversed every year at about the same time, so that the observations have some degree of probability.

In 1906 I acquired my first Hakgala leech at the bottom of the valley below Hakgala, where the Fort Macdonald footpath runs alongside the stream. This is at a much lower elevation than the Gardens, and I was not particularly surprised at the occurrence. In 1907 another found me on the grass by the roadside near the entrance to the Gardens, and this was considered a stray example brought up the road by cattle.

In 1909, however, I found leeches abundant in the boundary ravine of the Hakgala reservation, *i.e.*, the last of the ravines which run down the hillside across the Ambawela footpath between the Gardens and Albion estate. I had not met with any in that locality during the previous four years. They were confined to the part of the ravine below the path, and though they are still there, they have apparently not yet (1914) ascended into the upper part.

In 1912 leeches were common on the grass just below the laboratory at Hakgala, which is at a slightly lower level than the Curator's bungalow (5,600 feet). Better drainage has apparently driven them off that piece of grass, but they are always to be found now on the boundary of the oak plantation next the fruit garden.

Up to that time the Ambawela footpath formed the upper limit of the leech's range. In 1913, however, one found me near the (natural) bed of *Hedychium flavescens* in the upper part of the Garden, *i.e.*, above the level of the bungalow.

T. PETCH.

THE CEYLON NATURAL HISTORY SOCIETY.

Ninth General Meeting.

The Ninth (Second Anniversary) General Meeting of the Society was held in the Colombo Museum on February 27, 1913, with Mr. V. A. Julius in the Chair. The Secretaries' and Treasurers' Reports for 1913 were deferred to be read at a subsequent meeting. The following were elected as Office-bearers for 1914 :—

Patron :

His Excellency Sir Robert Chalmers, K.C.B.

President :

The Hon. Mr. R. E. Stubbs, C.M.G., F.Z.S.

Vice-Presidents :

V. A. Julius, Esq.
F. M. Mackwood, Esq.
A. Nell, Esq., M.R.C.S., L.M.S.
Sir S. D. Bandaranaike, Kt., C.M.G.

Council :

W. E. Wait, Esq., M.A.
T. Petch, Esq., B.A., B.Sc.
C. T. Symons, Esq., B.A., F.R.G.S.
O. S. Wickwar, Esq.

Joint Honorary Secretaries and Treasurers :

Joseph Pearson, Esq., D.Sc., F.R.S.E., F.L.S., and W. A. Cave, Esq.

Professor L. Plate, Professor of Zoology in the University of Jena, delivered a lecture on "Some Zoological Observations made in Ceylon." A few exhibits were placed on the table.

Tenth General Meeting.

The Tenth General Meeting of the Ceylon Natural History Society was held in the Colombo Museum on April 17, 1914, with Dr. A. Nell in the Chair.

Mr. E. J. Wayland, Assistant Mineral Surveyor, delivered a lecture on "The Interpretation of Nature and the Nature of the Interpretation."*

Eleventh General Meeting.

The Eleventh General Meeting of the Society was held in the Colombo Museum on June 12, 1914. Dr. A. Nell presided.

Rev. Father M. LeGoc, B.A., B.Sc., delivered a lecture on "Symbiosis, or Plant and Animal Life Partnerships." Dr. Pearson made a few observations on the subject.

Twelfth General Meeting.

The Twelfth General Meeting of the Ceylon Natural History Society was held in the Colombo Museum on July 24, 1914, with Dr. A. Nell in the Chair.

Mr. W. E. Wait, M.A., read a paper on "The Distribution of Birds in Ceylon, and its Relation to recent Geological Changes in the Island."* This being over, Commander Kitson, R.N., exhibited paintings of Ceylon fishes.

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* Printed in this Volume, Part XXXVI.

THE ECHINODERMS OF CEYLON OTHER THAN HOLOTHURIANS.

By Hubert Lyman Clark,
Museum of Comparative Zoology, Cambridge, Mass., U.S.A.

THROUGH the kindness of Dr. Pearson a collection of echinoderms belonging to the Colombo Museum was sent to me for examination in the Spring of 1914. There were no holothurians, but the other classes were well represented by ten species of crinoids, fifteen species of starfishes, eight species of brittle-stars, and twenty-two species of echini. Of these, one crinoid and one starfish seemed to be new to science. There were no data with any of the specimens, but all were from Ceylon. Many were taken on the pearl banks.

The first notice of the echinoderms of Ceylon is that published by Bell (1882), listing nineteen species from Point de Galle. There were no holothurians; and the single crinoid, one starfish, and one brittle-star were not identifiable. Three years later Walter (1885) reported on the echinoderms which Haeckel had collected in Ceylon, but (aside from holothurians) there were only fourteen species, and of one of these the identification was not complete. Nevertheless, eight of the species were additions to Bell's list. In 1887 Bell published a revised list of the echinoderms of Ceylon, in which he entered forty identified species, aside from holothurians. The following year Döderlein (1888), reporting on the Sarasins' collection, added twenty-three starfishes, brittle-stars, and sea-urchins to the list. In 1890 Ludwig added three more brittle-stars, besides an unidentified amphiurid. Four years later Thurston (1894), in "Notes on the Fauna of the Gulf of Mannar," gives eight additional species, and subsequent writers in scattered notes have listed a number of species. At the time of the

investigation of the Ceylon pearl fisheries by Herdman in 1902, therefore, not fewer than seventy-five well-authenticated species of echinoderms, other than holothurians, were recorded from the shores of Ceylon. Herdman's collections brought this number up to one hundred and ten at least, of which fifteen are crinoids, thirty-five starfishes, twenty-five brittle-stars, and thirty-five echini. Still more recently the reports on the echinoderms in the Indian Museum at Calcutta have lengthened the list, Koehler adding four starfishes and nine brittle-stars, while A. H. Clark adds seven comatulids. A few species have also been added in other Papers by various writers, so that the recorded echinoderm fauna of the shores of Ceylon, excluding holothurians, and allowing for cases where the same species is probably listed under two different names, is about one hundred and thirty. The collection before me from Colombo adds three crinoids, four starfishes, two brittle-stars, and one sea-urchin. Following the list of specimens from the Colombo Museum, I give a revised list of the littoral echinoderms of Ceylon, so far as it is known at this time (August, 1914), excepting the holothurians. I have ignored this interesting class, because Dr. Pearson is himself engaged in preparing a complete account of its representatives in Ceylon.

List of Echinoderms from Ceylon in the Colombo Museum.

1. *Comanthus* annulatum* (Bell).—A number of specimens (22) having from 40 to 54 arms. The division series are nearly always 4 (3 + 4).
2. *Comanthus parvicirrum* (J. Müller).—One small specimen with 21 arms.
3. *Comanthus samoanum*, A. H. C.—One specimen with 25 arms and 24 cirri, having 15–17 joints.
4. *Comanthus schlegelii* (P. H. C.).—Two specimens, one of which has about 120 arms.

* The Greek noun on which this word is based is neuter, hence specific names ought to use a neuter ending.

5. *Heterometra reynaudii* (J. Müller).—Fifty-five specimens, three of which are noticeably larger and with longer arms than the rest.
6. *Dichrometra protecta* (Ltk.).—Two specimens.
7. *Dichrometra tenera* (Hartl.).—One fine specimen with 40 arms and the cirri XL., 22-25.
8. *Cenometra herdmani*, A. H. C.—A calyx with the cirri and 2 arm-bases attached. In A. H. Clark's "Crinoids of the Indian Ocean," on p. 154, are given figures of a cirrus of this species, labelled "Cenometra insueta," while on p. 156 similar figures of a cirrus of that species are labelled "Cenometra herdmani." Mr. Clark's description of the difference between the two species is correct; he tells me that the labels on these figures have been unfortunately interchanged.
9. *Tropiometra encrinus*, A. H. C.—Two characteristic specimens.
10. *Tropiometra indica*, A. H. C.

Cirri XXV., 22, 23, about 20 mm. long; middle and distal joints 1 mm. long, 1 mm. wide, and 1·5–1·75 mm. thick. Centrodorsal 7–8 mm. across, thick and discoidal, with cirri in one, and a partial second, row. Brachials very low, less than a millimeter thick (longitudinally), even when the distal margin measures 4·5 mm.; near base of arm there are 14 brachials (including two syzygial joints) in a centimeter; beyond middle there are 18 or 19 brachials (including two syzygial joints) to a centimeter. Distal margin of basal brachials very uneven and irregular, slightly flaring, not at all serrate or spiny; there are at least three evident projections, the largest near the base of the pinnule, but separated from it by a re-entrant curve, the smallest on the other side of the brachial and the third median in position. This third projection becomes increasingly conspicuous on each succeeding brachial, until at the middle of the arm it is a rough projecting knot or rounded tooth. Distally it gradually decreases in size and disappears. Pinnules

much as in *T. encrinus*, but the two basal joints of the middle pinnules are conspicuously larger than the succeeding joints, and rather abruptly so ; these two joints are much wider than high. Arms stout at base, rather abruptly attenuate from near middle, probably about 60 mm. long, but none is complete. Colour, light brownish-white, without markings of any sort.

Comparison of the single specimen on which the above description is based with typical specimens of *carinata* and *encrinus* shows it is neither of those species. Nor does it seem to be any nearer *indica*, so far as Mr. Clark's fragmentary references to that species show ; but as he has examined the specimen and assures me it is *indica*, I have refrained from giving it another name. I have decided, however, to let the description I had drawn up stand. There are no data with the specimen.

11. *Astropecten andersoni*, Sladen.—One small specimen.
12. *Astropecten indicus*, Döderlein.—Four small specimens.
13. *Astropecten mauritianus*, Gray.—Five medium-sized and large specimens.
14. *Astropecten zebra*, Sladen.—Two small specimens. I agree with Bell that *zebra* is only a name for the young of some previously described astropecten, but I am not as yet prepared to assert which one.
15. *Luidia maculata*, M. & T.—Nine specimens, ranging from very small to very large ; the smallest and three others have 8 arms each ; the remaining five, including the three largest, have 7.
16. *Siraster tuberculatus*, gen. et sp. nov.

Generic diagnosis : Body stellate ; disk flattened, without secondary plates ; primary plates not concealed by skin ; medioradial plates reaching to terminal plate of arm ; entire abactinal surface granulated ; papulæ single, distinct, each pore surrounded by a few granules, obviously larger than those covering the neighbouring plates. Inferomarginal plates without conspicuous spines, but those beyond middle of arm, each with a low tubercle or flattened tubercle-like spine on

upper distal surface. Adambulacral armature much as in Stellaster, with a conspicuous, flattened, blunt spine on actinal surface. (Name from σιρός, *a pit in the ground for storing corn* + ἀστήρ, *a star ;* in reference to the papular pores surrounded by conspicuous granules.) Genotype—*S. tuberculatus*, sp. nov.

It is with much diffidence that I add a new genus to the perplexing family Goniasteridæ, but I cannot otherwise dispose of the present species and Studer's *Stellaster squamulosus*. That the two are congeneric will not, I think, be questioned ; that they cannot properly be placed in Stellaster seems to me equally true. Neither has the plates concealed by skin, although *squamulosus* is nearer true Stellaster in this respect than is *tuberculatus*. More important is the fact that neither has the characteristic spine on the inferomarginals, which is so conspicuous even in very young specimens of Stellaster. And finally, neither has the arched disc and slender pointed rays characteristic of Stellaster. Superficially the two species are much like *Goniodiscus forficulatus*, Perrier, but in that species (whose generic position, by the way, is quite uncertain) the medioradial plates do not reach the terminal plate of the arm, the papulæ are not surrounded by enlarged granules, and the adambulacral armature is in three parallel series, and has no conspicuous actinal spine.

Specific diagnosis : Body markedly stellate, flattened. R = 33 mm., r = 14 mm., and Br. (at base of arm) = 15 mm. R = 2·4 r. Abactinal plates granulated, but the outlines of the separate plates plainly visible. Proximal medioradial plates and some interradial plates, each with a more or less conspicuous tubercle ; altogether there are about fifty such tubercles on the holotype, the largest being on the fourth and fifth medioradial plates. Many plates which lack a tubercle have three or four central granules noticeably enlarged. Granules around the papular pores distinctly larger than those on the neighbouring plates. Superomarginal plates, 11 on each side of each ray, decreasing steadily in size distally, but becoming more and more swollen ; central granules of each

plate much larger than elsewhere on abactinal surface ; distally one (sometimes two or three) becomes evidently larger than the others, and may even become a low tubercle. Terminal plate smaller than penultimate superomarginal, bearing three distinct tubercles distally. Inferomarginal plates correspond in number and position with superomarginals ; proximally they are uniformly granulated, but distally a group of granules on the upper distal part of each plate becomes conspicuous, and one of these tends to develop into a distinct tubercle. Actinal interradial areas small ; actinal intermediate plates only extend outwards as far as fifth inferomarginal ; these plates are uniformly granulated, with here and there, generally near the adambulacral plates, low foraminate or bivalved pedicellariæ. Adambulacral armature made up of an inner series of 4–6 rather stout blunt spines, the middle ones the largest, and an outer series (on actinal surface of plate) of one or rarely two flattened blunt ovate spines ; if two are present, one is much smaller than the other, and commonly this smaller spine is replaced by a pedicellaria ; these ovate actinal-adambulacral spines are much larger than any other spines on the starfish. Oral spines stout and blunt, but not peculiar. Colour of dried specimen uniformly pale brown, not at all distinctive. Holotype from Ceylon without data.

This species is readily distinguished from *squamulosus* by the coarse granules of the superomarginal plates and the presence of abactinal tubercles ; actinally the adambulacral armature is distinguishably different. There is no other species known to me with which it needs comparison.

17. *Siraster squamulosus* (Studer).—Three large (R=30 mm.) and well-preserved specimens prove Koehler is right in maintaining the validity of this species. But, as already stated, it does not seem to me proper to retain it in Stellaster.

18. *Anthenea pentagonula* (Lam'k.).—Three small specimens of Anthenea agree well with specimens of the same size from Hong Kong, identified by Perrier as

pentagonula. I am not satisfied that *tuberculosa*, Gray, from tropical Australia, is really specifically distinct. I have not yet found any tangible, constant differences.

19. *Anthenea rudis*, Koehler.—Two small but well-marked specimens give support to the validity of this recently described form.
20. *Oreaster linckii* (Bl.).—Two characteristic specimens.
21. *Oreaster mammillatus* (Aud.).—The series of sixteen specimens shows considerable variation in the details of the tuberculation. One specimen is almost exactly like the type of *O. affinis*, M. & T. (figured by Koehler, 1910), and I have no doubt that *affinis* is a synonym of *mammillatus*.
22. *Culcita schmideliana* (Retz.).—Two specimens ; neither is perfectly typical, but there is little doubt of the identity.
23. *Linckia lævigata* (L.).—Two specimens.
24. *Echinaster eridanella*, M. & T.—Ten specimens, with five rays each. The absence of six- and seven-rayed specimens suggests that this is a selected series.
25. *Metrodira subulata*, Gray.—Five specimens ; at least two have shorter and stouter rays than usual.
26. *Ophioplocus imbricatus* (M. & T.).—One specimen.
27. *Ophiarachnella marmorata* (Lyman).—Seven specimens, 12–19 mm. across the disc. I believe that this species must be maintained as distinct from *gorgonia*, although it may be only a variety of the latter.
28. *Ophiolepis superba*, nom. nov. (= *Ophiura annulosa*, Bl. NON Lamarck).—One remarkable specimen, 22 mm. across the disc, uniformly deep buff, with *no* dark markings. It is curious that it has not previously been noted that de Blainville's name *annulosa* was preoccupied and is hence untenable. Both *Ophiura annulosa*, Lamarck, and *O. annulosa*, de Blainville, have been in constant use for many years, each being a conspicuous and well-known East Indian species.

29. *Ophiactis savignyi*, M. & T.—Seventy-eight specimens, mostly very young.
30. *Ophiothrix longipeda* (Lam'k.).—One small specimen.
31. *Ophiothrix exigua*, Lyman.—One small specimen.
32. *Ophiothrix nereidina* (Lam'k.).—Four specimens ; one is remarkable for its large size, the disc being 18 mm. across ; a second is notable for its colouration, the yellow (*red* in life) greatly predominating over the blue.
33. *Ophiocnemis marmorata* (Lam'k.).—One specimen.
34. *Phyllacanthus imperialis* (Lam'k.).—Two specimens.
35. *Prionocidaris baculosa* (Lam'k.).—One young specimen ; test 28 mm. in diameter ; primary spines handsomely banded with purplish-red and pale greenish-yellow.
36. *Echinothrix diadema* (L.).—One young specimen ; test about 45 mm. in diameter. The colouration of this specimen is entirely different from that of any other individual of the species I have ever seen. The test is yellowish ; ambulacral primaries *unbanded* yellow-green ; interambulacral primaries dull reddish-purple, with or without pale yellow-green bands. The large pedicellariæ and the character of the large primary spines show that this specimen is *diadema* rather than *calamaria*, but it is possibly representative of an undescribed species or a hybrid.
37. *Centrechinus savignyi* (Mich.).—Two specimens, 4 and 40 mm. in diameter. Both are remarkable for very light colouration. Test dull yellowish, with no black ; spines banded red or purplish-red and whitish or pale yellowish. The pedicellariæ of the larger specimen are like those of *savignyi*, and there are faint lines on the upper interambulacral plates which may represent the characteristic *blue* lines of that species.
38. *Stomopneustes variolaris* (Lam'k.).—Two specimens.
39. *Toxopneustes pileolus* (Lam'k.).—Two specimens.

40. *Tripneustes gratilla* (L.).—Two specimens.
41. *Temnopleurus toreumaticus* (Leske).—One specimen.
42. *Gymnechinus robillardi* (De Lor.).—One fine specimen, 28 mm. in diameter.
43. *Salmacis bicolor*, Agass.—Six fine specimens.
44. *Salmacis virgulata*, Agass. & Des.—Fourteen specimens.
45. *Pseudoboletia maculata*, Trosch.—Four specimens. Although these individuals have the conspicuous dark blotches of *maculata*, the buccal plates are large and close together, as is supposed to be characteristic of *indiana*. Probably the two species are not distinct.
46. *Echinostrephus molare* (Bl.).—One specimen.
47. *Echinometra mathæi* (Bl.).—One small green specimen.
48. *Clypeaster humilis* (Leske).—Seven specimens.
49. *Laganum depressum*, Agass.—Two specimens.
50. *Fibularia volva*, Agass. & Des.—One bare test, remarkable for the size and form of the ambulacral pores. These are not only conspicuously large, but are distinctly triangular in outline instead of circular. This is particularly true of those in the outer part of the posterior petals. There are altogether more than 70 such pores. The specimen was found in the stomach of a large starfish, *Luidia maculata*, M. & T.
51. *Echinodiscus auritus*, Leske.—Seven specimens.
52. *Echinolampas alexandri*, De Lor.—Six specimens.
53. *Echinolampas ovata* (Leske).—Four specimens.
54. *Lovenia elongata* (Gray).—Nineteen specimens, mostly young.
55. *Pseudomaretia alta* (A. Ag.).—Three specimens. I think there is no doubt Koehler is right in separating this species from Maretia. The difficulty with the "Challenger" report figures, to which De Loriol, De Meijere, and Koehler refer, is due to the fact that the specimen there figured is not *Maretia alta*, but appears to be quite a distinct, though superficially very similar, species. This statement is based on a

comparison of one of the "Challenger" specimens in the M. C. Z. collection with one of Agassiz's original types from Kagoshima Bay. The Ceylon specimens before me are notable for their large size; one is 42 mm. long. They are clearly the same species, however, as the individual from Kagoshima.

Littoral Echinoderms of Ceylon, excepting Holothurians.

In the following list I give in connection with each name a reference to a standard work,* where synonymy and other details may be found. Some of the species listed by Bell, Döderlein, or later writers appear here under other names. A very few are omitted, as I am convinced the supposed records are based on incorrect identifications. It should be borne in mind that this is a list of species actually recorded from Ceylon. No doubt there are many others living in the shallow water about the Island which have not yet been seen by a zoologist. Some of these are already recorded from the Indian shores of the Gulf of Mannar. Particularly the comatulids and brittle-stars will prove to be as yet imperfectly known. Of the latter class, there are probably twice as many living in Ceylon waters as are here listed. The chief purpose of this compilation is to serve as a basis for further investigation.

FEATHER-STARS (*Comatulid Crinoids*).

1. Comatella stelligera (P. H. C.). A. H. Clark, 1912, p. 68.
2. Capillaster multiradiata (L.). A. H. Clark, 1912, p. 74.
3. ———— sentosa (P. H. C.). A. H. Clark, 1912, p. 73.
4. Comatula pectinata (L.). A. H. Clark, 1912, p. 80.
5. Comanthus annulatum (Bell). A. H. Clark, 1912, p. 96.
6. ———— parvicirrum (J. Müller). A. H. Clark, 1912, p. 97.

* See "Literature List" at end of Paper.

7. Comanthus samoanum, A. H. C. A. H. Clark, 1912, p. 95.
8. ——— schlegelii (P. H. C.). A. H. Clark, 1912, p. 91.
9. Amphimetra milberti (J. Müller). A. H. Clark, 1912, p. 111.
10. Heterometra bengalensis (Hartl.). A. H. Clark, 1912, p. 130.
11. ——— reynaudii (J. Müller). A. H. Clark, 1912, p. 121.
12. Stephanometra indica (Smith). A. H. Clark, 1912, p. 135.
13. ——— marginata (P. H. C.). A. H. Clark, 1912, p. 135.
14. ——— monacantha (Hartl.). A. H. Clark, 1912, p. 136.
15. ——— tenuipinna (Hartl.). A. H. Clark, 1912, p. 135.
16. Dichrometra palmata (J. Müller). A. H. Clark, 1912, p. 148.
17. ——— protecta (Ltk.). A. H. Clark, 1912, p. 143.
18. ——— tenera (Hartl.). A. H. Clark, 1912, p. 148.
19. Cenometra herdmani, A. H. C. A. H. Clark, 1912, p. 154.
20. Decametra taprobanes (A. H. C.). A. H. Clark, 1912, p. 159.
21. Colobometra discolor, A. H. C. A. H. Clark, 1912, p. 166.
22. Oligometra serripinna (P. H. C.). A. H. Clark, 1912, p. 169.
23. Tropiometra encrinus, A. H. C. A. H. Clark, 1912, p. 177.
24. ——— indica, A. H. C. See *ante*, p. 85.
25. Mastigometra micropoda, A. H. C. A. H. Clark, 1912, p. 227.

STARFISHES (*Asteroids*).

26. *1.* Astropecten andersoni, Sladen. Koehler, 1910, p. 24.
27. *2.* ——— hemprichii, M. & T. De Loriol, 1885, p. 74.
28. *3.* ——— indicus, Död. Koehler, 1910, p. 27.
29. *4.* ——— mauritianus, Gray. Koehler, 1910, p. 32.
30. *5.* ——— petalodeus (Retz.). Lütken, 1871, p. 231 (under the name A. euryacanthus).
31. *6.* ——— polyacanthus, M. & T. De Loriol, 1885, p. 76.
32. *7.* ——— tamilicus, Död. Koehler, 1910 p. 32.
33. *8.* ——— velitaris, v. Mart. Döderlein, 1896, p. 307.
34. *9.* ——— zebra, Sladen. Sladen, 1889, p. 212.
35. *10.* Luidia hardwickii (Gray). Perrier, 1875–76, p. 147 (331 in reprint).
36. *11.* ——— maculata, M. & T. Perrier, 1875–76, p. 154 (338 in reprint).
37. *12.* Stellaster incei, Gray. Sladen, 1889, p. 322.
38. *13.* Siraster squamulosus (Studer). Koehler, 1910, p. 81.
39. *14.* ——— tuberculatus, H. L. C. See *ante*, p. 86.
40. *15.* Asterope carinifera (Lam'k.). De Loriol, 1885, p. 67.
41. *16.* Anthenea pentagonula (Lam'k.). Perrier, 1875–76, p. 90 (274 in reprint).
42. *17.* ——— rudis, Koeh. Koehler, 1910, p. 86.
43. *18.* Oreaster lincki (De Bl.). Bell, 1884, p. 72.
44. *19.* ——— mammillatus (Aud.). Bell, 1884, p. 67.
45. *20.* ——— nodosus (L.). Bell, 1884, p. 70.
46. *21.* ——— thurstoni (Bell). Bell, 1888, p. 385.

47. *22.* Culcita schmideliana (Retz.). De Loriol, 1885, p. 64. Döderlein, 1896, p. 315.
48. *23.* Asterina cepheus (M. & T.). De Loriol, 1885, p. 69.
49. *24.* ——— lorioli, Koeh. Koehler, 1910, p. 129.
50. *25.* Disasterina ceylanica, Död. Döderlein, 1888, p. 825.
51. *26.* Anseropoda sarasini (De Lor.). Koehler, 1910, p. 127.
52. *27.* Linckia guildingii, Gray (= pacifica, Gray). Perrier, 1875–76, p. 408 (144 in reprint).
53. *28.* ——— lævigata (L.). De Loriol, 1885, p. 36 (under name miliaris).
54. *29.* Ophidiaster cylindricus (Lam'k.). De Loriol, 1885, p. 20.
55. *30.* ——— ornatus, Koeh. Koehler, 1910, p. 151.
56. *31.* Nardoa ægyptiaca (Gray). Koehler, 1910, p. 157.
57. *32.* ——— novæ-caledoniæ (Perr.). Perrier, 1875–76, p. 426 (162 in reprint).
58. *33.* ——— tuberculata, Gray. Perrier, 1875–76, p. 421 (157 in reprint).
59. *34.* ——— variolata (Retz.). Perrier, 1875–76, p. 423 (159 in reprint).
60. *35.* Fromia milleporella (Lam'k.). De Loriol, 1885, p. 44.
61. *36.* ——— tumida, Bell. Bell, 1882, p. 124.
62. *37.* Ferdina offreti, Koeh. Koehler, 1910, p. 143.
63. *38.* Retaster cribrosus (v. Mart.). Perrier, 1875–76, p. 199 (383 in reprint).
64. *39.* Acanthaster planci (L.). Döderlein, 1896, p. 320. De Loriol, 1885, p. 6 (under the name A. mauritiensis).

65. *40.* Echinaster purpureus (Gray). De Loriol, 1885, p. 10.
66. *41.* Metrodira subulata, Gray. Koehler, 1910, p. 172.

BRITTLE-STARS (*Ophiurans*).

67. *1.* Pectinura arenosa, Lyman. Lyman, 1882, p. 15.
68. *2.* ——— fallax (Peters). De Loriol, 1894, p. 4.
69. *3.* Ophiarachnella gorgonia (M. & T.). H. L. Clark, 1909, p. 123.
70. *4.* ——— marmorata (Lym.). Lyman, 1874, p. 222.
71. *5.* ——— septemspinosa (M. & T.). De Loriol, 1893, p. 395.
72. *6.* Ophiarachna incrassata (Lam'k.). H. L. Clark, 1909, p. 127.
73. *7.* Ophiolepis cincta, M. & T. De Loriol, 1894, p. 9.
74. *8.* ——— rugosa, Koeh. Koehler, 1898, p. 64.
75. *9.* ——— superba, H. L. C. (See *ante*, p. 89.) De Loriol, 1894, p. 10.
76. *10.* Ophioplocus imbricatus (M. & T.). De Loriol, 1894, p. 12.
77. *11.* Ophiura kinbergi (Lym.). Lyman, 1882, p. 38.
78. *12.* Ophiactis savignyi (M. & T.). Koehler, 1905, p. 26.
79. *13.* Amphiura duncani, Lym. Koehler, 1905, p. 33.
80. *14.* Ophiocnida sexradia, Dunc. Koehler, 1905, p. 33.
81. *15.* Ophionereis porrecta, Lym. Koehler, 1898, p. 74.
82. *16.* Ophiocoma brevipes, Peters. De Loriol, 1894, p. 25.
83. *17.* ——— erinaceus, M. & T. De Loriol, 1894, p. 21.
84. *18.* ——— pica, M. & T. De Loriol, 1894, p. 28 (under the name lineolata).
85. *19.* ——— scolopendrina (Lam'k.). De Loriol, 1894, p. 23.
86. *20.* Ophiarthrum elegans, Peters. Koehler, 1898, p. 108.

87. *21.* Ophiomastix annulosa (Lam'k.). Lyman, 1882, p. 174.
88. *22.* Ophiacantha decora, Koeh. Koehler, 1898, p. 80.
89. *23.* Ophiocnemis marmorata (Lam'k.). Döderlein, 1888, p. 833.
90. *24.* Ophiomaza cacaotica, Lym. Koehler, 1898, p. 84.
91. *25.* Ophiothela holdsworthii, E. A. Smith. E. A. Smith, 1878, p. 464.
92. *26.* Ophiopteron elegans, Ludw. Koehler, 1905, p. 112.
93. *27.* Ophiothrix aspidota, M. & T. Koehler, 1904, p. 87.
94. *28.* ———— ciliaris (Lam'k.). Koehler, 1904, p. 100.
95. *29.* ———— comata, M. & T. Koehler, 1904, p. 105.
96. *30.* ———— exigua, Lym. Lyman, 1874, p. 236.
97. *31.* ———— foveolata, Mrktr. Koehler, 1905, p. 76.
98. *32.* ———— innocens, Koeh. Koehler, 1898*a*, p. 164.
99. *33.* ———— longipeda (Lam'k.). De Loriol, 1894, p. 36.
100. *34.* ———— nereidina (Lam'k.). Döderlein, 1888, p. 832.
101. *35.* ———— punctolimbata, v. Mart. Koehler, 1905, p. 93.
102. *36.* Ophiomyxa brevispina, var. irregularis, Koeh. Koehler, 1898, p. 110.
103. *37.* Astrophyton clavatum, Lym. Lyman, 1865, p. 191.

SEA-URCHINS (*Echini or Echinoids*).

104. *1.* Eucidaris metularia (Lam'k.). H. L. Clark, 1907, p. 184.
105. *2.* Phyllacanthus imperialis (Lam'k.). H. L. Clark, 1907, p. 188.

106. *3.* Prionocidaris baculosa (Lam'k.). H. L. Clark, 1907, p. 189.

107. *4.* ———— bispinosa (Lam'k.). H. L. Clark, 1907, p. 188 (under the name Phyllacanthus annulifera).

108. *5.* Centrechinus savignyi (Mich.). A. Agassiz & H. L. Clark, 1908, pp. 112–114.

109. *6.* Centrechinus setosum (Leske). A. Agassiz & H. L. Clark, 1908, pp. 112, 113.

110. *7.* Echinothrix diadema (L.). A. Agassiz & H. L. Clark, 1908, p. 116.

111. *8.* Astropyga radiata (Leske). A. Agassiz & H. L. Clark, 1908, p. 123.

112. *9.* Asthenosoma urens, Saras. A. Agassiz & H. L. Clark, 1909, p. 172.

113. *10.* Stomopneustes variolaris (Lam'k.). A. Agassiz, 1873, p. 437.

114. *11.* Temnopleurus reevesii (Gray). H. L. Clark, 1912, pp. 312, 313.

115. *12.* ———— toreumaticus (Leske). H. L. Clark, 1912, p. 312.

116. *13.* Salmacis bicolor, Agass. H. L. Clark, 1912, p. 316.

117. *14.* ——— dussumieri, Ag. & Des. H. L. Clark, 1912, p. 316.

118. *15.* ——— virgulata, Ag. & Des. H. L. Clark, 1912, p. 316.

119. *16.* Toxopneustes pileolus (Lam'k.). H. L. Clark, 1912, p. 283.

120. *17.* Tripneustes gratilla (L.). H. L. Clark, 1912, p. 285.

121. *18.* Gymnechinus robillardi (De Lor.). H. L. Clark, 1912, p. 287.

122. *19.* Microcyphus maculatus, Agass. H. L. Clark, 1912, p. 323.

123. *20.* Pseudoboletia indiana (Mich.). H. L. Clark, 1912, p. 345.

124. *21.* Pseudoboletia maculata, Trosch. H. L. Clark, 1912, p. 345.
125. *22.* Echinostrephus molare (Bl.). H. L. Clark, 1912, p. 342.
126. *23.* Echinometra mathæi (Bl.). H. L. Clark, 1912, pp. 371, 372.
127. *24.* ———— oblonga (Bl.). H. L. Clark, 1912, pp. 372, 373.
128. *25.* Clypeaster humilis (Leske). H. L. Clark, 1914, pp. 24, 36.
129. *26.* ———— reticulatus (L.). H. L. Clark, 1914, pp. 24, 34.
130. *27.* Laganum depressum, Agass. H. L. Clark, 1914, p. 45.
131. *28.* Fibularia volva, Ag. & Des. H. L. Clark, 1914, pp. 57, 58.
132. *29.* Echinodiscus auritus, Leske. H. L. Clark, 1914, pp. 70, 71.
133. *30.* ———— bisperforatus, Leske. H. L. Clark, 1914, p. 71.
134. *31.* Echinoneus cyclostomus, Leske. De Loriol, 1883, p. 38.
135. *32.* Echinolampas alexandri, De Lor. De Loriol, 1883, p. 43.
136. *33.* ———— ovata (Leske). A. Agassiz, 1873, p. 553 (under the name oviformis). See also p. 114.
137. *34.* Schizaster gibberulus, Agass. A. Agassiz, 1873, p. 612.
138. *35.* Metalia sternalis (Lam'k.). De Loriol, 1883, p. 44.
139. *36.* Lovenia elongata, Gray. Koehler, 1914, p. 111.
140. *37.* Maretia planulata (Lam'k.). Koehler, 1914, p. 106.
141. *38.* Pseudomaretia alta (A. Ag.). Koehler, 1914, p. 107.

Literature List.

A. Agassiz.—1873, "Revision of the Echini," Pt. III. Ill. Cat. M. C. Z., No. 7, pp. 379–628.

A. Agassiz and *H. L. Clark.*—1908, "Hawaiian and other Pacific Echini." Mem. M. C. Z., *34*, No. 2, pp. 43–134.

————————1909, the same. Mem. M. C. Z., *34*, No. 3, pp. 135–204.

Bell, F. J.—1882, "Note on the Echinoderm Fauna of the Island of Ceylon." Ann. Mag. Nat. Hist. (5), *10*, pp. 218–225.

————————1884, "The Species of Oreaster." Proc. Zool. Soc. London, pp. 57–87.

————————1887, "The Echinoderm Fauna of the Island of Ceylon." Trans. Roy. Dublin Soc. (2), *3*, pp. 643–658.

————————1888, "Report on a Collection of Echinoderms," &c. Proc. Zool. Soc. London, pp. 383–389.

Clark, A. H.—1912, "The Crinoids of the Indian Ocean." Echinoderma of Indian Museum, Pt. VII., pp. 1–325.

Clark, H. L.—1907, "The Cidaridæ." Bull. M. C. Z., *51* No. 7, pp. 163–230.

————————1909, "Notes on some Australian and Indo-Pacific Echinoderms." Bull. M. C. Z., *52*, No. 7, pp. 107–136.

————————1912, "Hawaiian and other Pacific Echini," Mem. M. C. Z., *34*, No. 4, pp. 205–384.

————————1914, the same. Mem. M. C. Z., *46*, No. 1, pp. 1–78.

Döderlein, L.—1888, "Echinodermen von Ceylon." Zool. Jahrb., Abt. f. Syst., *3*, pp. 821–846.

————————1896, "Bericht über die .... Asteroidea." In Semon's Zool. Forsh. Australien. Denk. Ges. Jena, *8*, pp. 301–322.

Koehler, R.—1898, "'Investigator' Échinodermes." Les Ophiures littorales. Bull. Sci. France Belgique, *31*, pp. 54–124.

————————1898*a*, "Description d'une Ophiure," &c. Bull. Soc. Zool. France, *23*, pp. 164, 165.

————————1904, "Ophiures nouvelles ou peu connues." Mem. Soc. Zool. France, *17*, pp. 54–119.

————————1905, "Ophiures de l'expedition du 'Siboga.'" Siboga Reports, *45b*, pp. 1-142.

————————1910, "Shallow-water Asteroidea." Echinoderma of Indian Museum, Pt. VI., pp. 1–184.

————————1914, "An Account of the Echinoidea: Spatangidés." Echinoderma of Indian Museum, Pt. VIII., pp. 1–258.

Loriol, P. de.—1883, "Échinodermes recueillis .... a l'ile Maurice: Échinides." Mem. Soc. Phys. Hist. Nat. Geneva, *28*, No. 8, pp. 1–64.

————————1885, "Échinodermes recueillis .... a l'ile Maurice: II. Stellérides." Mem. Soc. Phys. Hist. Nat. Geneva, *29*, No. 4, pp. 1–84.

————————1893, "Échinodermes de la Baie d'Amboine." Rev. Suisse Zool., *1*, pp. 359–427.

————————1894, "Échinodermes recueillis .... a l'ile Maurice: III. Ophiurides et Astrophytides." Mem. Soc. Phys. Hist. Nat. Geneva, *32*, Pt. I., No. 3, pp. 1–64.

Ludwig, H.—1890, "Ceylonesische Echinodermen." Sitz. Niederrheinischen Ges. Nat. Heilk. in Bonn, pp. 98-105.

Lütken, C.—1871, "Fortsatte kritiske og beskrivende Bidrag til kundskab om Söstjernerne (Asteriderne)." Vid. Med. .... for .... 1871, Nos. 15–19, pp. 227–304.

Lyman, T.—1865, "Ophiuridæ and Astrophytidæ." Ill. Cat. M. C. Z., No. 1, pp. 1–195.

Lyman, T.—1874, "Ophiuridæ and Astrophytidæ, new and old." Bull. M. C. Z., *3*, No. 10, pp. 221–272.

————1882, "'Challenger' Ophiuroidea," pp. 1–386.

Perrier, E.—1875–76, "Revision de .... Stellérides." Arch. Zool. Exp.

Sladen, W. P.—1889, "'Challenger' Asteroidea," pp. 1–893.

Smith, E. A.—1878, "Description of a remarkable new form of Ophiuridæ from Ceylon." Ann. Mag. Nat. Hist. (5), *1*, pp. 463–465.

Thurston, E.—1894, "Inspection of Ceylon Pearl Banks." Bull. Madras Gov. Mus., No. 1, pp. 36–54.

Walter, A.—1885, "Ceylon Echinodermen." Jena. Zeits., *18*, pp. 365–384.

NOTES ON CEYLON COCCIDÆ.

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Ischnaspis longirostris, Sign.

On *Graptophyllum hortensis.*

Scale lepidosaphes-like, long, narrow, very dark brown in colour. Dorsal surface of pygidium of adult with a tessellated patch. Two pairs of lobes, median lobes about half their width apart, each lobe somewhat triangular and minutely serrated along the margin. Second lobe duplex, the mesal part much the larger, non-serrated, projecting almost as far caudad as do the median lobes, and with a chitinous band on each side running well into the pygidium. Third lobe and sometimes fourth may be slightly developed. Apex of pygidium slightly concave. Two short setæ between the median lobes, a seta, a plate, and a conspicuous pore-projection between the median and second lobes, a seta, a plate, and a pore-projection laterad of the second lobes, four plates (or five) on the pygidial margin, and six or seven plates on the two abdominal segments in front of the pygidium.

Circumgenital pores 2 (5 and 4) (2 and 2). On *Landolphia kirkii* specimens were seen with the circumgenital pores irregularly arranged in six groups of from two to five each—totalling seventeen.

On coffee pores were—3 (5 and 6) (2 and 2); 3 (5 and 5) (2 and 2). Insects, which were examined as soon as collected, contained larvæ in an advanced stage of development. An insect from leaves of coffee contained four large eggs as long as the breadth of the body, but lying in a slightly oblique position.

FROGATTIELLA PENICILLATA, Gr.

(= *Odonaspis penicillata.*)

J. B. N. H., Vol. XVI., p. 346.

The " hairs " of Green are in reality plates, of which there are six or seven. There are also 2 long setæ which reach as far caudad as do the plates. There is a seta just mesad of the second paraphyses and another at the anterior limit of the pygidium. A third pair of paraphyses was not visible in the insects examined. The body contained larvæ with mouth-setæ well developed. There are parastigmatic pores associated with the anterior spiracles. The pygidium and the lateral margins of the preceding segments are more highly chitinized than the rest of the pygidium. The anus is surrounded by a ring of chitin.

CHRYSOMPHALUS CISTULOIDES, Gr.

Ibid., p. 342.

I am not certain that Green is correct in his interpretation of the shape of the scale. Some look very like it, but though the ventral scale does stand up, I think there is also a tilt upwards in the dorsal scale. Many scales are quite without the erect part of the ventral scale. The clear canal-like area running cephalad from the margin of the pygidium to the anus is very conspicuous. There is a conspicuous broad plate truncate and notched at the apex laterad of the second and third lobes, and others may have been broken off.

Circumgenital pores 2 (4 and 2) ; 1 (4 and 4) ; those of each group in a row. The body contains larvæ with mouth-setæ developed.

CHIONASPIS (SUBCORTICALIS, Gr. ?).

Ibid., p. 351.

Under bark of *Artocarpus integrifolia.*

The secretion is very thin ; scale otherwise as in *C. subcorticalis*, Gr. Adult female elongated or with the pygidium somewhat retracted. In its pygidial characters the insect resembles *Chionaspis subcorticalis*, Gr. The median lobes, however, are closer together, while the second lobes are

distinct, though hyaline and duplex, each half being longer than broad; the dorsal pores are slightly fewer than are represented in Green's figure, there being six in place of nine in the second series, four in the posterior, and two in the anterior portion of the arch. There is a prominent pore-opening laterad of the median lobes and of the first plate. Plates 0, 1, 1, 1, 2.

The anterior spiracles possess a prominent group of small parastigmatic glands (*C. subcorticalis*, Gr., is said to have no such glands).

Circumgenital pores 5 (19 and 18) (24 and 27).

Anus located as in *C. subcorticalis*, Gr.

Aspidiotus (cuculus, Gr. ?).

Ibid., p. 341.

Insect oval, not "long pyriform." The lobes very distinctly notched on each side, not "obscurely emarginate" (in his figure, however, Green represents the notches as very distinct); apex broadly rounded, the mesal and lateral notches at the same level. Laterad of the lobes some 8 or 9 long pectinæ; these are in a continuous series, as in *Morganella maskelli*, Ckll., not in two groups as in *A. cuculus*. No "distinct marginal prominence" between the groups, nor a "larger conical point" beyond the outer group. Pectinæ (two ?) between the lobes; all pectinæ frayed at apex. The anal orifice has a comparatively broad chitinous margin, as in Green's figure of *A. cuculus*. A small seta just laterad of median lobes, 2 or 3 longer setæ in region of the pectinæ, and 3 or 4 on the margin of the pygidium cephalad of the pectinæ. A clear dorsal pore in the pygidium cephalad of the base of each lobe, as in Green's figure of *A. cuculus*. Minute dorsal pores especially distinct in a row running cephalad from the lateral side of the median lobes.

On twigs of *Mesua ferrea*, Peradeniya.

Though this insect shows several points of difference from *A. cuculus*, Gr., I hesitate to consider it as a separate species, the more so as both occur on *Mesua ferrea*. The one may be a younger stage of the other.

PARLATORIA PERGANDII, var. PHYLLANTHI, Gr.

Ibid., *p.* 350.

On *Diospyros ebenum*. Colouration of scale as in type.

The fourth lobe on one side is lobe-like with faint serrations, on the other with distinctly deeper serrations, but still not pectina-like.

Circumgenital pores (6 and 5) (5 and 5).

DIASPIS BOISDUVALII, Sign.

Scale circular, exuviæ more or less central; grayish-white. Adult female but little longer than broad; a conspicuous tubercle on margin of thorax on each side. Apex of pygidium deeply notched; median lobes slightly divergent, narrowing towards apex, which is blunt, serrated on mesal edge, not markedly free at apex. There is a gland-pore and two short setæ between the median lobes. There is a seta and a plate laterad of the lobes. A pore-projection, situated between the median and second lobes, projects as far caudad as does the apex of second lobes. Second lobe duplex, mesal half reaching further caudad than do the median lobes; each half-rounded at apex with a slight lateral notch. Between second and third lobes a plate and a pore-projection. Third lobes duplex, slightly larger than second and of much the same shape. There is a seta on the lateral half of each of the second and third lobes. Laterad of third lobe is a plate and a duplex lobe-like projection; then two short, stout, pointed plates, and a stout spinous projection followed by four similar plates. Similar plates occur on the two abdominal segments cephalad of the pygidium.

Circumgenital pores bunched, 8 (16 and 19) (14 and 14).

On leaf of Orchid, Peradeniya.

ASPIDIOTUS (ORIENTALIS, Newst. ?).

Asp. osbeckiæ, Gr. *Ibid.*, p. 47.

On leaves of *Limonia alata*. Antennal tubercle broader than long, with a short median projection and bearing a long seta laterally. Mesal lobes as in Green's figure. Second lobes much as in Green's figure, but the lateral notch is more distinctly caudad of the mesal. Third lobes almost as broad as second lobes and deeply notched on the lateral margin.

Pectinæ 2, 2, 3, and 3 beyond the third lobes, deeply divided at apex and scarcely projecting beyond the lobes. All the pectinæ laterad of the third lobes with *dictyospermie*-like processes; these processes bent towards the mesal lobes. Paraphyses indistinct, those on the mesal side of the median lobe being the most distinct. Anus large, about its own length from the apex of the pygidium. Interval between second and third lobes wider than between median and second lobes.

Circumgenital pores present (6 and 6) (5 and 6); (6 and 5) (4 and 4); (7 and ?) (5 and 4).

Chrysomphalus rossi, Mask.

Green, "Coccidæ of Ceylon," Pt. I., p. 45.

On leaves of *Cycas* sp.

The lobes are distinctly notched on the lateral margin, obscurely on mesal margin. The pectinæ appear as if united at the base. There are seven pairs of distinct paraphyses; a pair at the base of each lobe and a pair between the second and third lobes, one on each side. The second, fifth, and seventh paraphyses of each side the longest. Numerous finer paraphyses on the pygidial margin.

Circumgenital pores (9 and 8) (7 and 7); (13 and 13) (7 and 8).

The mouth-setæ and lobes of unborn young are distinct. The median lobes of the embryo are widely separated, longer than broad, convergent, serrated on lateral margin, slightly notched at apex on mesal side; two small pointed plates in the interval between them, also two setæ projecting cephalad and crossing. A second pair of lobes is present, longer than broad, notched on both margins.

Aonidiella (Chrysomphalus) aurantii, Mask.

Ibid., p. 58.

On *Morus* sp.

The pygidium and one or two segments in front of the pygidium are less heavily chitinized than the rest of the body. The paraphyses are inconspicuous. The median lobes are distinctly larger than the second lobes. The second lobes may be without a notch on the mesal margin, resembling the third lobes in that respect.

Pseudaonidia trilobitiformis, Gr.

Ibid., p. 41.

On *Peddeia africana*.

Antenna consists of a single long seta. Anterior parastigmatic pores 12. Median lobes more strongly chitinized than the others. Median lobes do not reach quite so far caudad as do the second lobes. All lobes except fourth rounded at apex and obscurely notched on each side near the apex ; the fourth notched on the lateral side only. Second and third lobes of much the same width and but slightly narrower than the median lobes.

Circumgenital pores (18 and 19) (15 and 18).

On *Ixora* sp.

Lobes narrowing towards the base, apices rounded. Median, second, and third lobes project almost equally far caudad.

Anterior parastigmatic pores 17–18. Circumgenital pores (30 and 25) (23 and 14). Adult female dark purple, tip of abdomen paler. Larvæ dark purple.

Aonidia perplexa, Gr.

J. B. N. H. Soc., Vol. XIII., p. 252.

Lobes of the second exuvium expanded caudally, the apex directed towards the meson ; apex on unbroken curve. Two pectinæ between the median lobes, two between the first and second and second and third lobes, and eleven laterad of the third lobes ; these eleven pectinæ produced into a long point and pectinate on the lateral margin.

Antonina sp.

Female very dark brown in colour, almost completely covered by loose white wax. Antennæ situated on the anterior margin, 2-jointed, the basal joint short, the terminal with about 7 hairs at its apex. Legs absent. Spiracles large, each with from 22 to 25 parastigmatic glands. Derm pores circular, of variable size. Derm covered with setæ. Apex of abdomen chitinized and bearing numerous derm pores and setæ. Anal ring with 6 stout setæ, which reach to the

posterior margin. Posterior margin slightly concave with large setæ on the edge of the concavity. Under the leaf-sheaths of *Panicum uncinatum* at Peradeniya.

MORGANELLA MASKELLI, Ckll.

(*Aspidiotus longispinus*, Morg.)

J. B. N. H. Soc., Vol. XVI., p. 340.

Antenna a low tubercle bearing several smaller tubercles, and at the base a long stout seta curved towards the middle line. On the cephalic margin between the level of the antennæ and placed close together are two stout setæ. Each lobe with two lateral notches, the proximal near the base and obscure, the distal very distinct. The lobes project into the pygidium as far as the anus, and the cephalic end of the projection may be knobbed. The pygidium is not markedly chitinized, though there may be several strands of chitin laterad of the vagina. The first pair of setæ laterad of the lobes are short and stout, the one more laterad the longer ; the second pair may be similar in shape or long and slender and curved at the apex. The pectinæ are much more pectinate than in Green's figure, the fringe being present on both sides of the main shaft and projecting at right angles to the shaft. The first pair of setæ are separated from the lobes by at least two pectinæ. The larva is broadly oval and possesses a well-marked pair of lobes, which are somewhat convergent and project slightly into the pygidium. Each possesses three notches, one mesad and two laterad of the rounded apex. Between the lobes are two short stout setæ and two long setæ, one at the base of each lobe. Laterad of the lobes are several short setæ and a hyaline projection serrated at the apex.

An insect on *Morus* sp. contained in the posterior abdominal region a parasite with stout, sharply-hooked mandibles, and at the caudal end a tube continuous with the alimentary canal and apparently reaching to the outside of the scale insect, and containing small granular bodies. There were several parasites present, but only one had developed.

On *Cinnamonium zeylanica*, *Morus* sp., and *Brousonettia papyrifera*, in the last case buried in the bark.

Aulacaspis barberi, Gr.

M. D. A. I., Vol. II., No. 2, p. 35.

On *Loranthus* sp. growing on Avocada Pear, Peradeniya, June 18, 1913.

Median lobes slightly divergent. Apex of mesal half of second lobe obliquely truncate, slightly incised; lateral half small and pointed. Third lobes present on one side, small, not duplex. Laterad of third lobes are several serrated projections, those associated with gland pores being large and prominent. Plates 1, 1, 1 or 2, 2, 3.

Circumgenital pores 8 (17 and 15) (17 and 17).

Two dorsal pores immediately laterad of the circumgenital pores.

On *Loranthus* sp. growing on *Cassia nodosa*, Peradeniya, June 3, 1914.

Female scale on petiole. Secretion grayish-white, exuviæ reddish-brown, situated just within margin. Scale highly convex.

Male scales in hundreds on under surface of same leaf. Exuviæ yellowish-brown, secretion white, with faint median carina. Scales lying flat on leaf, the exuviæ all pointing towards base of leaf. Antenna of adult female a tubercle bearing a short spine apically and a long seta laterally. Anterior spiracles with from 5 to 11 parastigmatic pores.

Three dorsal pores immediately laterad of circumgenital pores. Mesal half of second lobe dilated, rounded at apex; lateral half absent or small and pointed.

Circumgenital pores 6 (12 and 18) (24 and 25); 7 (20 and 16) (22 and 21); 10 (22 and 22) (22 and 20). Median circumgenital pores in a transverse row or in a bunch.

Criococcus (araucariæ, Mask. ?).

Larva, antenna with 7 segments, third longest. Body with a fringe of stout, conical, truncate spines on the dorsal side, and a fringe of slender pointed spines ventrally. Derm mamillated. Small pores and larger ring-like pores scattered over dorsum. Venter covered with slender setæ and circular pores. Tarsi of first legs longer than tibiæ, of almost the same length

as tibiæ in the second and third pairs. Anal ring with 8 setæ. Anal lobe with two shoulders near the base, each bearing a stout, conical, truncate spine; another lobe on mesal margin near apex also bearing a spine. A long seta on apex of lobe. Two large setæ and several smaller setæ on venter of anal lobes.

On *Araucaria cookii*, Peradeniya.

Aspidiotus hederæ, Vall.

On leaf of *Artocarpus integrifolia*, Peradeniya.

Scale circular, yellow, transparent. Mounted insect tapering rapidly towards the posterior end; pygidium small, the extreme apex rather suddenly truncated. The body contains yellowish eggs.

The median lobes are broader in comparison with their length than in *Aspidiotus transparens*, Gr. (Coccidæ of Ceylon, Pt. I., p. 49); they are rounded at the apex and distinctly notched on both sides, the mesal notch being caudad of the lateral. The second lobes are narrower than the median, longer than broad, rounded at apex, slightly notched on both sides. The third lobes are slightly narrower than the second, are longer than broad, rounded at apex, and notched on the lateral side. Laterad of the third lobes are about seven or eight short, broad pectinæ, deeply pectinate at apex, not so distinctly produced on the mesal side as in Green's figure of *A. transparens*, Gr. Dorsal pores in more or less regular rows running cephalad from the margin of the pygidium. Anus as in Green's figure of *A. transparens* as regards shape and position. Circumgenital pores (13 and 11) (9 and 10), those of each group in two more or less distinct longitudinal rows.

Protopulvinaria longivalvata, Gr.

Coccidæ of Ceylon, Pt. IV., p. 254.

On *Gardenia latifolia*. In fresh specimens the dorsum is seen to bear wax-plates of the form of those in *Paralecanium expansum*, Gr. The marginal, dark-coloured zone is very distinct.

The eighth segment of the antenna is the longest, while the second is slightly longer than the third. The tarsus is shorter than the tibia, and in the first pair of legs is distinctly constricted distad of its middle. The marginal hairs are dilated at the base and apex and extend for half their length beyond the claw. Tarsal hairs long and knobbed at apex. Four small "fringe setæ," two on each side.

On Guava. Eighth segment of the antenna the longest, and the second is fully as long as the third.

Pseudoparlatoria parlatorioides, Comst.

On leaves of Guava.

Scale circular, pale yellow, transparent; exuvia large, situated towards one side.

Three pairs of lobes. Median lobes well separated, each with sides parallel towards base; abruptly narrowed towards apex, which is rounded. Second and third lobes duplex, each part usually notched at least on the lateral side. There is a pair of short diverging plates united at base between the median lobes. There is a plate laterad of the median and second lobes and two small spinous processes on the margin of the pygidium cephalad of the third lobes. There is a prominent pore-opening laterad of the median, second, and third lobes, and a fourth on the base of the mesal half of the third lobe.

Anus conspicuous and not far from apex of pygidium.

Circumgenital pores (12 and 12) (7 and 8).

The pygidium of the second exuvium is very similar to that of the adult, except that the third pair of lobes is absent The pygidium of the first exuvium bears a pair of minute hyaline lobes, widely separated and abruptly narrowed towards apex.

There is a stout plate laterad of each lobe and two or three similar plates more cephalad.

Chionaspis simplex, Gr.

Coccidæ of Ceylon, Pt. II., p. 160.

Underneath leaf sheaths of small bamboo (? *Dendrocalamus* sp.) at Peradeniya. Pygidium without lobes, asymmetrical, with small crenulations only and a few short setæ.

Pores of exterior spiracles 6–8, of posterior none. Antenna a tubercle bearing two setæ. Anal opening situated just cephalad of the anterior group of circumgenital pores, the vagina at the level of the interval between the cephalo-lateral and caudo-lateral groups of circumgenital pores. Numerous small glands opening on pygidium. Numerous curved striæ all over body. Chitinous bands run cephalad from the apex of the pygidium.

Circumgenital pores in five compact groups, 23 (30 and 39) (37 and 47).

This insect resembles Green's insect from Mauritius, which, he states, resembles in every way, except in number of groups of circumgenital pores, his *C. simplex*. Green may have colonized this insect at Peradeniya.

Chionaspis herbæ, Gr.

Under leaf sheaths of *Panicum* sp.

The median lobes are sunk in a slight cleft, and are finely but distinctly serrated on the mesal margin.

The number of circumgenital pores in the specimen I have seen is fewer than that given by Green ; 17 (27 and 30) (30 and 25) ; 15 (29 and 32) (27 and 30) ; 14 (33 and 38) (31 and 33).

The antenna is a tubercle bearing a single seta.

Fiorinia fioriniæ, Targ. Tozz., Green.

Coccidæ of Ceylon, Pt. I., p. 94.

Male. Scale white, with a slight median carina sometimes visible towards the posterior end. Exuvium yellowish-brown. Scale surrounded by powdery wax.

On *Cupressus* sp.

The antennæ of the female are very variable in shape and size ; generally they consist of a broad, sometimes quadrangular, tubercle, rounded, pointed, or notched at the apex, and bearing a stout curved seta near the base. I have never seen them showing the regularity represented in Green's figure. Anterior spiracles with about 5 parastigmatic pores.

The marginal abdominal tubercles are blunt at apex (on *Turpinia* sp.).

The median lobes are situated in a cleft, narrow, tapering, strongly divergent, pointed, distinctly free at apex and serrated along the mesal margin and at the apex.

The second lobes are duplex. The mesal half may be almost twice as broad as the lateral half, which may be well developed or minute (*Turpinia*); the mesal half may project caudally as far as the apex of the median lobes and may be slightly serrated on the lateral margin (Avocado Pear). Both halves are usually rounded at the apex.

There are two short setæ between the median lobes, a seta on the lateral side of the median lobes, a seta and a plate laterad of the median lobes. Thereafter in succession a prominent gland-pore, the second lobe with a seta on the base of its lateral half, a long plate broad at the base and abruptly narrowed thereafter, a prominent gland-pore, and three more gland-pores at intervals on the margin of the pygidium, the most anterior small, a seta being associated with the first of the three, and another lying near the third. No plates visible cephalad of the one laterad of the second lobes (*Cupressus* sp.).

In an insect from *Turpinia* sp. the setæ between the median lobes project beyond the lobes.

The number of gland pores on the pygidium is variable, though four appears to be the rule. In an insect from Avocado Pear only three could be made out on each side, one laterad of the median lobes, one laterad of the second lobes, and one slightly caudad of the level of the posterior end of the caudo-lateral group of circumgenital pores; and on one side the last-mentioned pore was either absent or so much reduced as to be unrecognizable as such.

In an insect from *Walsura piscidia* there was a plate cephalad of the third gland-pore and having a seta mesad of it.

Circumgenital pores. Median in a distinct group: 8 (9 and 5) (13 and 15), *Walsura*. Median group distinctly isolated: 3 (12 and 11) (11 and 13); 2 of the 11 of the posterior group situated midway between the anterior and the posterior groups (*Turpinia*). Median group of 8 in a double transverse row: Host ?

Median and anterior-lateral groups practically in a continuous arch, 5 (9 and 10) (13 and 13); 6 (9 and 8) (12 and 12);

Eugenia sp. Pores practically in a continuous arch : 7 (9 and 7) (12 and 12) ; 5 (11 and 9) (11 and 12) ; 6 (6 and 6) (5 and 10). Avocado Pear.

Median group distinct or continuous with the anterior groups ; anterior and posterior groups massed or separated. A median group showed 7 pores partly in a single and partly in a double transverse row. *Cupressus.*

Anus just caudad of the median group of circumgenital pores. Vagina in a line between the break in the lateral groups of circumgenital pores. (*Turpinia.*)

The second exuvium may have both halves of the second lobe well developed, and laterad of the second lobe is the lobe-like projection of a gland-pore. Laterad of this is a series of 4 or 5 serrated projections and still farther laterad 2 short plates. There are at least 5 gland-pores opening on the margin of the pygidium. There is a prominent seta on the lateral half of the second lobe. (*Turpinia.*)

Larva with two chitinous processes meso-caudad of the base of the antenna (*Eugenia*). In the larval exuvium two clear areas in corresponding position (Host ?).

Larva with two setæ projecting cephalad between the antenna.

Apex of the pygidium with 2 minute, widely-separated lobes, and laterad of these two long plates, the one more caudad the larger.

There are several small setæ between the lobes, and two situated cephalo-mesally of the base of the lobes and convergent caudally. (*Eugenia* sp.)

It is with deep regret that we record the death of Mr. Andrew Rutherford, Government Entomologist, which occurred unexpectedly on February 3, after a brief illness. Mr. Rutherford was appointed in March, 1913, and though his career in Ceylon has been prematurely brought to a close, it was sufficient to demonstrate to his colleagues his thorough grasp of his subject and keen devotion to the furtherance of entomological knowledge.

Mr. Rutherford held the degrees of M.A. and B.Sc. of Edinburgh University. For some time he was Professor of Biology at the Agricultural College, Cirencester, and afterwards Lecturer in Zoology and Botany at University College, Cardiff. Obtaining a Carnegie Studentship he proceeded to America and studied entomology at Cornell University. While in America he visited Trinidad, and travelled through the United States in order to obtain a first-hand knowledge of field entomology as conducted in admittedly the best and most highly organized entomological service in the world. It may be questioned whether Great Britain has ever sent out to the Colonies a man who had so thoroughly equipped himself for his work.

Mr. Rutherford devoted himself, especially in Ceylon, to the collection and study of injurious insects and their parasites, and had laid the foundation for a complete literature relating to such as affect Ceylon plants. The large collections which he amassed were submitted to specialists in Europe and America, where his work was well known and appreciated. In his special subject, Coccidæ, he had already gained a wide reputation, and was consulted by entomologists in all parts of the East. These labours were just beginning to bear fruit, as is evidenced by his Papers in the Tropical Agriculturist, the Bulletin of Entomological Research, the Journal of the Bombay Natural History Society, and Spolia Zeylanica, though these represent but a small fraction of the results which would naturally have accrued.

Scientific by training and inclination, Mr. Rutherford abhorred slipshod work and unsupported hypotheses; he subjected his own work to the most rigorous scrutiny, and expected others to do the same. His loss is deplored not only in Ceylon, but also by a wide circle of personal friends and co-workers in Europe and America.

T. PETCH.

Peradeniya, July, 1915.

NOTE ON TWO ABERRATIONS OF CEYLON BUTTERFLIES.

By G. M. Henry,

Assistant in Systematic Entomology, Colombo Museum.

(*With one plate.*)

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1. **Telchinia violæ,** Fabr.—This specimen was presented to the Colombo Museum recently by Mr. G. W. Halkett, who caught it in November, 1913, between Kurunegala and Matale, on Delwita estate. It is an interesting aberration of this common butterfly, and differs from the normal in the following points :—

Fore-wing, upper side.—The usual spots and streaks in and beyond the cell are merged in a large, rather ill-defined dark patch, which occupies almost the whole of the cell and extends to the usual position of the black spots in spaces 4, 5, 6, and 10. The black spots in interspaces 1 and 3 are replaced by long irregular dark patches, and there is a similar patch in interspace 2. In other respects the fore-wing is normal.

Hind-wing, upper side.—There is a much larger black spot than usual in interspace 7. The spot in interspace 3 is absent. The spot in interspace 2 is obsolescent in the left wing, but well marked in the right. There is a small spot at the point where vein 6 leaves the cell. The light spots in the interspaces of the black terminal band are confluent with the tawny of the disc of the wing. The black band thus becomes a series of dentate marks at the veins.

Fore-wing, under side.—This does not greatly differ from the normal, but the large black patches on the upper side show through the wing, producing a dusky appearance.

Hind-wing, under side.—All the spots anterior to the middle of the cell are much enlarged. The spots in interspaces 1*a*,

1*b*, 1, 3, and 5 are absent. The large whitish spots in the terminal black band are confluent with the colour of the disc, as on the upper side. The head, thorax, and abdomen are normal.

The figure should make these points clear.

2. **Pyrameis cardui,** Linn.—I caught a curious aberration of this species at Scarborough estate, Maskeliya, on October 20, 1913. Many normal specimens of the species were flying about at the time. It may be described as follows :—

Fore-wing, upper side.—The irregular black band which in normal specimens crosses interspaces 1 and 2 and projects into the cell is absent, its place being taken by the tawny of the ground colour. Instead of the normal two rows of white spots in the black apical area, there is a single row of five large ill-defined white spots. This row is continued down towards the tornus by small obsolescent whitish spots in interspaces 1 and 2. The black terminal band is broader than in the normal, and very ill-defined proximally.

Hind-wing, upper side.—The dusky brown area at the basal half of the wing is very restricted in area. The row of round black spots in interspaces 2 to 6 is absent, and is replaced by a row of ill-defined white spots. There is a white spot in interspace 1 belonging to the same row. The inner terminal row of black lunules is absent.

Fore-wing, under side.—The differences here are practically the same as on the upper side. All the black markings are paler and less well-defined than in normal specimens. There are no white spots in the apical area.

Hind-wing, under side.—The row of ocelli in interspaces 2 to 6 is represented by two obsolescent ones in interspaces 2 and 5 only. The dark subterminal lunules are absent, and the bold marblings of the normal *P. cardui* are reduced to a few ill-defined smudges.

The specimen was sent to Mr. E. E. Green in England, who has not yet returned it. I have described it from my coloured drawing, made before the specimen was sent to Mr. Green.

Telchinia violæ, Fabr. × 1.

Pyrameis cardui, Linn. × 1.

G. Henry, *del.*

NOTES ON ANIMAL AND PLANT LIFE IN THE VEDDA COUNTRY.

By Frederick Lewis, F.L.S.

(*With one map.*)

THE locality to which these notes apply represents the whole of the Maha Wedirata, the eastern half of the Buttala-Wedirata, and the southern half of the Panawa Pattu of the Eastern Province.

This large extent of country falls within part of Uva from the Monaragala range eastwards, and, as indicated above, part of the Eastern Province, or more specifically within the following rough boundaries. Starting from the conspicuous needle-pointed mountain called Wadinagala on the north, it follows the provincial limits of the Eastern Province to the point where it crosses the Government cart road from Potuvil to Muppane. From that point the road to Muppane is adopted as far at Potuvil, from thence following the sea-coast to Kumuna on the banks of the Kumbukkan river.

Next the Kumbukkan river is followed to a point called Kebilitte, at the foot of the imposing mass of rock shown on the Admiralty charts as "Chimney Hill." From here, a line drawn to Sirigala and thence to Wadinagala encloses the whole.

Within this area there is only one perennial river—the Kumbukkan-aar, which forms the southern limit of the region in question. The next largest stream is the Heda-oya, which in the north-east monsoon is a wide and formidable river. To the north the Lankiya-oya is an important stream, which is supplemented by several considerable branches that after uniting with it form a great branch of the Namal-oya.

The Govindu-oya, rising on the east flank of the "Westminster Abbey," forms a useful branch of the Karandi-oya that drains the eastern half of the Maha Wedirata country,

while the Wila-oya and Kulapan-oya convey the waters from the eastern limits of the Buttala-Wedirata to the sea through the Panawa Pattu.

The chief mountains are Wadinagala (2,414 ft.), "Westminster Abbey" (1,830 ft.), Degalhella, Nilgala, Hibitalanagala, Kiripokunagala, "Chimney Hill," and Obbekota in the Monaragala range.

Most of these mountains rise abruptly from the plains below, and terminate in high masses of rock. There are, in some cases—particularly on the summit of "Westminster Abbey"—small patches of vegetation, but in the majority the summits of the more conspicuous hills are bare. The country described, therefore, may, broadly speaking, be considered as flat, broken by a few low undulations, the whole being dotted over irregularly with abrupt mountainous masses of rock.

The rainfall of this area is comparatively low, and probably does not exceed an average of 60 inches for the year, nearly the whole of which falls in the north-east monsoon, thus involving a period of extreme drought during the south-west monsoon, when for months there is not a drop of rain, followed by torrential showers of variable intensity and uneven distribution.

I am indebted to Mr. Balfour, the Director of Irrigation, for the details of rainfall at Ampari and Rotawewa,* well outside the area I refer to, and to the Surveyor-General† for the same particulars at Monaragala, these being given in tabular form in the Appendix.

As might be anticipated from such variation and extreme, it would follow that the vegetation of the country embraced must be, for the most part, what is called dry-zone flora, but other influences have to be considered in relation to distribution. These may be considered as being affected—

(*a*) By influence of streams rising in high altitudes, or in moister regions;
(*b*) By the operations of human beings;
(*c*) By animal transport of seed;
(*d*) By wind action.

* Appendix A. † Appendix B.

Before passing to a brief detailed investigation of the influences roughly classified as above, it may not be out of place to examine the historical records that apply to the area at the moment under consideration. Thus, we find Arugam Bay corresponds to Mardi, or Morduli Portus, in the time of Ptolemy. Okanda Bay is the same as Bocana—as the sound nearly implies ; Kumuna, according to the Sanskrit, is the same as Gonagramuka ; while the Kumbukkan river appears in Ptolemy's time to have been called Baracus fluvius.

From this it may be inferred that at least two bays on our eastern coast, south of Batticaloa, were known to the Romans, in addition to the perennial Kumbukkan-aar, and it may be deduced with probable certainty that these bays were ports of call, while the Kumbukkan river was more than likely to have been well known as being the one spot on the east coast where fresh water could always be obtained in both monsoons, for trading boats of light draught.

From this circumstance alone it is probable that the traders of the Roman period had dealings at Kumuna, while Okanda and Arugam Bays both offered a safe anchorage to the traders' vessels.

The whole of the Panawa Pattu from a point south of Komari was included in the region called in Sanskrit times Lambakarna, which, according to Pliny and Ptolemy's map, covered Bocani, of which Bocana (= Okanda) was the port.

Passing to more modern maps, we find about 1681 Knox gives Pottin for Pottuvil ; Coemena for Kumuna ; and Konokan-aar for the Kumbukkan, showing that these places had, up to that time, sufficient importance to find their recognition in maps of the day. Knox, moreover, distinctly shows Pannoa or Panova Regnum, implying that that part of the country was under a sovereign at that time, insignificant though he may have been.

This evidence, however, which might be elaborated but for pressure on the space of this Paper, points to the definite conclusion that for a considerable period a large extent of our eastern coast was well known, even to the traders of the western world, and we must anticipate, therefore, that in the course of that trade there would be an exchange of

commodities which would produce both directly and indirectly its effect upon local plant life, either by the introduction of species of economic value, or by the direct export of woods found at hand.

In support of this it is noticeable that to the north-west of Pottuvil, Palu (*Mimusops luxandra*) and Satinwood (*Chloroxylon swietenia*) are comparatively abundant, as contrasted with the scarcity of the same species on the banks of the Kumbukkan river. Again, while Mi (*Bassia longifolia*) is abundant on the Kumbukkan, it may be called rare west of Pottuvil. As this last-named is an introduction of great value, it was spared where it existed near towns, but was neglected in those localities where the population had no permanent settlement, as we find is the case with the majority of the Maha Wedirata "villages" of the present day, and it is only in some places of old establishment that we find the Mi tree now.

The present population is very much scattered, its distribution being undoubtedly governed by the presence or absence of water; hence it will be found that the so-called villages are at considerable distances apart, and only where a supply of water can be got, however small or impure, all the year round. On the other hand, one finds the example of an unpopulated area bounded by a perennial stream, as in the case of the valley of the Kumbukkan river for the last thirty miles of its course. Here, however, we have the instance of a stream that rises to an enormous flood that inundates the country to a depth of many feet on both its banks, thus drowning out, in the wet season, any annual cultivation, and leaving the place parched and dry during the periods of drought—two factors sufficient to keep back a people unprepared to establish strong measures to secure permanent occupation.

Nor is this all. The Kumbukkan river, after it passes the foot of the isolated mass of the Monaragala hills, enters a country that afforded the Veddas their best hunting ground, and the Veddas appear in their early history to have been a race of people who depended almost entirely on the chase, using for their dwellings the rudest shelters of caves and temporary branch huts. They had no inducement to build

houses of lasting character, as neither their instincts nor habits necessitated such procedure.

At Kumuna alone we find a modification of these conditions, in that the greater part of the land where the village stood is above flood level, and possessed of constant fresh water all the year round, besides being at a spot where there was a prospect of trade.

It should be added that all the many anicuts on this river between Kumuna and Kebilitte bear silent testimony to the violence of the floods on the river, and to the once existence of a large population, that probably vanished as soon as these engineering works were destroyed—a population who could enjoy the benefit of the river's floodings by diverting the water into immense tanks, that now are but park-like pieces of jungle.

The present inhabitants of the region embraced within the boundaries recorded here are unquestionably of mixed origin, as it is easy to trace on the western limits the pure Sinhalese type of feature, these fading again to a more specific type through the Maha Wedirata, and again changing markedly on the north-east of that country, till it is practically replaced by Tamils in the Panawa Pattu. Thus, it would seem that the Vedda type lay between the Uvan Sinhalese on the west and the Tamil on the east, with the result that frequently one would hear men, while asserting that they were pure Sinhalese, conversing with each other in Tamil. This I found to be actually the case at Bowela, where the villagers insisted that they were of the Goigama caste.

I was completely baffled in my attempts to secure a vocabulary of Vedda words, though I offered liberal payment for a few lessons in that language. I was pointed out men who were able to speak Vedda, and it was arranged that we should meet, in secret, at a definite time, and at a fixed spot, but when the time came I was told the men had gone away to find stray cattle, or some other equally trumped-up story.

One night I camped close to some huts in the village of Wattegama, and after my lamp had been put out and I was supposed to be asleep, I heard an animated discussion in the nearest hut, but though I could hear every word, I did not

recognize a single expression. The following morning I taxed the people with speaking in Vedda language, but they stoutly declared that they could only speak Sinhalese.

In my opinion the majority of the people of the Maha Wedirata are of Vedda origin, but have discarded their primitive customs as they dwindled in numbers, and while other causes, such as marriage with neighbouring people, tended to still further break down the older customs of the isolated clans that made up the Vedda race as a whole, they still clung in secret to the language of their forefathers, as a binding link and a means of private communication.

At Salavai, in the Panawa Pattu, I found one family who admitted that their grandfather was a real Vedda, belonging to one of the clans occupying the country on the confines of the Kumbukkan river.

From the oldest member of this family I obtained a mass of information respecting the habits and customs of the Vedda people.

According to this individual, who has adopted the Sinhalese name of Dissan Hamy, the Veddas were divided up into a number of waruge or clans, each of which occupied and hunted over a specific area of country, and had no connection with the others who lived as separate communities.

The members of each clan were more or less related, and previous to the disintegration of the Veddas as a race, they could not marry any but members of the same waruge.

They lived by hunting, in which only the males took part. Their habitations were caves, and occasionally leaf shelters, but the latter was uncommon.

The females were kept in a state of rigid subjection to the males, and could not take part in the chase, ordinary ceremonials, or conversation with any but those who were immediate relations, or the closest relatives of the husband.

If the husband was pleased to *throw* some meat to his wife, as part of his spoil in the chase, that was all the woman was entitled to. She could not claim a share simply because she was the man's wife.

Under ordinary circumstances, both the males and females were naked, assuming only for special occasions a loin cloth

of the bark of the Ritti (*Antiaris toxicaria*) for males, and a sort of leaf-skirt for the females.

No jewellery was worn by the males or females. Sometimes a necklace made of shells (" Bellan ") was worn by the younger females, but such things as rings were unknown to the earlier Veddas.

They had no idea of time beyond the subdivision of the 24 hours into two divisions, viz., that of light and darkness. Other than this there was no computation except a man's knowledge of a certain striking event that happened in his " small time," but how long ago that was could not be stated.

The taking of a woman to wife required mainly the sanction of the girl's father, after which a few exchanges might be made in signification of the consent of parties. After this the man and woman lived together, while before they would not so much as dare speak to one another in public, unless related.

The age of the woman was invariably extremely youthful at the time of her " marriage," and even at the present day, notwithstanding the comparative civilization of the modern Vedda descendants, youthful marriages still prevail.

I found in response to my inquiries in all parts of the Vedda country that I visited, that 12 years was a common age for a girl to be taken to wife at. In one village I was present at an inquiry by a headman into a case where the girl was only 8. In this case the headman expressed the opinion that the marriage was " very bad."

My informant told me that with the Veddas there was no custom for the woman, when about to give birth to a child, to go to a separate house or hut for the purpose, but that this custom had only come in later.

Among the Veddas there was no such thing as prostitution, nor could I learn that there was polyandry.

The bearing age of women would be at about 14, that of puberty being a year earlier.

Women would have children up to about 28, and as might be expected from the condition of youthful cohabitation for one or two years prior to puberty, the proportion of males and females in a family would be pretty nearly equal. On

the other hand, the mortality would be very considerable among the offspring. This mortality, when infantile, would generally be among the first born and last born, owing to maternal immaturity in the first case and constitutional depletion in the last.

On the question of sex I found that the prevalent idea was that if a wife was not thoroughly obedient to her husband she would invariably give birth to females, and it was only complete subjection to the husband's will that could secure a preponderance of males.

I could get no information on the subject of barrenness or sterility.

As regards the religion of the Veddas previous to their modernization, it appears that they believed in certain "Yakko," who exercised certain influences for good or evil. There was no conception of a Supreme Creator. On the other hand, the "Yakko" possessed, in common with humanity, a tendency to favour; so that it was always possible to secure its influence in return for special molifying ceremonies. Thus, by certain incantations, ceremonial offerings, or honorific declarations, the Yakko who exercised specific powers could be induced to subtend influence to the advantage of the individual then desiring it. Thus, the Yakka who guarded the deer might be induced to direct the deer to come within the reach of the Vedda's bow and arrows. On the other hand, another Yakka might be propitiated so as to render the hunter invisible to the leopard, so that the hunter would escape harm.

Special incantations were supposed to render an individual successful in the chase, so that his aim would be deadly, or that more game would come his way.

Again, disease or sickness was the direct outcome of certain malign Yakko, who could be propitiated, and this was specially to be considered when a woman was pregnant, so that the evil might be diverted from the unborn child.

I was not able to discover from my informant if the Veddas in their primitive times had any definite form of agriculture. It is certain that they were acquainted with rice, but I could not ascertain how it was procured.

Equally they were acquainted with tobacco and betel, for I was shown a place where the Veddas established a toll that was paid usually in these particular commodities.

The dog was the only domestic animal reared by the Vedda, and special names were given to these pets.

The Veddas appeared to have no knowledge of melting iron for the manufacture of their particular implements, which consisted of the bow and arrow, the spear, and the small axe, or hatchet. Arrow and spear-heads were procured by barter; the method of procedure was to clear a small space round the foot of a tree by the wayside leading to a village known to contain smiths. Here the Vedda would hang up to the branch of a tree a vessel containing honey, or a piece of meat, which would be taken by the smith, who in return would hang up an arrow-head.

It was understood by both that the quantity or number of articles required would be represented by the number of parcels of meat or honey. Should the smith, however, take the meat and not leave the arrow-heads that were thus silently requisitioned, he would pay the penalty with his life, or some of his animals would be shot by the defrauded Vedda.

The bow was usually made from the wood of the Dunumadala (*Stereospermum chelonioides*) and of the Bignoniaceæ. It was not always of the same length, as this appears to have depended on the springiness of the wood. The arrow was generally about 4 ft. long, or as much as a man could draw the bow to. The arrow-head appears to have been small, large arrow-heads being for ceremonial purposes only.

Fire was obtained by spinning, under moderate pressure, a vertical rod of Welanga wood (*Pterospermum suberifolium*) on a flat piece of wood of the same species, with the point of the former surrounded by floss, or some quickly inflammable material. Later, the flint and steel were found more effective. One example of a flint and steel was shown to me at Panawa, and I tried to purchase it at the owner's valuation, but I found he was most reluctant to sell. I understood that the flint and steel, a lock of hair, and a fragment of cloth represented a title deed, these being given by a dying man to his heir, or adopted heir, as a mode or evidence of transfer.

According to my authority the Veddas indulged in no games, unless, indeed, the custom of tossing dry leaves in the air and speculating on their position when they fell back upon the ground could be called a game. This, I am told, was only an occasional recreation, and indulged in by boys alone.

The limits of the hunting ground were jealously guarded by the Veddas, and anything like poaching by the members of one clan in the area recognized as belonging to another was punishable by death. Should a hunter lose his way and fall into the hands of a neighbouring clan, he would be closely watched, remaining for the time being in a sort of captivity. If the man's conduct during that time was such as to disarm suspicion he was permitted to go, and might even be accompanied to the confines of the clan's hunting ground, but he would have to proceed at once without looking back, or his conduct might lead to the belief that he was a spy, with fatal consequences.

The method of fishing was to hem in a piece of water by closely fencing in both ends of the stream. People would then enter the enclosed piece of water, armed with slender sticks, thrashing the water therewith till a fish was actually struck, when it would be captured. I saw this actually done in one pool on the Kumbukkan.

My informant told me that the Veddas were at one time harassed by a race of pygmy people, called the Nittawo, who lived in the country known as Lenama, that extended from Bagura in the Panawa Pattu in the east to the confines of the Kattaragama hills on the west.

According to him, these people lived in small troops of from 10 to 40, inhabiting caves, hollow trees, and crevices of precipices. They were about 3 feet or a little more in height, exactly like normal human beings, only in miniature. Their legs were hairy like those of the Wanduroo; they walked erect, and had no tails.

Their arms were short and very powerful, with strong hands, and talon-like finger-nails with which they tore and disembowelled whatever they captured. These generally were small animals, such as hare, mouse-deer, monkeys, iguanas, and tortoises. Their method of attack was by surrounding

the prey, especially if it was sleeping. In this way the Veddas occasionally fell victims, and in consequence they revenged themselves by exterminating the Pygmies. According to my authority, the Nittawo existed at the time of his grandfather, who, he asserted, took an active part with the other members of his clan in burning out one of their encampments.

The Nittawo were an entirely naked race; the females were shorter than the males. Their language appears to have been understood by the Veddas, and was described to me as like the twittering of birds.

My informant knew nothing of their customs, or if they made use of fire. They were, however, unarmed, and appear to have been finally exterminated by the Veddas about three or four generations ago.

I may here mention that as I was sceptical as to the story about this race, I took particular care to make inquiries at the distant village of Waradeniyawa (the furthest inhabited spot on the south of the Buttala-Wedirata) if the oldest inhabitant of that place could give me any confirmation of it. This inquiry was made when Dissan Hamy was not present, and it would have been impossible for my questions to have been anticipated. To my surprise, a very old man of the village completely confirmed in detail Dissan Hamy's description.

I also made further inquiry at another village from a headman, and he repeated the same story, adding that the Nittawo were destroyed by the Veddas out of fear.

It is difficult to reject as false a story, told devoid of the usual fantastic embellishments that characterize the history of mythical creatures such as Yakko, when it is completely confirmed by parties ignorant of what the others have said. Even though tangible evidence is not forthcoming, and it would be difficult to find any, of a people so primitive as these creatures appear to have been, I see no valid reason for disbelieving the statements made to me.

It would appear that the early Vedda and the Nittawo to some extent lived side by side, and both were primitive. In time the Nittawo were destroyed by a race who were armed, and these in turn were disintegrated and absorbed by forces they were powerless to overcome. The clan system was

effectual so long as there were no influences to weaken it, but when once a preponderating force came to surround these clans, their chance of survival was small, and to prevent individual extinction amalgamation presented the path of minimum resistance.

The effect of this amalgamation was to break down the primitive methods, and concurrently to infuse new blood, and with it to stay, or lessen, the forces that were weakening an already over-inbred stock.

If we refer to certain statistics, as recently as 1840 we find that a rough enumeration of the so-called Rock-Veddas disclosed that only thirty families in Bintenna then existed.

Since then the increase of civilized races pressed with yearly greater insistence, till we are forced to conclude that the primitive Vedda is now no more, or nearly so.

In my Paper read at the meeting of the Ceylon Branch of the Royal Asiatic Society on September 19, 1914, I have described the features of the Vedda family I found at Setawa. but I venture here to repeat it for easy reference.

The man Dissan Hamy is about 5 ft. 10 in. in height, thin, small round the chest, with rather short arms, slender legs, with hardly any calf development. He does not know his age. His head is small, with small dark-brown beady eyes set far back in their sockets. His hair is short, not tied in a knot, staring, and frizzy. His younger brother is shorter in stature, but with the same character of hair on the head. The elder has short, scanty, and bristly moustaches, but in both brothers there is a marked scarcity of hair on the face and body. Dissan Hamy's two sisters are both of normal height, and dress like the other women of the country. They are about 5 ft. 3 in. in height, with slender limbs. Both women are mothers, and both indicated the small breast development that appears to be characteristic of women residing in the arid parts of the country I explored. In both women the hair is short and frizzy. Their infants had shaved heads.

I remarked that the skin of Dissan Hamy's body is darker than that of the other members of the family. The nose is strongly formed, with thin dilated nostrils. The mouth is rather wide, with lips of no unusual thickness.

I remarked that while walking through the jungle, though provided with a knife, Dissan Hamy rarely used it to cut away any intercepting branch or creeper, these being invariably bent to one side by the hand.

I observed this custom many years ago when travelling through a distant village called Uda Wellawey at the foot of the Haldummulla hills, and I understand it is to prevent persons from finding a hunter's trail.

I made inquiry, in addition to direct observation while exploring the Vedda country, as to the prevailing diseases among the inhabitants, and what was done as regards remedies. The result of my investigation led me to conclude that the commonest disease among adults was fever, but I could get no statistics on which I could rely to form an opinion as to the percentage this particular disease afforded as compared with others.

It was, however, difficult to discriminate in what proportion of fevers typhoid was to be regarded, as I found in many cases the people did not know the difference. Dysentery appears to be well known, and is locally called "Le-pachchane," but I was told that it was not nearly so common as fever. Fever is not common as compared with the prevalence of that disease in the Tamankaduwa District.

Venereal, I am told, is unknown, and probably for reasons I gave earlier in this Paper. It occurs, however, more in the neighbourhood of civilized centres. I did not see a single instance of goitre, or of elephantiasis, though I cannot suppose the latter is unknown. I found numerous cases of sores on the feet and legs of both adults and children, but these were explained as being in all cases due to accidental injuries. Bronchitis, however, is common, more especially in children, who also appear to be commonly troubled with anæmia, which may or may not be directly due to intestinal parasites.

As regards treatment, I found that the remedy was invariably based on the theory that diseases may be divided into two great classes—heating or inflammatory, and the opposite —therefore the cure was to be found in those specifics which were opposed to these two heads of causation. For example, if a man had a violent cold, the "milk" of the coconut could

not be drunk. Again, in case of fever a decoction would be given of a number of vegetable productions that were *believed* to be cooling. I may here mention that when questioned as to the exact effect any one of these ingredients would specifically bring about, I could get no clear answer. I found that both *Cassia auriculata* and *Evolvulus alsinoides* were regarded as most beneficial in fever, but I failed to find an answer as to their direct action. Equally *Munronia pumila* would be considered as a most valuable medicine for fits, as well as fevers.

Charms and incantations appear to be more important than medicines with the people.

I found that castor oil was appreciated and its action understood, but it is curious to note that it is supposed to be effective by outward application, as well as inward. Generally speaking, I found that the local knowledge of our plants was very wide, and it would be difficult to find a plant of any use that the people could not correctly name.

In some cases where a plant was rare, I found that no name could be given to it; as, for instance, I obtained a few examples of *Centranthera procumbens*, but the people had no acquaintance with its name whatever. Nor did I find names invented in order to afford answers to my questions: it was a case of giving the right answer, or expressing ignorance.

I might mention incidentally, that though our familiar Kitul (*Caryota urens*) is well known, I found the people equally unacquainted with toddy or jaggery, except as *purchaseable* commodities, just as much as kerosine oil is. This ignorance of a source of alcohol may have much to do with the striking absence of crime in the country I refer to, and I mention it in passing, as worthy of consideration. On the other hand, I would again point out that owing to the rigidity of certain customs there is not the same scope for jealousy over women that plays such an important factor in crimes of violence in other parts of this Island. Again, it should not be lost sight of that in the Vedda country small groups of people congregate round centres where water, however limited in quantity and impure in quality, is to be found, and are therefore much more mutually dependent

than in densely populated areas, where the individuality of the creature is lost in environmental immensity. In the one case he and his are known, in the other he and they are but a fraction.

Considerations of space preclude my enlarging on this subject, or describing in detail the individual conditions of the different villages that I explored, but I venture to think that a careful examination of local factors would throw much light on the evolution of the race from its early stages of primitive existence to its present state of partial civilization.

Domestic Animals.—These consist of cattle, buffaloes, goats, dogs, cats, and fowls.

Black cattle are abundant in all the inhabited parts of the country I explored, and naturally more so where the opportunities for trade in them exists than in very isolated places. Milk is nearly always procurable, but I heard of no instance of children being exclusively reared upon cow milk. Buffaloes are, where possible, reared for agricultural purposes, and also for the supply of milk, which is often turned into a form of junket that is in much demand.

In one village in the Panawa Pattu I found a Tamil man owning a large herd of buffaloes, and to my surprise I found that he called them by individual names, the animals responding to his call.

I was informed that quite a large proportion of the domesticated buffaloes were half-breeds between the wild and the tame. This may explain why the Vedda-country animal is so much larger than the buffalo of, say, the Western Province.

Goats are rare, and only occur where there are Tamil or Moorish people. I met with them occasionally, but nowhere away from the influences above mentioned. Pigs, except wild, I never met with. Dogs are plentiful, and of a much superior build and type to the village pariah of the civilized country. This is doubtless due to the care the real Vedda has bestowed upon this animal from the earliest time. In point of size the dogs of the Vedda country are large, powerfully built, and bold. Black and white, or brown and white, are the usual colours of these animals. Cats are, generally speaking, scarce, though I remarked at Kumuna that while I only saw one dog, I found six cats in that little village.

Of fowls, I observed a remarkable diversity of breed. They may be classed as—

(*a*) The Bantam type, with the medium length of saddle and conspicuous *erect* tail.

(*b*) The wild type, with long saddle and large *drooping* tail.

(*c*) The Cochin-China type, with feathered tarsi.

In the first of these the crow of the cocks is quite distinct, it being what I call a shrill falsetto. In (*b*), what I call the wild type, the plumage of the males approximates that of our jungle fowl, both in its beauty of colouring and in the disposition of the tail feathers. The hens, too, were more commonly brown than in the Bantam type, where white is the prevailing colour of this sex. In (*c*) the feathered leg is the outstanding characteristic. Here the size of bird is larger than in the first group, but shorter in the back than in what I call the wild type. In no case did I find birds with yellow combs, though the early presence of the comb in cock chickens is particularly noticeable. It would appear, therefore, that the domestic fowl has here developed characteristics that would imply crossing from three stocks, one of which is analogous to, if not identical with, the wild bird. On the other hand, the unmistakable crow of the wild bird is different from that of any of the village races.

Of wild animals, the following is a brief list of observed mammalia:—

(1) *The Gray Wanduroo.*—Scarce in the Maha Wedirata, plentiful towards the sea coast in the Panawa Pattu and in the valley of the Kumbukkan river. Probably this species was common all through the Vedda country, but as its flesh was eaten it became exterminated, except in uninhabited places.

(2) *The "Red Monkey" or Rilawa* (Macacus pileatus),—Not common. I found a few in the valley of the Heda-oya and near Lahugala.

(3) *The Loris* (Loris gracilis).—Very rare. I did not see a single example, but I was told by the people that it was known near the "Westminster Abbey" range of hills, and again near Monaragala.

(4) *Leopard* (Felis pardus).—Common. I constantly came upon the tracks of the leopard in all parts of the Vedda country, except very far away from water.

(5) *Indian Civet* (Viverricula malaccensis).—Occasional.

(6) *Mungoose* (Herpestes mungo).—Very common, usually pale coloured.

(7) *Jackal* (Canis aureus).—Very common all through the Vedda country, and probably crosses with the domestic dog. It is commonly believed that the jackal conveys rinderpest, owing to its devouring cattle that have died of that disease. I secured a jackal pup out of a hollow scraped at the foot of a Mustard tree (*Salvadora persica*). The little creature at first showed considerable timidity, but rapidly got over this shyness. Finding a difficulty in providing it with food I had it put back at the place where it was captured. It soon ran off, apparently led by its mother, as I found the spot afterwards to be completely unoccupied.

(8) *Indian Otter* (Lutra nair).—I found the marks of this animal on the Kumbukkan river, but nowhere else. It is well known by the name of Diya-balla, so that I cannot suppose it is rare.

(9) *Bear* (Melursinus ursinus).—Common. I found foot-prints of bear in the driest parts of the country that I explored, and in places where I could find but few other traces of animals. The fruits of the Palu (*Mimusops luxandra*) and Wira (*Hemicyclia sepiaria*) are readily devoured by bears, who in this way to some extent spread the growth of these plants. I am informed by the people that direct attacks upon human beings by bears are uncommon, and that when injuries have occurred the animal has invariably been startled. Thus, I was told that hollow trees should be approached with caution, as a bear roused suddenly from its sleep within might with equal likelihood spring upon, as away from, its disturber.

Near Nahmaluwahela, on a rocky mass, I found a dead bear. He appeared to have fallen from the rock above on to a ledge below which there was a still larger drop, and being maimed was unable to get up or down from the spot where I found the body.

(10) *Musk Rat* (Crocidura cœrulea).—Very uncommon. I found it at Potuvil only.

(11) *Flying Fox* (Pteropus medius).—I can only remember seeing this bat once in the Buttala-Wedirata.

(12) *Bats*.—I did not shoot any, so am unable to specifically name those that I saw, which included—

(*a*) The cave bat ;
(*b*) The house bat ;
(*c*) A small brown bat, locally called " Kiri-wawula "—a most active species ; and
(*d*) A gray bat—probably the Indian Vampire.

The first of these is found in great abundance in caves, but I did not find them as widely distributed as the last three.

I noticed when lying on my camp bed at night under trees that the brown bat would hover quite close to my face. I tried the experiment of lying still with my feet uncovered, to see if they would attack the exposed limb, but beyond hovering within a few inches of me they did no harm.

(13) *The Rock Squirrel* (Sciurus macrurus).—Common, *away* from habitations, as it has been shot down for food. On the Kumbukkan I found it plentiful, while at Bowela, Danakirigama, and Manawela it is distinctly rare. The black variety is perhaps a little more rare than the gray.

(14) *Palm Squirrel* (Sc. palmarum).—Not generally common, and appears to follow human distribution. It is more plentiful near Muppane than at Bowela.

(15) A *Jungle Squirrel*, probably Sc. tristriatus, was seen by me at the base of the " Westminster Abbey " hills. It is readily distinguishable from the last by being a dark slate-coloured animal, with bright chestnut stripes. It is usually solitary.

(16) *Rats* are not very plentiful from my observations, except at Kumuna.

(17) *Bandicoot* (Nesocia bandicota).—I repeatedly heard of this animal as being very destructive to chena crops, but I did not actually see one. It is said to be eaten as freely as the mouse deer.

(18) *Porcupine* (Hystrix leucura).—Uncommon. I found traces of it on the banks of the Kumbukkan river and at

Siyambala-anduwa, but the people do not speak of it as common.

(19) *Hare* (Lepus nigricollis).—Common.

(20) *Elephant* (Eliphas maximus).—I came on elephants frequently, but as regards their abundance or the reverse, it appears to be a matter of water distribution ; thus, near the Kumbukkan river, the Heda-oya, and Kurapan-oya one would find abundant traces, or, as I did, the animals themselves. As soon as the country gets dried up in the south-west monsoon the distribution ceases to be general, and the places where elephants will be found is only within reach of water. Directly the rains begin and the fresh grass springs up—as it does do with remarkable rapidity—elephants may be found in all parts, so that it might be said that there is a distinct symptom of migration. I entirely disagree with the opinion, frequently expressed, that " elephants are on the increase "; on the contrary, I believe the opposite to be the case. The elephant has to-day a much more restricted area to wander in than it had a hundred years ago. This area, by the cultural operations of man, is yearly being shrunk up, while shooting for " sport " and kraaling still further lessen the numbers of these magnificent animals. The ease with which one can get an elephant proclaimed a " rogue " adds another to the many causes of its destruction, not to mention the facilities that have in the last twenty years been offered to certain Chiefs to have kraals, the few survivors of which do not breed in captivity. It is only a matter of time for the elephant to be completely exterminated in Ceylon, unless steps are taken, with the aid of suitable sanctuaries, in addition to the complete prohibition of kraaling, except at intervals of, say, twenty years, to prevent this disaster. The actual damage done by elephants is not to be compared with their value as transport animals, and nothing can be more deplorable than allowing such valuable creatures to be shot in the cause of so-called " sport."

(21) *Buffalo* (Bos bubalus).—I found these to be generally distributed in the country I traversed, but not nearly in the same numbers as I found them in 1906. I found many skeletons—usually much devoured—of buffaloes, all pointing

to the fact that rinderpest had destroyed numbers of these creatures. I am informed that in the Panawa Pattu alone that disease killed the wild and tame buffalo alike, and that thousands died in a few months. I found one herd on the Kumbukkan in which I counted some thirty individuals, while in 1906, on the Gajabahu plain, I counted in a single herd over one hundred.

(22) *Sambur* (Cervus unicolor).—Moderately common.

(23) *Spotted Deer* (C. axis).—Common, especially in the valley of the Kumbukkan river. I repeatedly came on herds in this river, in one case finding over 200 drinking in the stream at noon.

(24) *Mouse Deer* (Tragulus meminna).—Moderately common, but more so in the south.

(25) *Wild Pig* (Sus cristatus).—Fairly common, but much less abundant than in 1906, owing to their having been killed out by rinderpest.

(26) *Pangolin* (Manis pentadactyla).—I found traces of this animal occasionally, and by inquiry I heard frequently of its occurrence. It is, however, not common near the coast.

Of reptiles, the crocodile is plentiful where there is water, either in tanks, rivers, or backwaters towards the sea, as, for instance, at Setawe, and all up the Kumbukkan river I found these creatures in abundance.

The *Monitor* or *Talla-goya* is fairly plentiful. It is eaten by both Tamils and the Sinhalese of this locality. I am inclined to believe that there is a dark and a pale race of this species, as I remarked that the latter were much more numerous towards the sea coast, and much lighter coloured than examples obtained near Muppane.

The *Kabaragoya* is comparatively rare. I only saw one or two examples near Muppane. This scarcity I attribute entirely to the absence of water all the year round.

On the north bank of the Kumbukkan I found a (?) Ceratophora in considerable abundance. These animals are protectively marked, and usually select trees with dark rugged bark to take up their position upon, their own colouring assimilating precisely with that of the bark. Under sexual stimulus in the males the lips become a rich crimson red, with

large rhomboidal dorsal patches of the same bright colour. On the stimulus diminishing, these points of colour become a dull ashen gray, turning to a pale horny gray with death. The females have similar markings, only in a very inconspicuous degree.

I failed to find any examples of this reptile in the north or west of the country to which this Paper refers.

The so-called Chameleon I found no examples of. I obtained a green Calotis, and two examples of Gecko, one about seven inches in length.

Of snakes I only saw three species, viz., the Rat Snake (*Zamenis mucosus*), Russell's Viper (*Vipera russelli*), and the Green Whip-snake (*Dryophis mycterizans*). I specially looked for Cobras, but without success. Russell's Viper, on the other hand, is comparatively common.

As regards the bird distribution, I have thought it desirable to supply a list* in which I have detailed the distribution, as it is of interest to note the exact localities for future reference.

Before passing to this list I would draw attention to certain points of special interest that appear to me to be worthy of more than a brief catalogue notice.

The curious distribution of one Fan-tailed Flycatcher (*Rhipidura albifrontata*) is singular. I found it did not occur east of Monaragala or north of Kebilitte, though in 1906 I found it breeding freely at Pottuvil. On my present exploration I observed it at a place called Kobaragoda, south of Okanda in Panawa Pattu, and from thence still further south to Kumuna, on the Kumbukkan river. It was not seen north of Siyambala-anduwa, nor in any part of the country round the "Westminster Abbey" hills, thus indicating a piece of country of limited extent touching the sea south of Okanda and forming a strip running into Monaragala. From here it passes to the Lunagalla hills, and thence right up to Bandarawela and into Haputale, where it may be found up to 4,000 feet.

I have found it resting at Miriabedde estate, at about 3,800 feet altitude. Again I have found it in abundance in the

* Appendix C.

Wallawe valley below Kaltotta, and from there it spreads into the Tangalla District, and again at Tellijjawella and Henegama in the Matara District, where the rainfall exceeds 100 inches per annum. Briefly, therefore, it is to be found both in the dry and wet zones. It breeds at sea level, and at over 3,500 feet it is common in "park" country as well as in "chena" country. I am not acquainted with a more remarkable distribution—remarkable for its contradictions—of any Ceylon land bird.

Of the Woodpeckers—*Pici*— both *Chrysocolaptes stricklandi* and *Brachypternus erythronotus*—are common in the Vedda country, but chiefly in damp forest areas, where owing to the presence of moisture the trees are large. Away from the damp forests the little *Iyngipicus gmnophthalmus* is common right to the coast at Kumuna.

At Galamuna, on the Kumbukkan river, I secured a *Brachypternus* that may prove to be a new species. It resembles *erythronotus*, except that the inner hind toe is only rudimentary, forming only a minute dactyle projection, terminating in an apiculate point that serves as a claw. My example—an adult ♀—measured 10½ in. in length : wing 5⅛ in., tail 3¼ in., bill (along ridge) 1⅛ in., tarsus 1 in. Unfortunately the skin of this bird got destroyed, so that I have been unable to compare it with Museum examples.

I have already hinted that the presence or absence of water governs the question of human distribution within the area under consideration, and I venture to think that the same applies, in some particulars, to the distribution of birds ; thus, for instance, the common Black Crow (*Corvus macrorynchus*) occurs only where there are villages ; nowhere did I find it in uninhabited forest areas. It was equally common at Kumuna on the sea coast and at Muppane—far inland—in a hilly country. The same might, with some curious exceptions, be said of our Sparrow, that I noticed was common at Pottuvil, Panawa, and Okanda on the east coast, but was absent at Kumuna, and equally absent from many of the smaller villages in the interior of the Vedda country.

The drying up for several months of the year of most of the streams naturally causes a restricted distribution among the

Kingfishers, but it is conceivable that this periodical flooding and drying of these streams initiates a form of migration that on a more extended scale, brought about by weather fluctuations in geological times, might indicate the impulse of migration in birds. Thus, reverting to the local migration incident to the drying up of large waterways, I noticed on the Kumbukkan river that *Alcedo ispida*, *Pelargopsis gurial*, and *Halcyon smyrnensis* were plentiful, while not one of these birds could be found on the Heda-oya—a river only a few miles to the north ; the explanation being that the former stream is perennial, and the latter dry in the south-west monsoon. For the same reason *Ketupa ceylonensis* occurs at tanks that have water, and is absent where the opposite is the case. *Ketupa* is, therefore, to be found along the valley of the Kumbukkan in both monsoons, but only in the north-east on the Heda-oya.

As the time at my disposal was necessarily very limited I could do no more than note what was then to be found, so that a more studied verification of these observations becomes desirable in order to establish proofs of what might be called a local migration law. It is, however, rather striking that species of wide general distribution in the wet zone should show an erratic distribution in the dry, the key to the explanation being possibly found in water distribution. In that direction therefore we may anticipate room for the development of a definite form of migration, though its range may be comparatively limited.

I observed in the immediate vicinity of the Kumbukkan river that at night numbers of insects were attracted by a light, while in the dry country south-east of " Westminster Abbey " there was a comparative scarcity of what I might call *lamp*-followers.

At a spot midway between Kebilitte and Ellebubbura I had a unique opportunity of observing the effect of scarcity of moisture and its influence on insect life. I had seated myself under a tree for a few minutes, to rest after a hot march of about 15 miles. The jungle all round me appeared to be utterly faint with the drought, and I may add that I felt much the same myself. I was in a considerable state of perspiration, when I noticed a couple of butterflies hovering

quite close to me. Presently one of them lit on my wrist, and began sipping the moisture as it came from my skin. The second insect quickly followed exactly the same procedure on my slowly extending my arm.

At a small puddle, measuring about 2 ft. by 18 in., I found the whole of the damp ground covered with wasps sipping the moisture.

Some idea of the dryness of the locality can be judged from these instances, and I submit that animal distribution must be affected thereby.

The distribution of plants, not of direct value to man, moreover shows certain erratic conditions. The most striking instance of this is in the distribution of the Dipterocarps. At Monaragala, and a little to the eastward, our common Hora (*Dipterocarpus zeylanicus*) is moderately plentiful. From Liyangalla onwards towards the east it is absent, but to the north-east of Siyambala-anduwa, near the village of Newgalla, one finds fringes of *Vatica obscura* on the banks of the dry streams; in other words, there is an enormous belt of country the opposite sides of which have representations of this important order of trees, with no examples in the intermediate area.

On the other hand I found no examples of *Vatica obscura* to the south of Siyambala-anduwa on any of the streams I crossed.

Of the Dilleniaceæ, I found *Dillenia indica* on the higher reaches of the Heda-oya, and a few individual examples—probably introduced—towards Waragoda in the north and at Kumuna in the south-east.

Of the Anonaceæ, the usual dry-zone *Polyalthias* are very abundant. Both *Anamirta paniculata* and *Tinospora cordifolia* are abundant representations of the Menispermaceæ.

In the tanks where there was water, both *Nymphæa lotus* and *Nelumbium speciosum* are common Lotuses. Both roots and bulbs of these plants are eaten.

In some of the chenas I found *Brassica juncea* grown with the other crops, but I could get no definite explanation why it was cultivated.

Of the Capparideæ, the typical *Capparis zeylanica* is plentiful. Its fruits are eaten by the Veddas as well as the Tamils. I

found that towards the coast *Cratæva roxburghii* occurs, but it is by no means plentiful, as in the Hambantota country.

Of the Bixaceæ, I found a few examples of *Cochlospermum gossypium*, but clearly these were introductions connected with Buddhistic places of worship. It may be safely assumed that where an " escape " of this species is found, one may look for temple " remains," and the same may be said of Ironwood, *Hibiscus ficulneus*, or *Balsamodendrum caudatum*.

Scolopia gærtneri is a wild and plentiful representation of this order, and abundant round " Westminster Abbey " and Degalhela. *Hydnocarpus venenata* occurs in abundance by stream sides, and is probably more plentiful than *H. alpina*, which is confined to the dry low-country, notwithstanding its inappropriate specific name.

Passing over unimportant orders to the Guttiferæ the following claim notice : *Garcinia spicata* is very common and widely distributed; *Calophyllum burmanni* is occasional; *C. tomentosum* occurs at " Westminster Abbey " and near Degalhela ; *C. inophyllum* is practically confined to the coast, though not entirely so, while a further example of this genus (the identity of which has yet to be determined) I have referred to already in an earlier Paper, published in the Journal of the Ceylon Branch of the Royal Asiatic Society, as being a probable foreigner.

Ironwood—*Mesua ferrea*—occurs in quite a forest form round the base of Himitillanegala, where, I suspect, it was introduced. It occurs at all the old temples, but is otherwise scarce.

Of the Malvaceæ, *Sidas* and *Abutilons* are exceedingly common. *Urenas*, on the other hand, are to be looked for in damp waste places, where they attain to considerable size. *Thespesia populnea* is an introduction, and not particularly common. *Hibiscus tiliaceus* occurs near backwaters, but it is not generally plentiful. *Bombax malabaricum* occurs in the form of immense individuals, but it is certainly not plentiful ; while *Eriodendron anfractuosum*, on the other hand, is a plentifully introduced garden plant.

Among the Sterculias prominence should be given to *S. fœtida*, well known to the Tamils as the Katu-tengai or forest coconut, *S. colorata*, and *S. thwaitesii*. I obtained a

few solitary examples of *S. urens*, but I feel confident that this last is an introduction. *Pterospermum suberifolium*—the Welanga of the Sinhalese—is very abundant.

The young straight shoots of this plant supplied the Vedda arrow, while the wood was employed by them for the manufacture of "fire drills."

The distribution of *Helicteres isora* is curiously restricted to what might be turned "patches," the largest of which I found at Etmole. *Heritiera littoralis*—the Chomanturai of the Tamils—is scarce, but occurs near Panawa and Pottuvil.

Of the Tiliaceæ, I noticed that the distribution of Halmilla (*Berrya ammonilla*) was not very general, while its abundance or scarcity appeared to be a matter of its easy access or the reverse. This is to be expected of so valuable a timber tree.

"*Vidpani*" (Tamil) (*Pityranthe verrucosa*), so plentiful in the Trincomalee District, is comparatively scarce in the Vedda country. Of the Grewias, *G. tiliæfolia*, *G. microcos*, and *G. polygama* are the commonest, but the first of these is not so abundant here as in the dry zone of the Ratnapura District.

As representing the Linaciæ, *Erythroxylon monogynum* may be taken as an abundant typical example. It is alleged in the Panawa Pattu that meat hung in the smoke from burning wood of this plant, if eaten produces a purgative action.

Both *Hiptage madablota* and *H. parvifolia* of the Malpighiaceæ occur in the Vedda country, but in no abundance.

The bright, but pestiferous, *Tribulus terrestris*, is to be found near Pottuvil and at Panawa, in places where the soil is not too dry, but its distribution does not spread far inland.

Of the Geraniaceæ I found very few examples. In some slightly moist spots, west of "Westminster Abbey," I observed *Biophytum sensitivum*, and in some of the tanks I got *Hydrocera triflora*, but in other respects, except the introduced *Averrhoa bilimbi* and *A. carambola*—common in gardens—this order is poorly represented. The Rutaceæ is not well represented in *wild* species, if we except the well-known *Feronia elephantum*, *Murraya kœnigii*, and *Toddalia aculeata*. In the gardens oranges, lime, and pummalo have been introduced, but with no marked success either in the matter of quality or quantity

of fruit, an insipid fibrous product being the usual type of Vedda-country orange.

In dry rocky ground *Ochna wightiana* is to be found in some abundance, as exemplifying the small order of the Ochnaceæ.

Of the Burseraceæ, I have already pointed out that *Balsamodendrum cordatum* may be taken as indicating some place of veneration. I found in many cases where there were ruins, or abandoned monastic caves, this plant would be sure to occur. On the summit of "Westminster Abbey" it is comparatively abundant, as also at Nuwaragala—another ancient fort. Doubtless the fragrant smell of the wood led to its use as an incense, and, thus, to its cultivation. *Canarium zeylanicum* occurs very sparingly west of Bowela, and *Filicium decipiens* may be found in the forest valleys, though it does not attain any striking proportions.

The Maliaceæ is very well represented. The Margosa, however, as typical of this order, is an introduction, and where it is found under semi-wild conditions the inference is that that particular spot was once inhabited. This beautiful tree, however, is afflicted with a disease that kills back the young twigs, and I remarked that this sickness is very widespread. *Melia dubia*, often called Wal-kohomba, occurs in the western part of the Vedda country, but in no great abundance. *Walsura piscidia* and *Dysoxylum binectariferum* are both common, while the famous Satinwood is, of course, very fairly abundant, except in what might be called wet forest. The abundance of Satinwood has, as I have hinted, doubtless from very early times been influenced by human operations, as the value and quality of this excellent wood is widely known. That being so, its spread has been materially governed, with the result that in a great deal of the country where it once must have been plentiful there are now only isolated examples.

Munronia pumila occurs in tolerable abundance round Bowela, Waragama, and Danakiria. It is medicinal.

Of Celastracious plants, *Elæodendron glaucum* is very common near the coast, and attains a large size. A *Kurrimia*, probably a variety of *K. zeylanica*, is found occasionally in the northern half of the country I explored, but does not appear to attract native attention.

It is almost superfluous to remark that the Rhamnaceæ are abundantly represented by various forms of *Zizyphus*, both as an abominable thorny climbing bush, or in the more elegant *Z. jujuba*. *Scutia indica* is plentiful near damp spots, while *Ventilago maderaspatana* is most abundant.

Vitis quadrangularis is, perhaps, the most common example of the Ampilideæ, while *Leea sambucina* is specially noticeable in the vicinity of large streams.

The Sapindaceæ afford plentiful examples in *Allophylus cobbe*, *Sapindus emarginatus*, or soap-nut, *Nephelium longana* (*Mora*, Sinhalese), *Schleichera trijuga* (*Kon*, Sinhalese), and *Gleniea zeylanica*, all of which are about equally distributed.

In waste ground the creeping *Cardiospermum halicacabum* is plentiful; its use as a tonic appears to have been known to the Veddas.

I also observed *Dodonæa viscosa* in a few isolated places, particularly near Wattegama, but to my surprise its use as an embrocation was apparently unknown.

Of the Anacardiaceæ, if we except cultivated species, few occur. The wild mango (*Mangifera zeylanica*) is to be found near or in the Heda-oya valley, but not in great profusion. *Odina wordier* is to some extent cultivated, as it is frequently to be found preserved where there are fields. *Nothopegia colebrookiana* is seemingly unknown to the people, though I found it frequently. *Spondias mangifera* I believe to have been introduced.

Passing to the Calycifloræ, the small order of Connaraceæ finds as its best representative the widely distributed *Connarus monocarpus*, that appears to thrive equally well in the wet and dry zones. I found it in abundance in some of the driest situations. It is said to be of use for buffalo ropes.

Of the Leguminosæ, space considerations oblige me to make but the briefest reference to the better known examples in a list form :—

Crotalaria retusa. In open waste places.
C. striata. Occasional, in dry fields.
Indigofera pauciflora. In abandoned fields.
I. hirsuta. In waste places and road sides.
Æschynomene aspera. In damp places or puddles.

Abrus precatorius. Very common in scrub jungle.
Mucuna (?) pruriens. Moderately common (in fruit).
Erythrina indica. In gardens—occasional.
E. ovalifolia. Near streams and tanks—uncommon.
Butea frondosa. In the park country near Etmole.
Clitoria ternatea. Common; not seen in forest.
Flemingia strobilifera. Near streams and cool spots.
Pterocarpus marsupium. In park country—common.
Pongamia glabra. Common near water.
Dalbergia lanceolaria. Moderately common; of large size.
Derris scandens. Common all over the country.
Cæsalpinia bonduk. Occasional; possibly introduced.
Cassia fistula. Moderately common.
C. marginata. Common, even close to the sea.
C. auriculata. Commoner near the coast than inland.
Dialium ovoideum. Common on the summit of "Westminster Abbey."
Saraca indica. Occasional in damp forests.
Tamarindus indica. In gardens, abandoned or otherwise. An introduction.
Bauhinia tomentosa. Plentiful.
Entada scandens. Generally near streams.
Dichrostachys cinerea. Moderately common in bush land.
Mimosa pudica. Occasional.
A. leucophlœa. Comparatively rare.
A. eburnea. Common near the coast.
A. cæsia. Very common, especially near damp forests.
A. pennata. Less common, generally locally plentiful.
Albizzia odoratissima. Moderately abundant in the west.
A. stipulata. Occasional.
Pithecolobium geminatum. Locally abundant.

Of the Rosaceæ, I noticed a Pygeum near Bowela, in a valley, but procured no examples for identification. On the banks of the Heda-oya I also secured another, probably an escape from higher altitudes.

Bryophyllum calycinum, as representing the Crassulaceæ, is probably an introduction. It infests places where the soil is not deep, as, for example, near slab rocks, but generally in these cases near habitations or places once inhabited.

Of the Droseraceæ, *Drosera burmanni* is to be found on the edges of tanks where the soil is damp, and again I have found it on thin soil on rocks. This plant appears to be equally at home at all altitudes in Ceylon, both in the wet as well as the dry zone. I failed to find it near the sea, though it occurs at no great distance inland.

The Rhizophoraceæ are well represented by Mangroves that occur in tidal estuaries. Of these, *Rhizophora mucronata* is by far the most common. *M. candaria*, with its large leaves, is also often found along with the last, and with *Bruguiera gymnorhiza*. I also observed a *Ceriops*, but not in flower. In a valley south of "Westminster Abbey" I saw *Anisophyllea zeylanica*, but this plant appears to belong to a higher altitude. *Carallia integerrima* is to be met with in the Kumbukkan valley.

The Combretaceæ afford magnificent examples of Kumbuk (*Terminalia glabra*), that are to be found on the banks of all the streams in the Vedda country. The "Aralu" (*Terminalia chebula*) is also common in the "park country" near Etmole, while its close ally, *T. belerica*, is frequently to be met with right through the Maha Wedirata. Again, in the "park country" *Anogeissus latifolia* is fairly common. *Combretum ovalifolium* occurs in rocky places in some abundance. The gaunt *Gyrocarpus jacquini* is very common; it forms a characteristic tree in this dry locality.

Of the Myrtaceæ, I found the most abundant examples in *Eugenia jambolana*, that occur in tank beds, while *E. bracteata* occurs in all the dry forests. By the sides of backwaters, or where the soil is damp, *E. corymbosa* forms a common bush.

I noticed a few examples of our common Guava (*Psidium guajava*) in some of the old gardens, but nobody could tell me how it came to be introduced. *Barringtonia acutangula* is moderately common in and about tanks, where it attains a considerable size. On the banks of the larger streams I obtained *B. racemosa*, but it is not plentiful. *Careya arborea*, however, is moderately common in the northern part of the country I am treating of.

Of Melastomaceous plants, I found very stunted forms of *Osbeckia* (?) *aspera* growing in most impossible places. Near

Bowela I found, in a damp valley, a *Sonerila* growing in a rocky crevice. *Memecylon umbellatum*, *M. grande*, and *M. capitellatum* are all very common in the forest areas.

Of the Lythraceæ, I found *Lagerstrœmia flos-reginæ* not uncommon on the banks of the larger streams, where it frequently occurs as a large tree. *Lawsonia alba* is cultivated at Panawa. In the "park country" I found a few examples of *Woodfordia floribunda*, but this is far more common near Passara and Bandarawela.

The poisonous *Modecca palmata* is often to be met with, but is not common. I was surprised to notice that it was little known to the people. *Passiflora fœtida*, however, appears to be well known, though its distribution is probably more restricted. The Papaw has been introduced here, and is to be found in some of the gardens, but sparingly.

Of the Cucurbitaceæ, I found *Trichosanthes integrifolia* to be fairly common, its brilliant red billiard-ball-like fruits being very conspicuous. I suspect that it is eaten by monkeys, as I frequently found fragments of the fruit. *Cephalandra indica* is often to be seen in dampish forests. In all the chenas Cucumbers of sorts are grown, and appear to find a considerable market demand.

Possibly these may have originated in the well-known cucumber, but owing to degeneration and environment have changed their form, for certainly the average shape of Vedda-country "Kekiri" is more round in outline than ovate. The "rind" is remarkably bitter to the taste.

Of the Begonias, I found a few examples of what I take to be *B. malabarica* not far from the base of Westminster Abbey, but it may have been an "escape."

Our monotypic *Tetrameles undiflora* occurs but sparingly in the north of the Maha Wedirata, while the individual trees are immense.

Of the Cactaceæ, *Opuntia* (*?*) *dillenii* is frequently to be met with, both in a semi-wild state and in hedges. I found it growing in profusion at Okanda, and all down the coast where there were, or had been, gardens. I am unable to say if the Veddas knew it, though the name Katu-patuk is well known. I am inclined to suppose that it was spread by the Tamils.

Considerations of space oblige me to avoid more than a passing reference to the larger Gamopetalous plants, hence my having unnoticed several of botanical interest. I therefore select of the Rubiaceæ the following :—

Sarcocephalus cordatus. Moderately common in beds of tanks and by river sides.

Anthocephalus cadamba. Rather rare, but occurs towards Muppane.

Adina cordifolia. Locally plentiful.

Stephegyne parviflora. Rather common, and valued for its timber.

Wendlandia notoniana. Occasional, towards the Monaragala hills.

Mussenda frondosa. Not uncommon near streams.

Gardenia latifolia. Plentiful in rocky ground.

Canthium didymum. Common, especially near rocks.

Ixora parviflora. Common.

Morinda tinctoria. Common, especially near the coast, and often found in gardens.

Webera corymbosa. Exceedingly common.

Of the Compositæ :—

Vernonia cinerea. Exceedingly common.

Elephantopus scaber. Plentiful in the whole country, but avoids deep shade.

Ageratum conyzoides. Everywhere an abundant introduction.

Sphæranthus indicus. Common in fields.

Bidens ? Not uncommon near abandoned villages, and occasionally on river banks.

Of the Gordenoviaceæ, I found *Scævola lobelia* common at Okanda on the sea coast, the only place I have found it in Ceylon.

Of the Plumbaginaceæ, our only Plumbago is occasionally found in most unexpected places, but nowhere in abundance.

Of the Myrsinaceæ, I found an *Ardisia* in many of the forests near rivers, but I am uncertain of its identity. The leaves are large and grow in verticils.

Of the Sapotaceæ, by far the most important is the Palu (*Mimusops hexandra*), but its distribution is erratic. It is plentiful between Lahugala and Pottuvil, but the individual trees are not large. Towards the Heda-oya, and in the arid country west of Panawa, it also occurs plentifully, but towards the Kumbukkan valley it again ceases to be abundant. This erratic distribution in a country that favours the growth of Palu is probably, as suggested earlier in this Paper, the outcome of early trade in this valuable timber.

Munamal (*Mimusops elengi*) occurs very frequently, but does not become very large. *Bassia longifolia* I have already referred to. It is very plentiful up the Kumbukkan river, the trees there attaining an enormous size; elsewhere it is practically rare.

Of the Ebenaceæ, perhaps the most common is *Diospyros embryopteris*, that occurs where there is moisture near at hand. The Veddas eat its fruit.

D. ebenum, like "Palu," appears to have been largely exploited, with the result that it is only in remote spots that it is to be found in any abundance. *D. ovalifolia* occasional, growing in patches.

Both *Salvadora persica* and *Azima titracantha* are abundant, the former being common near the coast, but neither in real forests.

Of the Apocynaceæ, the most distressingly common is undoubtedly *Carissa spinarum*, that occurs always where treed forest has been cleared. *Cerbera odollam* is fairly plentiful in the Panawa Pattu, and is regarded as useful for fencing fields.

Plumeria acutifolia is always associated with temples, abandoned or otherwise, but I failed to obtain any information regarding its introduction.

Alstonia scholaris is not uncommon, and attains enormous proportions.

Tabernæmontana dichotoma is also to be found sparingly, but generally in damp spots.

Of Asclepiads, *Hemidesmus indicus* is very plentiful in waste land.

Calotropis gigantea is very abundant, especially near the sea.

Sarcostemma brunonianum occurs frequently, especially in the bush country.

Dregea volubilis is also fairly abundant near to Liyangolla and Muppane.

Of the Loganiaceæ, the well known *Strychnos nux-vomica* is most abundant. It is remarkable, in view of its being so common, that cases of children poisoning themselves by eating the seed are rarely heard of.

S. potatorum occurs, but is not abundant. I looked out for cases where the seeds were used for precipitating muddy water, but failed to find an instance of its use in this direction.

Of the Gentianaceæ, *Exacum zeylanicum* occurs in fields, but the flowers are much paler than in wet-country examples.

Of the Boragineæ, *Cordia myxa* is fairly common. *Tournefortia argentea* occurs on the seashore, but is not plentiful. *Heliotropium indicum* is very common in waste ground.

Of the Solanaceæ, mention need only be made of *Datura fastuosa*, which appears in nearly all the more established gardens. The various "Battus" I can pass over, as being common all over the Ceylon low-country, and as probably introduced.

Of the Scrophulariaceæ I desire to draw attention to only one, *Centranthera procumbens*, owing to its presence in a dry country being remarkable. I found it on two occasions only, first between Nangalla and Danakiriya, and the second time about five miles south of Liyangolla. On both these occasions I asked the villagers if they could name it, but without success. Its presence is singular, as it is generally to be found only in the wet zone, or in a country where extremes of drought are not experienced.

Of the Bignoniaceæ, *Oroxylum indicum* is moderately common, but I think there is little doubt that it was introduced for the sake of its medicinal value. *Dolichandrone rheedii* occurs near the coast, near standing water. *Stereospermum chelonioides* is fairly common. Its wood was used by the Veddas for bows.

Of the Pedaliaceæ, *Pedalum murex* is common near the coast, and is used by both the Sinhalese and Tamils for a demulcent. *Martynia diandra* occurs on the fringes of villages

in waste ground, as if introduced. *Sesamum indicum* is sparingly cultivated.

The Verbenaceæ afford, among many others, the valuable Milla (*Vitex altissima*), which is generally plentiful. I am inclined to doubt if var. *alata* can be sustained, as I repeatedly obtained examples of "broadly-winged" petiolated leaves on the same tree that bore normally petiolated leaves. This "winging" of the leaf stalk appears to be a matter of maturity, as in very young shoots the "wings" are often markedly pronounced. *V. leucoxylon* is common about tanks. *Gmelina asiatica* is moderately common in waste ground near habitations. *Premna tomentosa* and *P. serratifolia* are both abundant, the leaves of the latter being eaten. *Avicennia officinalis* is common in wet ground near the coast.

Passing to the Lauraceæ, the most useful is the well known "Ranai" (*Persea semecarpifolia*), fairly common in the forest areas, especially south of Kallu Obba and below Degalhela.

Of the Thymelæaceæ, I repeatedly obtained *Gyrinops walla*, its value as a cordage being known to the Sinhalese Veddas.

With a rapid glance at the Euphorbiaceæ and the Urticaceæ I must conclude my notes on the plants of the Vedda country :—

Euphorbia antiquorum is frequently to be met with, but it does not attain the proportions so marked in the Hambantota District.

E. tortilis, if I may accept a *4-winged* branch as indicating this species, I observed near Buddama.

E. tirucalli is common as a hedge plant, especially near the coast.

Bridelia retusa. Rather common.

Phyllanthus emblica. Occasional, more common towards Monaragala.

Fluggea leucopyrus. Very common in land that has been cleared.

Hemicyclia sepiaria. Exceedingly abundant. Its fruits are much relished by the Veddas, and, I might also add, by bears and monkeys.

Mischodon zeylanicus occurs sparingly by the rivers, but is not generally distributed.

Aleurites triloba is to be found in a few village gardens towards the west, but is nowhere cultivated in much quantity. It is an introduction.

Dimorphocalyx glabellus. Exceedingly common, except near the sea shore.

Mallotus albus. Tolerably plentiful, especially in the west.

Macaranga tomentosa. Occasional. There is reason to suppose this has been to some extent introduced merely for the sake of the large peltate leaves, that afford a useful substitute for plates. By tracing a group of these trees I was able to find one of the most important of the caves on the east flank of "Westminster Abbey."

Chætocarpus castanocarpus. Occasional.

Sapium insigne. Common, especially near rocks.

Holoptelea integrifolia, representing the Urticaceæ, is very common up to within a short distance of the coast. It occurs right up the Kumbukkan valley to the foot of the Uva hills, after which it becomes scarce.

Trema orientalis I found to be locally plentiful, but more so towards the hills.

Streblus asper. Very common, and with much variation in the size of the leaf.

Ficus benghalensis (the Banyan of Europeans) is very abundant right down to the coast. It appears in all the old established villages, which leads one to the idea that it was introduced. I have, however, found it in localities where it may have been introduced by birds transporting the seed from the (?) cultivated trees, as the fruits are readily devoured by Barbets and Pigeons.

F. retusa. Very common.

F. arnottiana. Occasional, especially in rocky places.

F. tsjakela. Occasional, and appears to be singularly partial to old ruins.

F. hispida. Not uncommon near rivers and in damp forests.

F. religiosa. Common near any temple. At Kumuna I found some enormous examples, as also at Wattegama.

Antiaris toxicaria. Rare. I am informed, as stated early in this Paper, that the Veddas use it for making "loin cloths" to be worn on ceremonial occasions.

Artocarpus nobilis. Quite rare, and only seen up the Heda-oya valley.

A. integrifolia. Cultivated, but not usually attaining any very large size, unless water is within reach.

A. incisa. At Buddama I was shown a solitary example of our well known Breadfruit tree, and I was informed that it was the only one of its kind to be found in the Veḍda country. While this may not be strictly correct, I may mention that I found Breadfruit trees became exceedingly rare east of Monaragala.

APPENDIX A.

Amparai Rainfall.

	1904.		1905.		1906.		1907.		1908.		1909.		1910.		1911.		1912.		1913.	
	Inches.	Days.	Inches.	Days.	Inches.	Days.	Inches.	Days.	Inches.	Days.	Inches.	Days.	Inches.	Days.	Inches.	Days.	Inches.	Days.	Inches.	Days.
January ..	—	—	12·23	7	4·97	8	4·32	7	10·36	15	4·85	9	17·70	13	8·82	11	2·24	6	50·06	28
February ..	—	—	2·75	3	0·09	1	1·58	4	7·59	6	7·00	8	4·01	11	2·71	6	0·81	2	7·73	12
March ..	—	—	0·00	0	1·21	4	5·40	5	8·53	8	2·64	4	0·00	0	1·45	2	4·77	6	2·02	5
April ..	—	—	7·41	19	0·53	3	4·72	8	4·37	6	1·77	6	1·07	5	0·00	0	2·52	7	2·80	7
May ..	—	—	5·63	8	1·13	3	1·08	3	1·31	3	0·86	5	1·09	6	1·90	2	1·44	5	0·53	3
June ..	—	—	2·49	7	2·00	3	4·48	4	0·00	0	0·89	1	0·20	3	1·33	4	6·93	4	0·05	1
July ..	—	—	0·10	1	5·66	7	0·23	2	2·55	3	0·00	0	3·18	9	1·69	1	0·03	2	0·76	4
August ..	—	—	3·03	6	8·24	9	3·38	5	2·20	7	5·31	8	5·38	13	7·35	5	2·82	4	1·35	4
September .	—	—	2·85	4	3·51	5	1·27	5	3·20	9	2·70	6	5·78	9	9·30	10	6·74	5	1·36	3
October ..	—	—	2·02	8	10·84	10	6·52	13	7·11	17	9·56	16	14·66	17	10·41	17	7·32	19	12·17	15
November .	—	—	23·15	19	10·82	22	9·61	13	9·06	11	4·24	12	11·58	12	23·96	24	12·15	16	11·90	19
December..	—	—	5·08	10	9·30	9	3·50	5	24·92	25	7·79	19	21·95	19	32·91	24	14·72	19	33·99	19
Total ..	—	—	66·74	92	58·30	84	46·09	74	81·20	110	47·61	94	86·60	117	101·77	106	62·49	95	124·72	120

ROTAWEWA RAINFALL.

	1904.		1905.		1906.		1907.		1908.		1909.		1910.		1911.		1912.		1913.	
	Inches.	Days.	Inches.	Days.	Inches.	Days.	Inches.	Days.	Inches.	Days.	Inches.	Days.	Inches.	Days.	Inches.	Days.	Inches.	Days.	Inches.	Days.
January ..	—	—	4·00	7	2·71	6	6·57	8	8·85	14	6·03	7	32·93	12	5·92	9	5·27	4	58·55	24
February ..	—	—	3·94	5	0·52	1	0·45	4	9·77	7	3·09	4	0·82	2	0·43	2	0·89	2	11·43	8
March ..	—	—	0·00	0	2·17	3	4·26	8	8·82	9	3·81	4	1·95	2	0·32	2	3·15	7	6·49	5
April ..	—	—	10·66	12	1·42	3	6·82	9	1·22	3	0·86	5	1·68	5	0·00	0	2·75	5	0·20	1
May ..	—	—	1·20	4	6·63	4	0·51	2	5·95	3	2·49	4	0·95	2	0·33	1	4·89	7	0·00	0
June ..	—	—	1·67	2	0·00	0	1·88	2	0·00	0	0·00	0	0·23	1	0·15	1	1·20	3	0·00	0
July ..	—	—	0·00	0	1·79	4	0·25	1	0·54	2	1·33	3	0·00	0	0·64	2	0·00	0	0·79	3
August ..	—	—	0·37	2	3·75	7	1·99	5	1·06	2	6·11	9	1·40	2	1·24	5	0·63	2	0·61	3
September .	—	—	0·17	1	0·60	1	0·47	1	6·25	6	0·00	0	2·38	3	4·56	7	4·29	2	0·29	1
October ..	—	—	6·89	9	6·18	8	6·32	10	4·10	9	3·17	6	6·92	6	2·99	7	5·48	14	8·29	8
November .	—	—	24·52	17	11·06	16	11·68	13	3·21	11	4·74	6	8·80	9	20·83	23	6·61	15	6·47	12
December ..	—	—	6·49	11	6·84	8	4·39	6	19·24	15	3·86	10	20·47	14	23·73	22	15·44	16	28·52	15
Total ..	—	—	59·91	70	43·67	61	45·59	69	69·01	81	35·49	58	78·53	60	61·14	81	50·60	77	121·64	80

APPENDIX B.

	Monaragala Hospital, 700 ft. altitude. Inches.	Mean for 15 Years. Inches.
January ..	3·13	7·51
February ..	·26	3·51
March ..	3·20	3·78
April ..	15·07	7·02
May ..	7·64	8·48
June ..	1·23	1·72
July ..	·70	3·09
August ..	3·33	3·72
September ..	2·47	4·41
October ..	4·88	12·72
November ..	8·74	9·80
December ..	10·33	10·15
Total ..	60·99*	70·91†

* 110 days for 1912. † 101 days.

APPENDIX C.

List of Birds observed in the Vedda Country during July, 1914, giving Local Distribution.

1. *Astur badius.* One seen at Guruhela.

2. *Accipiter* sp. (?). The Museum Collector obtained a ♀ Accipiter, which I am inclined to think is a new species to Ceylon. It was one of a pair that were engaged in building at the time it was shot. It possesses the characteristic long central toe, but in size it is much smaller than *A. nisus* or *A. virgatus*, with the breast boldly marked with dark smoke-brown streaks and blotches, and not barred. The second and third primaries also differ from the last mentioned, while the tarsus is also markedly stouter. My example was obtained at Newgala.

3. *Pernis cristatus.* Observed at Panawa and Bargura

4. *Spilornis cheela.* Observed at the base of the Monaragala hills, at Guruhela, Etmole, Panawa, and near Kebilitte.

5. *Haliætus leucogaster.* Observed at Panawa, Okanda, Lahugala, and Kumuna.

6. *Haliastur indus.* Common at Panawa and at Bargura.

7. *Falco peregrinus.* Nesting in the eastern cliff of "Westminster Abbey."

8. *Ketupa zeylonensis.* Heard at Muppane, Liyangolla, but only near places where there was water.

9. *Huhua nepalensis.* At Panawa I heard the cry of what I believe to be this, but I include it doubtfully.

10. *Scops giu.* Heard at Siyambala-anduwa.

11. *S. bakkamuna.* Heard at Danakirigalla, Ellebubbura, Muduwa, and Kumuna. I think there is no doubt about this being *bakkamuna*, though I did not actually obtain one.

12. *Glaucidium.* I heard these owls repeatedly at Panawa, Bargura, Danakirigalla, Ellebubbura, Muduwa, and Moramalpokunna, but unfortunately obtained none so as to determine the species, but judging by the note I believe the birds I heard were *Castanonotum.*

13. *Palæornis eupatria.* Distinctly scarce. Occur in the valley of the Kumbukkan.

14. *P. torquatus.* Kumbukkan valley, Uva boundary, Siyambala-anduwa, Manawela, Ellebubbura, and Liyangolla.

15. *P. calthropæ.* Common at Danakirigalla, some at Liyangolla, Muduwa, and Panawa.

16. *Loriculus indicus.* Seen at the Uva boundary near Siyambala-anduwa, and heard in the Kumbukkan valley.

17. *Iyngipicus gymnophthalmus.* I obtained two at Siyambala-anduwa. Common at Ellebubbura, Ampitiya, Kitulana, Kumuna, and east of Panawa. My examples are both ♀, and measure:—

(*a*) Length 4·75 in., tail 1·50 in., wing 3 in., bill ·54 in., tarsus ·50 in.

(*b*) Length 5·00 in., tail 1·50 in., wing 3 in., bill ·50 in., tarsus ·50 in.

18. *Chrysocolaptes stricklandi.* Plentiful at Lahugala. Occurs at Kurapan-oya, in Kumbukkan valley, Heda-oya valley, Danakirigalla, Ellebubbura, Ampitiya, and Etmole.

19. *Brachypternus.* I obtained, while going up the valley of the Kumbukkan river, what I have referred to in the text as possibly a new species belonging to this genus. The short, or I should say rudimentary, inner hind toe is particularly striking.

20. *B. erythronotus.* Valley of the Kumbukkan, Panawa, and Bargura.

21. *Thereiceryx zeylonicus.* Occurs at Lahugala, Panawa, Kurapan-oya, Okanda, Kumuna, valley of the Kumbukkan, Bowela, and round "Westminster Abbey."

22. *Cyanops flavifrons.* Not particularly common. Found near Degalhela, Ellebubbura, Lahugala, Panawa, Okanda, Kumuna. Plentiful near Monaragala.

23. *Xantholæma rubricapilla.* Common all over the Vedda country.

24. *Cuculus sonnerati.* Observed in the valley of the Kumbukkan river.

25. *Coccystes jacobinus.* Not seen east of Muppane, where it is plentiful.

26. Without having actually seen the bird, I venture to include a Cuckoo that may be identified by its monotonous and melancholy note, that represents the words "Captain Philpotts." It is common in the dry forests and plentiful near Maha-oya. I have spent considerable time and trouble in trying to obtain it, and while getting to within a few yards of the creature, I have always failed. I found it to occur at Etmole and the dry country towards Chimney Hill. Its exact identity is unknown to me.

27. *Eudynamis honorata.* Heard at Panawa.

28. *Phœnicophæs pyrrhocephalus.* Seen at the Uva–Eastern Province boundary, Kumbukkan valley, Siyambala-anduwa, but not near the sea.

29. *Rhopodytes viridirostris.* Scarce; only near Monaragala.

30. *Centropus sinensis.* Abundant right down to the coast.

31. *Harpactes fasciatus.* Common at Siyambala-anduwa; seen in the valleys of the Kurupan-oya and Kumbukkan river: not elsewhere.

32. *Anthracoceros coronatus.* Common in the valley of the Kumbukkan. Seen at Panawa and Bargura, at which last place I obtained two measuring:—

♂ Length 35·50 in., wing 12·85 in., tail 14 in, bill 7 in., tarsus 2·25 in.

♀ Length 33·50 in., wing 12·25 in., tail 12·25 in, bill 6 in., tarsus 2·30 in.

33. *Tockus singalensis.* At Lahugala, Kurupan-oya, Kumbukkan river. Comparatively a scarce bird.

34. *Ceryle varia.* Occurs at Panawa and the lower reaches of the Kumbukkan river.

35. *Alcedo ispida.* Common at Lahugala, Panawa, Kumbukkan river, Kurapan-oya, and near all the wet paddy fields round Monaragala.

36. *Pelargopsis gurial.* Common on the Kumbukkan river, at Lahugala, Panawa, Okanda, Kumuna, and lower reaches of Heda-oya.

37. *Halcyon smyrnensis.* Common at Pottuvil and down the coast to Kumuna, and in all places where flowing water is present.

38. *Merops philippinus.* These migrants had already arrived, and were plentiful at Lahugala, Kumuna, and at Muduwa. In the early part of August they had reached Muppane.

39. *M. viridis.* Occurs at Ullapola, Bargura, Lahugala, Panawa, Okanda, but is scarce towards the centre of the area involved.

40. *Tachornis batassiensis.* At Pottuvil, Okanda, and Kumuna.

41. *Collocalia fuciphaga.* Abundant, and nesting at Monaragala.

42. *Macropteryx coronata.* Common at Panawa and all down the coast to the Kumbukkan. I also found it sparingly at Siyambala-anduwa.

43. *Caprimulgus kelaarti.* Heard in the Kumbukkan valley.

44. *C. asiaticus.* Common down the coast from Pottuvil to Kumuna.

45. *C. indicus.* Common down the coast from Pottuvil to Kumuna.

46. *Corvus macrorhynchus.* Common where there are inhabited villages only.

47. *Oriolus melanocephalus.* Common right to the coast.

48. *Graucalus macii.* Found at Ampitiya.

49. *Pericrocotus flammeus.* Common in the Heda-oya valley.

50. *Lalage sykesi.* Found at Muduwa, Kumuna, and plentiful up the Kumbukkan valley.

51. *Tephrodornis pondicerianus.* Heard at Pottuvil and at Lahugala.

52. *Dissemurus lophorhynus.* I suspect that this bird occurs, but not having actually shot one I include it doubtfully from Kumbukkan valley.

53. *D. paradiseus* (locally called Kudamahawaraliya) is very plentiful all through the Vedda country forest area. Unlike its relations in the Sabaragamuwa Province it does not associate with numbers of the *Malacocerci.* The following measurements of examples were obtained :—

♂ Length 17 in., tail 12 in., wing 5·87 in., bill 1·37 in., tarsus 1 in.

♀ Length 13½ in., tail 8 in., wing 5·25 in., bill 1 in., tarsus 1 in.

54. *Bucanga leucopygialis.* Plentiful west of Siyambalaanduwa.

55. *Terpsiphone paradisi.* Seen at Pottuvil, Panawa, Okanda, and in Kumbukkan valley.

56. *Hypothymis azurea.* Common. I found a nest of this species on the summit of "Westminster Abbey." It occurs comparatively sparingly in the Eastern Province.

57. *Rhipidura albifrontata.* See text.

58. *Cyornis tickelli.* Common at a place south-east of Kotiyagoda, and at Ellebubbura, Liyangolla, Etmole, and the base of "Westminster Abbey."

59. *Copsychus saularis.* Common up to the Heda-oya, but not seen east of "Westminster Abbey." Few at Lahugala, plentiful south of Pottuvil.

60. *Cittocincla macrura.* Abundant right to the coast. The local name is Sudu-waraliya.

61. *Thamnobia fulicata.* Comparatively scarce. Found breeding at Lahugala ; occurs down the coast to Kumuna.

62. *Turdus spiloptera.* Heard in the high forest south of Degalhela, but nowhere else.

63. *Hypsipetes ganeesa.* Plentiful at Kotiyagoda, Heda-oya valley, Bowela, Etmole, and towards Monaragala.

64. *Iole icterica.* Common in the Heda-oya and Kurapan-oya valleys, but scarce north and east of Degalhela. Not seen west of Kodiyana.

65. *Pycnonotus luteolus.* Common right to coast.

66. *P. melanicterus.* Common in the river valleys, especially near Kumuna westwards.

67. *P. hæmorrhus.* Common right to the sea.

68. *Chloropsis jerdoni.* Very scarce ; only near Monaragala hills and at Pottuvil.

69. *Ægithina tiphia.* Not very common. Seen near coast line.

70. *Crateropus.* Common down the coast, but comparatively rare towards Siyambala-anduwa. I found a few at Bowela and towards Buddama.

71. *Pomatorhinus melanurus.* Heard at Panawa, Himitillanegalla, round "Westminster Abbey" and Muduwa, but *not* in the Kumbukkan valley.

72. *Alcippe nigrifrons.* Common at Lahugala, Kumuna Breeding near Panawa and on summit of "Westminster Abbey," extending south to the Kumbukkan valley.

73. *Pellorneum fuscicapillum.* Common, but the birds from the region under consideration are distinctly paler than those from the wet districts.

74. *Orthotomus sutorius.* Common everywhere right down to the sea-side.

75. *Prinia valida.* Seen at Bowela, and in a piece of grass land at Karane. Heard at Lahugala and Okanda.

76. *Drymœca insularis.* (I am retaining Legge's species and name.) Seen only in the park lands south of Etmole.

77. *Cisticola cursitans.* Only seen at Newgalla in an abandoned field and at Panawa.

78. *Citta frontalis.* Heard at Siyambala-anduwa.

79. *Cinnyris lotenius.* Seen at Wattegama, Siyambala-anduwa, Pottuvil, down the coast to the Kumbukkan.

80. *C. zeylonicus.* Seen all down the coast from Panawa, but few only observed near "Westminster Abbey."

81. *Dicæum erythrorhynchum.* Seen at Lahugala, Ketulana, Pottuvil to Kumuna, but becoming distinctly scarce between the Kumbukkan valley and Monaragala.

82. *Zosterops palpebrosa.* Heard at Siyambala-anduwa.

83. *Hirundo hyperythra.* Common. I found its nest at Kebilitte. It is quite plentiful at Okanda.

84. *Passer domesticus.* Not generally common. I found it at Pottuvil, Panawa, Okanda, but not at Kumuna, on the coast ; again at Bowela and Nambanna (few), while it is plentiful at Etmole and Muppane.

85. *Alauda gulgula.* Common.

86. *Ploceus baya.* Near Okanda I found several trees in which the familiar pendulous nests were in abundance, but in all cases these were last year's work. I looked in vain for this bird in the northern part of the Wedirata, where I suspect it occurs when the rice fields are in cultivation, but as that is not of regular occurrence, I assume that a local migration takes place.

87. *P. manyar.* I found this species at Lahugala, where, the tank being full all the year round, both rushes and sedges are available for nesting in.

88. *Uroloncha kelaarti.* Occurs near Monaragala, but I have no notes of it eastward of that place.

89. *U. malabarica.* Seen at Kumuna.

90. *U. striata.* Common. Plentiful in the Panawa rice fields. Kumbukkan valley, Wattegama, and Muppane.

91. *Artamus fuscus.* Common at Barawaya, Ellebubbura, abundant at Pottuvil.

92. *Acridotheres melanosternus.* At Panawa and near coast, and plentiful at Monaragala, Wattegama ; not generally common.

93. *Eulabes religiosa.* Common up the Heda-oya valley. Plentiful at Ellebubbura, Liyangolla, and the Kumbukkan valley, down to the coast.

94. *Columba intermedia.* From a description given to me I think this bird occurs at Okanda, but personally I did not observe it.

95. *Turtur suratensis.* Common throughout the whole of the Vedda country where there is any open land ; especially common in fields.

96. *Chalcophaps indica.* Common. The variability of the bearing of the tail feathers is striking.

97. *Carpophaga ænea,* locally called Godabowa, is fairly common, especially in the valleys of the larger streams, such as the Heda-oya, the Kurapan-oya, and the Kumbukkan river.

The following measurements I took from examples shot at Newgala and the Kurapan-oya, respectively :—

♂ Length 15 in., tail 5·75 in., wing 8·25 in., bill 1·25 in., tarsus 1·12 in.

♂ Length 15·25 in., tail 6·00 in., wing 8·00 in., bill 1·25 in., tarsus 0·87 in.

98. *Osmotreron bicincta.* Common right down to the coast line, especially where ripe Banyan fruit is plentiful.

99. *O. pompadora.* Common like the last, but, perhaps, more abundant.

100. *Pavo cristatus.* I did not see a single trace of Peafowl in Uva. All down the coast from Pottuvil to the Kumbukkan it is common over a belt of country varying from 6 to 15 miles in width, but these birds appear to exclude themselves from high forests.

Near Lahugala I found cock birds more plentiful than hens, and at Bargura I saw a procession of eleven cock birds walking in single file down to a pool. Hens appear to be either solitary or more shy than the males, hence their seeming rarity.

101. *Gallus lafayetti.* Exceedingly common, and, like the last, the males are seemingly more common than the females.

There is much reason to believe that this species crosses with the village fowl, but evidence as to further intercrossing is obscure, as no definite examples of connected history can be obtained from a people to whom such a subject is of no interest. In the text reference has been made to distinct strains of domestic fowls that, it may be assumed, have developed without any definite human intervention, and it is beyond demonstration to show how these strains came to be established ; but whether the variation arose from the cross-breeding of domestic birds with

others of their own species, or by crossing an inbred stock with the wild bird, is equally open to question.

I am inclined to believe that the inbreeding of the domestic bird has been an important factor in the forming of specific strains, and these have again been varied by the crossing with the wild bird: hence in one strain we find a distinct difference in the *note*, while in another we find a close identity of general "build."

102. *Galloperdix bicalcarata.* I was able to make careful notes of the distribution of our Spur-fowl. I found it to occur at the foot of some low hills west of Siyambala-anduwa; again at the foot of Digalhella, at Danakirigalla, at the base of Westminster Abbey, near Ullapola, Nambana, Monaragala hills, Ampitiya; plentiful at Lahugala and at Kumuna. This last named place is the nearest point to the sea that I have traced this species. It is remarkable that in the plains the Spur-fowl does not appear to occur unless at the base of small hills; thus, while it is common at the foot of the Lahugala hills, it appears to be absent between that point and Siyambala-anduwa, where the country is flat.

103. *Turnix taigoor.* At Kumuna and in park lands near Etmole.

104. *Erythra phœnicura.* Common where there is water. I found it at Newgalla and Wattegama, confining its movements to small tanks in each instance. Plentiful at Monaragala.

105. *Porphyrio poliocephalus.* At Lahugala tank.

106. *Totanus stagnatilis.* Common in small numbers near backwaters and pools right through the country I explored.

107. *Numenius arquata.* I found it in the neighbourhood of the sand dunes near Panawa, where it might be considered plentiful.

108. *Hydrophasianus chirurgus.* On the tank at Lahugala.

109. *Himantopus candidus.* Very numerous round shallow lagoons at Okanda and near Panawa.

110. *Lobivanellus indicus.* Common, especially in flat damp ground.

111. *Glareola lactea.* I only once met with it at Panawa, where it appeared to be very plentiful.

112. A Tern, which I take to be *Sterna media*, is common along the coast. I found it frequenting both Arugam and Okanda bays.

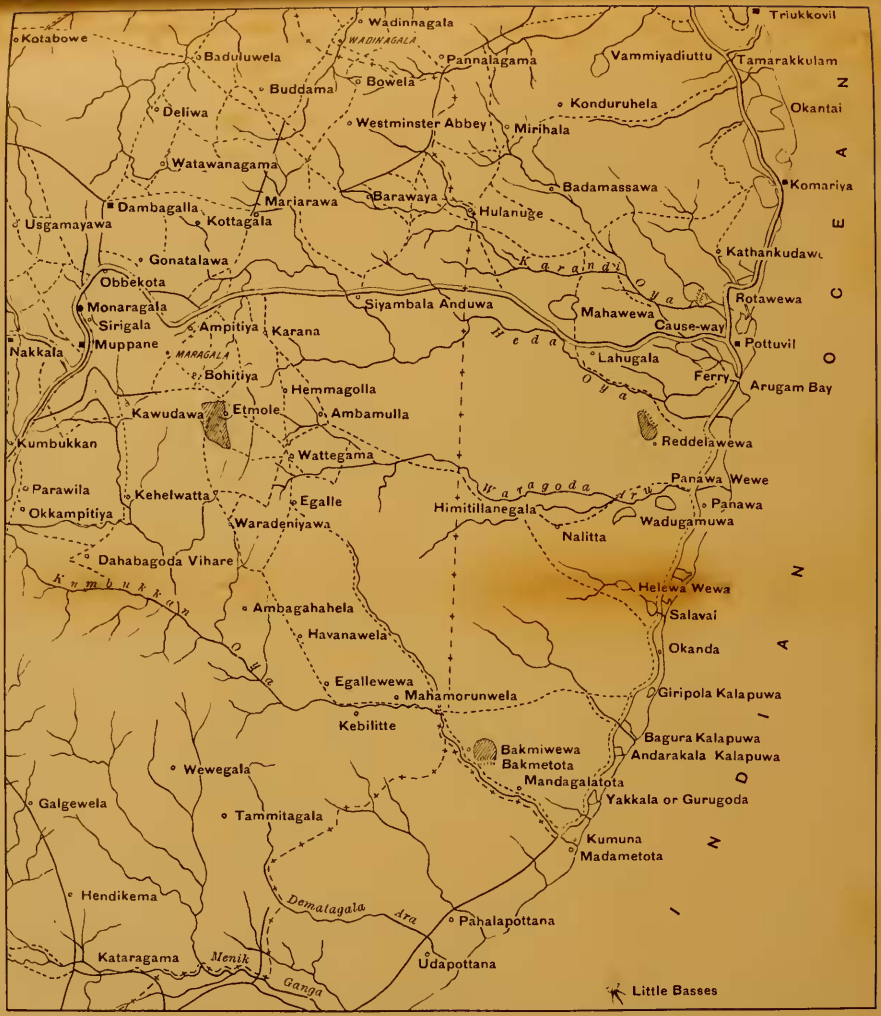
113. A smaller species than the last, that I presume to be *S. sinensis*, I saw at Panawa only.

114. *Nettapus coromandelianus.* Abundant at Lahugala only.

115. *Dendrocygna javanica.* Plentiful at Lahugala and Panawa tanks. Breeding near Kumuna.

116. *Phœnicopterus roseus.* When I was surveying near the coast south of Panawa in March of 1907 I found a large flock of these Flamingos at one of the shallow lagoons, but on the occasion of my present visit in July I did not see a single example.

117. *Platalea leucorodia.* Seen at Okanda.



The Vedda Country.

118. *Tantalus leucocephalus.* Seen at Kumuna.

119. *Anastomus oscitans.* Along the coast south of Pottuvil. Local name Gonbeli-kokka.

120. *Dissura episcopus.* Seen in numbers at Bargura.

121. A bird locally called "*Māno-kokka*" was seen by me at Lahugala, but I am uncertain if it is identical with *Leptopilus javanicus.*

122. *Xenorhynchus asiaticus.* I watched a pair at the mouth of the Kumbukkan river, seemingly feeding on fish, but I was unable to procure an example for more close identification.

123. *Ardea cinerea.* Near Panawa and at Bargura.

124. *Herodias alba.* Seen at Panawa and at Okanda, but doubtfully included here.

125. *Ardeola grayi.* Plentiful at Newgalla, Wattegama, and in wet fields round Monaragala.

126. *Ardeiralla cinnamomea.* Only seen near wet fields near Monaragala and the margin of the tank at Wattegama.

127. *Phalacrocorax carbo.* Plentiful in Panawa and Lahugala tanks.

128. *Plotus melanogaster.* Common ; often found in stagnant river pools right in the heart of the forest.

129. *Pelecanus philippinensis.* Only seen in the large "villu" at Kumuna, where it is very abundant, and breeds there.

NOTES CONCERNING THE OCCURRENCE OF SMALL DESERT TRACTS IN THE NORTH-WEST OF CEYLON.

By E. J. Wayland.

(*With five plates and a map.*)

PROBABLY no road in Ceylon is so little known as that which runs from Puttalam to Mannar. It can hardly be traversed without considerable difficulty, for in point of fact it is not a road but a track. Not always easy to determine, and varying considerably from point to point, it affords the traveller an interesting, if somewhat tiresome, journey. It passes through dense forest, thorny scrub, and park lands; over miles of parched red earth and sun-baked plains, over the dry beds of rivers and under the cool surface of lakes and permanent water-courses; through the mire and slush of reed-choked swamp, and in one place, at least, across a desert. This remarkable and unlooked for desert tract lies about half a mile to the south of the Moderagam-aar (the river which forms the northern boundary of the North-Western Province). There are, to my knowledge, two other desert-like areas within easy reach of Marichchukkaddi; the one which I propose to call (*b*) (reserving (*a*) for the first mentioned) is some four or five miles to the east of the village, and the other (*c*) immediately south of the Kall-aar (Northern Province). Some indications of a fourth are to be found about a quarter of a mile to the north of the same river. They share the peculiarity of being surrounded by jungle, which ends sharply at their edges; much as the up-country forests abut against the patnas. Not one of them is far from a water-course, but they are not in themselves stream beds. They are totally unlike the broad sandy channels of the rivers which dry up completely

for several months of the year.* During the rains the desert tracts drain off rapidly to the rivers, as indicated by the narrow effluent ravines choked with sand (plate I., fig. 2).

The deserts tend to assume the form of more or less elliptical depressions bounded by scarped faces, which are most conspicuous along the borders furthest from the main drainage line of the district.

Approaching the largest and most typical desert tract (*a*) from the south one passes through dense forest of the dry-zone flora springing from a brick-red soil, which evidently makes a very fertile ground. The forest ends abruptly on the edge of an escarpment, the upper fifteen feet or so of which is a red loamy deposit, while the lower half is composed of sedimentary deposits (plate II., fig. 1). The barren tract is scarcely more than a quarter of a mile wide, but extends laterally for a mile or so. On the northern side of the desert the jungle starts again, and nearly half a mile beyond this point lies the Moderagam-aar (Uppu-aar).

The sedimentary rocks which form the floor of the desert tract reach down to the coast and extend some miles inland. They vary in composition from compact limestone to arenaceous and calcareous beds, in which limonite concretions are common. The compact limestone does not occur, except as pebbles and isolated fragments, in any of the barren tracts.

During the early part of the monsoons strong winds blow across the country, catching up sand denuded from the rocks of the desert floor and carrying it along in scurries and whirlpools. These effect much wear and tear of softer parts of exposed rocks, so that the harder bands and concretions come, in time, to stand out in bold relief. As may well be imagined, the resulting surface is rough in the extreme and very tiresome to walk over. It recalls in some measure the less sandy parts of the great African deserts, which are locally such "bad

* At the time of my visit—February and March—the Pomparippu river was chest deep at the ford, while the Moderagam-aar was rapidly drying up. The Kall-aar was completely dry to its mouth. The country is almost uninhabited, and information concerning it is difficult to obtain, but I gathered from some fishermen at the coast that the Kall-aar never contains much water now-a-days.

going" that the Arabs are obliged to fit leather shoes to their camels in order to traverse this unhospitable ground (plate II., fig. 2, and plate III.). Mushroom-shaped rocks, which are common features of some arid regions, are hardly represented in this country; but hard stones polished by the attrition of the blowing sands are by no means rare (plate IV., figs. 2 and 3). Speaking of deserts in general Prof. James Geikie says :—

> So effective is the action of the sun and wind that the whole surface of a rainless region is gradually denuded and lowered, the loose materials continually travelling onwards to the borders of the desert. The sands of continental dune-lands, therefore, have no necessary connection with abandoned sea floors. It is true that within certain desert areas there exist lakes and inland seas that are gradually drying up. In the great desert of Gobi, for example, lakes occur which have obviously at one time been considerably more extensive. So again in the Aralo-Caspian depression, abundant sand hills are scattered over wide areas, which were certainly under water at quite a recent geological date. Within such tracts, therefore, after the water had disappeared, much loose sand was doubtless already prepared for the direct action of the wind. But in the case of extensive deserts, such as those of North Africa, Central Arabia, &c., the sand has been derived almost wholly from the sub-disintegration of rock.*

During the long dry season the heat is intense, and not a few stones which have offered a resistant face to the ravages of time have been burnt brown or black by continued exposure to the sun (plate IV., fig. 2). But sun-baked stones are much more common in or near the river beds than on this practically waterless tract. Though heat is certainly one factor in the process of tanning, moisture is undoubtedly another, and the present writer remembers his astonishment at seeing certain rocks near the Nile, on the Sudan border land, which were markedly more sun burnt on the sides which obtained most shade than on those which were subjected to the glare of the sun all day.

Disintegration through the action of solar heat is the most potent form of weathering in the desert tracts (*a*), (*b*), and (*c*) with which we are dealing; wind erosion has accomplished comparatively little. Its effects are, however, to be seen, and

* "Mountains: their Origin, Growth, and Decay," 1913.

probably better in tract (*c*) than in either of the other two. Faceted stones occasionally occur, and these are of interest in the present connection.

In most deserts, and especially in those whereon the wind-direction is constant for months together, the bigger stones and pebbles, which successfully resist the pushing power of the air current, become faceted by reason of the sand blast action of the grit-laden wind. It not uncommonly happens that these stones possess three faces separated by three sharp edges, for which reason they have been called "Dreikante." The exact mode of formation of Dreikante was an open question till five years ago, when Mr. Arthur Wade settled the matter in a short Paper to the Geological Magazine. Some were of opinion that the keels, or edges, were to be explained by the dividing effect which a stone might be supposed to have upon the incident blast, thus causing the simultaneous production of two facets, which, in time, would meet along an edge in the plane of the wind; but Wade's observations, made on the seaboard of the Egyptian desert, showed that the broad face of Dreikante are opposed to the wind and not parallel to its direction, as the above-mentioned theory would require. It is not proposed to go deeply into the theory of faceted stones in this short Paper, but briefly it may be stated thus: The natural sand-blast gradually wears away the stone upon which it impinges, producing, in time, a more or less smooth face, which exhibits, in profile, a very characteristic curve, convex below and concave above (plate V., fig. 1). The edge between the facet and the base is also a curve, as shown in plate V., fig. 3. A stone loses weight, of course, during the process of faceting, and the time comes when the wind is able to move it—or perhaps it is moved by some accidental circumstance. Sooner or later it takes up a stable position with another part of it exposed to the blast, so another face is formed, and, in time, they meet each other along a sharp edge. In the course of its subsequent movements the stone is almost sure to come to rest on one or other of these faces, and then maintain itself in stable equilibrium for a long period, wherein, unless one face chances to be again opposed to the wind, another face is formed. Not all wind-cut stones show three

facets; some have more, many have less. The example figured in plate V. has one wind-cut face—the curved face; the plain surfaces are the result of jointing in the original rock.

A peculiarity about faceted stones is that while they are characteristically desert products, they are often thinly distributed and are only locally abundant. In (*a*) desert faceted stones are scarce, but polished pebbles are not uncommon, while a fair proportion of stone age artifacts, in which the tract is peculiarly rich, bear a high lustre.

Besides these wind-cut and wind-polished stones some cherts occur with curious spongy surfaces; indeed not a few of the stone artifacts which were gathered on these sites showed this form of weathering (plate IV., fig. 1). It can hardly be doubted that the weathered surface is the result of exposure of the artifacts since the days of their manufacture. Many of the stone tools of the Lybian and Egyptian deserts are affected in a precisely similar manner, and it seems probable that the spongy exterior of these stones points to exposure continued over long periods of time, and may therefore be taken as a fair criterion of antiquity. It should be noted, however, that not all varieties of stone are subject to this form of decay, and therefore the absence of a spongy surface is no argument in favour of a recent production. In the absence of vegetation, the want of water, the characteristic features of erosion and sun baking, the tracts (*a*), (*b*), and (*c*) are typical deserts conforming more to the rocky type than to the sandy variety. They are peculiar in that they are circumscribed and abrupt in their occurrence. The exact mode of their origin is not altogether clear, but the following facts are suggestive :—

(i.) They are not far from rivers which appear to have dwindled in volume since their valleys were excavated.

(ii.) Their surfaces are extremely unfertile, for although of lower altitude than the surrounding forest country they support no vegetation.

(iii.) There is no reason to suppose that they are *chemically* unfertile.

(iv.) In texture the sedimentary beds are gritty and coarse. Their component grains and fragments vary considerably in size. They are generally more or less angular and are rather tightly packed.

(v.) The red, fertile earth, on the contrary, is fine and regular in grain, and its individual particles tend towards a spherical shape. The packing is by no means tight.

There can be no question that at one time the red earth cliff reached as far as the river bank, and it is probable that in those days precipitation was greater than now (see note at bottom of page 167). One may well imagine a gulley running off the escarpment to the river and being rapidly deepened during the rainy season. The intermittent stream would soon cut its way down to the sedimentaries below, and a small corrie might be started at its head by the collapse of the soft beds above, facilitated, perhaps, by a spring at their junction with the underlying series. Phenomena of this nature are by no means uncommon up-country, where the soft laterite overlies less permiable beds below. Whatever may be the true interpretation of the early beginnings of the desert tract, there is no doubt that exposure of the sedimentaries was the first landmark in its history, and (given a diminishing rainfall) from thence onwards the expansion of the barren area was merely a matter of time.

The thickly forested red earth shows that the unequal distribution of rainfall throughout the year* is not the main determining factor in the formation of the desert floors ; but it seems equally obvious that *the absence of moisture is the cause of the barren nature of the tracts*, and one naturally turns to the consideration of soils as water carriers.

The amount of water that can be held by soils and subsoils when saturated depends on the size and shape of the particles and stones (their mean diameter being termed the effective size), and on the consequent pore-spaces. Here ..... we cannot do better than quote from Warington,† who states that, "if a soil consisted

* The yearly average for the part of the country is probably about forty inches (*see* "Manual of the Puttalam District," 1908, p. 20).

† Referring to "Physical Properties of the Soil," 1911.

of spherical particles all of the same size, the empty spaces between these particles would amount to about 47 per cent. of the volume with the loosest packing, and to nearly 26 per cent. with the closest packing. The total empty space would be the same, whatever the size of the particles. If the interspaces with the closest packing were occupied by another set of smaller spheres, they would be reduced to 6·7 per cent. of the volume. If this process was again repeated, they would become 1·7 per cent. With loose packing the proportion of interspaces would, in all cases, be much larger ..... " In many subsoils the ingredients are of various sizes and irregular shapes, as in a mixture of gravel and sand, or in boulder clay, with a consequent reduction of pore-spaces. In many loams, clays, and marls, as well as sands, the materials are fairly uniform.*

It will be seen therefore that the character of the desert floor (recorded above) is such that it is unable to take up as much water as the red earth; and we learn, moreover, that its retentive powers are less, for as Woodward (speaking on the authority of Warington) says :—

The amount of water retained by a soil depends on the extent of the surfaces of the particles to which the water adheres, not on the volume of the interspaces; hence, the smaller the particles, if they are not excessively fine, the greater is the amount of the water held by capillary attraction."†

Add to this the fact that rain falling on a dry soil sinks but slowly, while in a moist soil it is freely absorbed, and the apparently anomalous juxtaposition of forest and desert becomes easy of explanation. It would seem that most of the rain which falls on the barren tracts flows rapidly away, and the remainder is abstracted by the process of evaporation, which, in the almost entire absence of vegetable growth, is unimpeded.

These, then, appear to be the conditions which have given rise to the small desert tracts which are described in these notes :—

(i.) The exposure of the sedimentary beds, possibly at a time when the rainfall was greater—or more evenly distributed throughout the year—than it is at present.

* H. B. Woodward : " The Geology of Soils and Substrata." 1912.
† *Op. cit.*

(ii.) The inability of the sediments to take up moisture to any considerable extent; which, combined with their poor retentive powers, has led, during the hotter months of the year, to the almost entire depletion of their free water content.

(iii.) The air spaces between the particles of the now perfectly dry soil resist the downward percolation of the rains when they fall; while in the absence of a continuous film of wetted particles to establish surface tension (and thus bear the water downwards) this resistance can hardly be overcome.

By the gradual crumbling away of the red earth deposit and the consequent exposure of fresh sedimentary surfaces the deserts are slowly expanding. Year by year they encroach upon the red earth.

Heat and the absence of water are the two chief factors in desert development.* Climate alone may account for desert conditions, and in this connection Corstorphine calls attention to the fact that certain sandstones and shales, which yield deep fertile soils in Southern Transvaal and in the Orange Free State, form desert areas in Cape Colony.† Here in Ceylon our small desert tracts are due, as we have seen, not so much to the arid nature of the climate as to the inability of the ground to hold water.

Once a desert is started it tends to grow, and our small examples in Ceylon are no exception to the rule. By the gradual crumbling away of the red earth deposit, and the consequent exposure of fresh sedimentary surfaces, the deserts are slowly expanding. Year by year they encroach upon the red earth escarpment, and by imperceptible degrees the living forest gives place to the barren wilderness.

Under the present conditions the sedimentary rocks of this type, and in this part of the country, must always give rise to arid tracts—unless the theory advanced for their origin be wrong.

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* For an account of the conditions which make for aridity see Prof. Macdougal's Paper (Jour. R. G. S., Vol. XXXIX., No. 2, Feb., 1912, pp. 105-120).

† Proc. Geol. Soc. (S. A.), 1907, p. xix.

It is pleasant to think that it probably lies within the power of man to control the conditions and reclaim the lost fertility. But Nature might reclaim it herself, and one wonders whether she has not already done so once. The well-defined line of demarcation between the two sets of deposits exposed along the scarp points to a discontinuity in the sequence of events. Thus, the question arises, Does the upper limit of the lower beds represent the buried surface of an ancient desert plateau or not? It is impossible to answer this question definitely at the present time, but the past existence of large desert tracts in the north of this country is quite a feasible suggestion, and the geological evidence, as it stands at present, is, perhaps, rather in favour of it than otherwise.

SKETCH MAP of parts of **NORTHERN NORTH-WEST,** and **NORTH-CENTRAL PROVINCES** to shew the approximate positions of **deserts A, B, and C** (based on the 4 miles to an inch maps of the Survey Department)

Miles 5 4 3 2 1 0 3

E. J. Lowe. 1915.

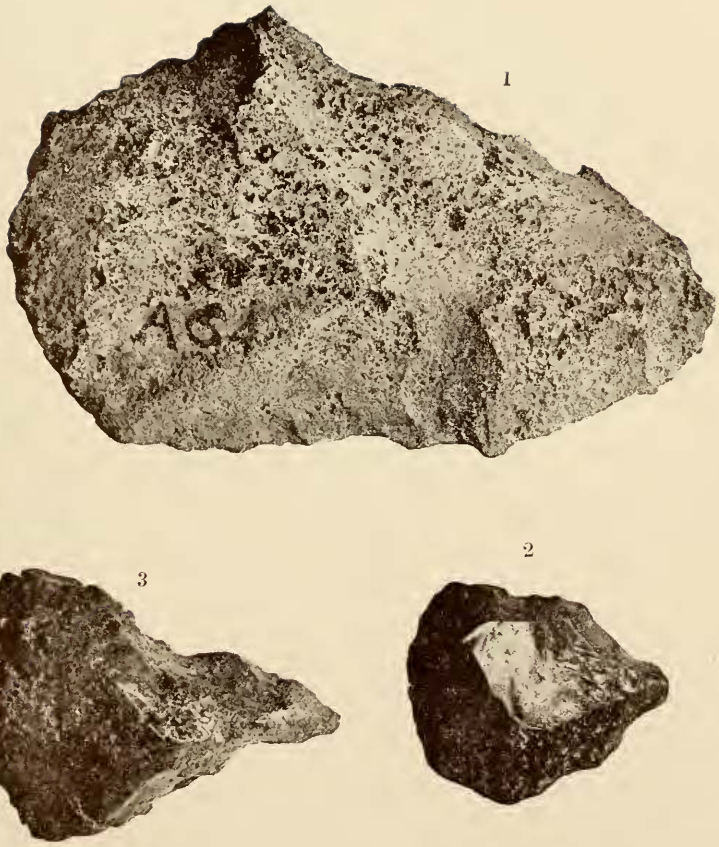
FIG. 1.—A GENERAL VIEW OF DESERT TRACT (*a*) AND THE FOREST BEYOND.

FIG. 2.—AN EFFLUENT RAVINE IN DESERT TRACT (*a*).

FIG. 1.—THE SOUTHERN ESCARPMENT OF DESERT TRACT (*a*).

FIG. 2.—A ROUGH SURFACE IN DESERT TRACT (*a*).

A ROUGH SURFACE IN THE EGYPTIAN DESERT.



ANCIENT STONE TOOLS FROM DESERT TRACT (*a*).

FIG. 1.—A CHERT BLADE SHOWING A SPONGY SURFACE.
FIG. 2.—A JASPOID IMPLEMENT, SUN-BURNT AND POLISHED.
FIG. 3.—A QUARTZ BORER, HIGHLY POLISHED.

1

2

3

A WIND-CUT STONE FROM DESERT TRACT (*a*).

FIG. 1.—SIDE VIEW.
FIG. 2.—THREE-QUARTER SIDE VIEW.
FIG. 3.—BASE VIEW.

NOTES.

Note on Halodeima atra (*Holothuria atra*).—During a visit to Galle in April, 1915, Mr. A. C. Hayley drew my attention to the presence of a worm living upon *Halodeima atra*, which is abundant on the reefs fringing the Fort at Galle. Mr. Hayley accompanied me to that part of the reef which lies between the lighthouse and the Triton Bastion, where some months earlier he had found *Halodeima atra* in abundance. On this occasion, however, we found no specimens. A few were discovered on the north-west side of the Triton Bastion, but the best locality was at the base of the Æolus Bastion. Incidentally I have suggested to Mr. Hayley that it would be of interest to determine the seasonal movements of this species on the reefs at Galle. Many Holothurians were examined by Mr. Hayley and myself, and about 30 per cent. of the specimens bore a Polynoid worm. As a rule not more than one worm was found on a Holothurian. The presence of the worm was difficult to detect owing to its colour adaptation. The colour of the general surface of the Holothurian was black or a deep brown, and the worm was black with a few insignificant white spots. If the worm were detached from its host it very quickly returned. Mr. Hayley stated from previous experience that the worm died very quickly if it were prevented from returning to its host, but I was unable to verify this. The identity of the Polynoid worm has not yet been determined.

Mr. Hayley also drew my attention to another case of commensalism in connection with the same Holothurian. A small crab was found on a few occasions in the cloacal cavity, and in one case in the intertentacular cavity formed by the partial withdrawal of the tentacles. This crab also exhibited cryptic colouring. The background was black, broken here and there by a few yellowish-white lines or spots. The crab has not yet been identified.

Most of the Holothurians were found living on sand, and in many cases the back (bivium) was covered with a thin coating of sand-grains fastened together by mucus from the epidermal cells. There were generally about seven pairs of

small circular patches of black arranged along the back where the layer of sand was interrupted and the black integument showed through. It is possible that there may be groups of sensory cells at these places.

Although *Halodeima atra* is one of the most abundant, and at the same time one of the largest Holothurians found on the Ceylon coast, it is not used commercially as " bêche-de-mer " or " trepang." This is also the case with *Bohadschia marmorata*, a large species which is so abundant at Trincomalee. So far as I know the bêche-de-mer which is most commonly dried and cured by the Jaffna fishermen for export is *Thymiosicya scabra* (*Holothuria scabra*).

Colombo, July 16, 1915. JOSEPH PEARSON.

Cannibalism in Pulchriphyllium crurifolium, Serv.—Mr. E. E. Green states in *Spolia Zeylanica, Vol. III., p. 221*, that specimens of *Pulchriphyllium crurifolium*, Serv., in captivity frequently nibble away portions of their companions. When Professor Plate was in Ceylon, he stated in the course of a lecture delivered before the Ceylon Natural History Society that Green was mistaken in supposing that the insects nibble each other. He remarked that the erosion of the sides of the body and tegmina, which Green put down to nibbling, was really part of the mimetic character of the insects, and was not an artificial effect, but the result of the infinite capacity for variation which this insect posesses, and which is shown in the colour-markings.

From personal observation I am able to refute this latter view of the case, as I have repeatedly witnessed the insects nibbling each other. It is amusing to watch the frantic efforts of a leaf-insect to dislodge its assailant when it is attacked. The adult insects seem to let each other alone, but half grown or very young ones are constantly to be seen chewing calmly, while their victims writhe and struggle to free themselves. This habit seems to be induced by overcrowding or shortage of food, and many vegetarian caterpillars become cannibals under the same circumstances.

Colombo, June, 1915. G. M. HENRY.

How Lizards Bathe.—On April 12, 1915, after a slight shower of rain I watched a lizard (*Calotes versicolor*) bathing. It was on a shoe-flower bush (*Hibiscus* sp.), and the bathing consisted in dragging itself along the branches and rubbing its sides against the wet leaves. I watched it for about five minutes, while it crawled slowly along and occasionally opened its mouth as if drinking the drops which adhered to its lips. It appeared to enjoy the feel of the water on its sides and back.

Birds frequently bathe in the same way. I have seen a little Ceylonese Sun-bird (*Arachnecthra zeylanica*) "scrabbling" about on the curved surface of a canna-leaf which had just been watered by the garden cooly, and hugely enjoying itself.

G. M. HENRY.

Colombo, June, 1915.

Do Rat-snakes Strike ?—Last February my son suffered an injury to his right foot while going for a rat-snake (*S. gerundiya*) in the garden, and subsequently developed an abscess near the ankle.

The doctor in attendance found no trace of a snake-bite wound, and was of opinion that the injury was caused by a blow (concussion) of some kind.

My son got the impression that he had been struck by the tail of the reptile, but from inquiries made this does not seem probable.

Mr. H. C. P. Bell writes : "I once drove a rat-snake into a corner, and the reptile in self-defence literally got its back against the wall and struck at me like a cobra—fortunately without effect. The rat-snake's bite (indeed the bite of all snakes) is known to be slightly poisonous, *i.e.*, likely to cause inflammation for a time. Mr. John Still when with me was bitten on the finger by an "eye-snake" (*S. gulla*), and was laid up with the wound for three days."

Mr. T. Wiggin, of Anuradhapura, writes : "I have seen rat-snakes strike out like cobras."

C. DRIEBERG.

Kandy, June 11, 1915.

PROCEEDINGS OF THE CEYLON NATURAL HISTORY SOCIETY.

Thirteenth General Meeting.

The Thirteenth (Third Anniversary) General Meeting of the Society was held in the Colombo Museum on May 7, 1915, with Dr. Andreas Nell in the chair. The Secretaries' and Treasurers' Reports for 1914 were duly adopted. The following were elected as Office-bearers for 1915 :—

Patron :

His Excellency Sir Robert Chalmers, K.C.B.

President :

The Hon. Mr. R. E. Stubbs, C.M.G., F.Z.S.

Vice-Presidents.

F. M. Mackwood, Esq.
Sir S. D. Bandaranaike, Kt., C.M.G.
Dr. A. Nell, M.R.C.S., L.M.S.

Council :

Joseph Pearson, Esq., D.Sc., F.R.S.E., F.L.S.
T. Petch, Esq., B.A., B.Sc.
W. E. Wait, Esq., M.A.
O. S. Wickwar, Esq.

Joint Hon. Secretaries and Treasurers :

W. A. Cave, Esq.
C. T. Symons, Esq., B.A., F.R.G.S.

Mr. Frederick Lewis read a Paper on "Some Notes on the Natural History of the Vedda Country."*

A few natural history specimens were exhibited.

* See p. 119 of this Part.

NOTES ON CEYLON RAILS, WADERS, GULLS, AND TERNS.

By W. E. Wait, M.A., M.B.O.U.

(*With two Plates.*)

SOME time ago it was decided to bring out a handbook of Ceylon birds, and the work was placed in the hands of Mr. Frederick Lewis, F.L.S., Mr. W. A. Cave, and the present writer, with Dr. Pearson as editor. As it is anticipated that some time may elapse before the whole handbook is ready for publication, it is thought desirable to place on record the rough draft of such instalments as have been completed. The present section deals with the Rails, Waders, Gulls, and their allies.

The classification followed is that of Dr. Blanford in Vol. IV. of the series on Birds in the "Fauna of British India," as being the standard work on Indian Birds. As is natural, the present paper is mainly based on that work and on Legge's "History of the Birds of Ceylon." I have, however, endeavoured to give as much fresh information as was possible on the distribution and nidification in Ceylon of the various species. I have also to acknowledge my indebtedness to Frank Finn's "How to know the Indian Waders."

The descriptions are taken from specimens, partly in the Colombo Museum, but mainly from the series in the British Museum, and I have to thank Mr. Ogilvie Grant for his kindness in granting me access to the latter.

Lastly, I owe much to Mr. E. C. Stuart Baker for his help and encouragement to a beginner in ornithology.

The measurements given are those adopted in the "Fauna of British India," expressed in inches and decimals, viz. :—

Length.—From the tip of the bill to the tip of the longest tail feather.

Tail.—From the root of the tail on the underside to the tip of the longest feather.

Wing.—The greatest distance from the bend of the folded wing to the tip of the longest quill, measured straight.

Tarsus.—The distance from the centre of the joint of the tarsus with the tibia to the base of the middle toe.

Bill.—The distance from the angle of the gape to the tip, measured straight.

The rough keys do not pretend to be based on strictly scientific distinctions, or to hold good for other species than those on the Ceylon list.

Order **GRALLÆ.**

Sub-order FULICARIÆ.

Family Rallidæ.

The Indian members of this order are divided into three sub-orders: *Fulicariæ*, the Rails; *Grues*, the Cranes; and *Otides*, the Bustards. In Ceylon, however, we have no Cranes or Bustards, and the *Fulicariæ* are confined to a single family *Rallidæ*, which comprises the true Rails, the Crakes, and the Water Hens.

The Ceylon members of the family are all marsh birds, greatly given to skulking in reeds and thick grassy swamps. Owing to their fondness for keeping to cover, it is probable that some of our rarer species are in reality far more generally distributed than would appear from the few recorded occurrences. Rails are usually slender in build, and stand fairly high on the legs. The toes are long and narrow and not webbed, though all our species are good swimmers. The wings are short, and the flight awkward; but in spite of this several species are migratory, and must cover long distances. The tail is short and constantly jerked up and down as the birds walk. The bill is usually moderately stout, the nostrils linear and lying in a grove.

The family is mainly vegetarian, feeding on seeds, grain, and water plants, but the food in addition consists of insects, larvæ, and the smaller forms of molluscs and crustaceans.

The nest is generally a large rough structure of grass or rushes placed on or near the ground. The eggs are spotted with two different colours, and are usually fairly numerous. The young when hatched are covered with down, and can run and swim within a few hours of their birth.

Within our limits are found nine species, each the sole representative of its genus, with the exception of *Amaurornis*, of which we have two members. The four larger species are resident and comparatively abundant, the five smaller are rare and mainly migratory, though two of them have been known to nest in the Island, and a third may possibly do so, as it is partially resident throughout its range in India and Burma.

Rough Key to the Ceylon Rallidæ.

I.—Bill from gape not shorter than tarsus. Length 10 to 11 inches.

(*a*) Bill slender, back streaked brown and black.
Rallus indicus (Indian Water Rail).

(*b*) Bill stouter, back brown speckled with white.
Hypotænidia striata (Blue-breasted Banded Rail).

II.—Bill from gape much shorter than tarsus.

A.—No frontal shield.

(*a*) Length 7·5 inches. Upper parts brown, streaked black, and smeared with white.
Porzana pusilla (Eastern Baillon's Crake).

(*b*) Length 10 inches. Back olive-brown. Lower parts below breast barred black and white.
Rallina superciliaris (Banded Crake).

(*c*) Length 8 inches. Upper plumage olive-brown, lower parts vinous chestnut.
Amaurornis fuscus (Ruddy Crake).

(*d*) Length 12 inches. Upper plumage black, breast white, stern chestnut.
Amaurornis phœnicurus (White-breasted Water Hen).

B.—Length 12 inches or over. A horny shield on forehead formed by a backward prolongation of upper mandible.

(*a*) Sexes alike, frontal shield rounded behind, toes with a narrow straight fringe.

Gallinula chloropus (Moor Hen).

(*b*) Sexes dissimilar, shield pointed behind and, in breeding males, prolonged into a horn, toes not fringed.

Gallicrex cinerea (Water Cock).

(*c*) Shield square behind, sexes alike, plumage blue.

Porphyrio poliocephalus (Purple Moor Hen).

RALLUS INDICUS (Blanford, Vol. IV., p. 158 ; Legge, p. 778).

The Indian Water Rail.

Description.—Upper plumage black with wide olive-brown margins to the feathers ; ashy gray above the eye, on the cheeks, and sides of throat ; a dark brown streak from the bill through the eye to the ear coverts ; most of wing quills dark brown ; chin white ; lower parts ashy gray, washed with brown on the breast ; flanks barred black and white ; under tail coverts black, edged with white.

Young birds have white bands on the wing coverts.

Bill brown, the basal portion of the lower mandible scarlet in adults, yellowy-red in young birds. Iris red ; legs and feet dull yellowish-pink.

Length about 11 ; wing 5 ; tail 2 ; tarsus 1·7 ; bill from gape 1·75. Females rather smaller.

Distribution.—A rare straggler to Ceylon. The only specimens recorded are a few birds taken years ago near Ja-ela. A winter visitor to parts of India, also occurring in China, Eastern Siberia, and Japan.

Habits.—A shy skulking bird found in grass and rushes round marshes or in paddy fields. It does not breed within the Indian limits.

HYPOTÆNIDIA STRIATA (Blanford, Vol. IV., p. 160; Legge, p. 775).

The Blue-breasted Banded Rail.

Description.—Crown and back of the neck chestnut; rest of the upper surface, including wings and tail, dark olive-brown speckled with broken white crossbars. Throat and chin white; face, foreneck, and breast ashy gray; remainder of the under surface blackish with white bars.

Females are duller, and have the middle of the abdomen dirty white.

Young birds have a brown cap and no white crossbars on the back.

Bill stouter and shorter than in the last species and variable in colour; upper mandible brown, lower some shade of red; legs and feet olive-green or gray; iris red or yellowy-brown.

Length 10·5; wing 4·65; tail 1·75; tarsus 1·55; bill from gape 1·65.

Distribution.—A rare resident scattered through the low-country; some birds may be migrants. The species occurs in the greater part of India and Burma, and through South-eastern Asia to the Malay Archipelago, and the Philippines.

Habits.—Similar to those of the last species, but the bird is more silent. It breeds apparently during the wet weather, as I have one clutch of eggs taken in December in the North-Western Province. The nest was a pad of flattened-down grass stalks on the edge of a paddy field; eggs five in number, pinky-white, rather sparingly spotted, chiefly at the larger end, with reddish-brown and pale grayish-purple. They measured 1·39 by 1·02.

PORZANA PUSILLA (Blanford, Vol. IV., p. 165).

PORZANA BAILLONI (Legge, p. 766).

The Eastern Baillon's Crake.

Description.—Upper plumage brown with black streaks and some white marks as if smeared with white paint. Face, throat, neck, and breast ashy-gray; a brown stripe runs from the base of the bill through the eye to the side of the neck;

abdomen barred black and white. In young birds the gray of the lower parts is replaced by buff.

Bill short and comparatively stout, green in colour; iris in adults red, in young birds reddish-brown; legs and feet green tinged with yellow; toes long.

Length about 7·5; wing 3·5; tail 1·75; tarsus 1·1; bill from gape ·7.

Distribution.—May be looked for in swamps throughout the low-country. Only recorded a few times from Ceylon, but largely overlooked owing to its small size and skulking habits. On one circuit in the Southern Province I came across five specimens. Most birds are probably migratory, but some may possibly be found breeding.

Found scattered throughout India and Burma in suitable localities, its range extending through Eastern Asia. Most birds are migratory, but some reside in India all the year round.

Habits.—This is smallest of our rails, being no larger than a slim quail. It runs in and out of the rushes round the edges of swamps, keeping much to cover and being hard to flush. The nest is the usual pad of rushes, grass, &c., on floating vegetation or amongst swampy grass. The eggs are five to seven in number, pale olive, rather streakily marked with darker brown, and measure about 1·16 by ·87.

Rallina superciliaris (Blanford, Vol. IV., p. 167).

Rallina euryzonoides (Legge, p. 772).

The Banded Crake.

(Plate I., fig. 1.)

Description.—Head, neck, and upper breast chestnut; chin and throat whitish; remainder of upper plumage dark brownish-olive; rest of lower parts boldly barred black and white.

An old female in the Museum collection resembles the male, another, probably younger, has the crown and nape olive-brown.

Young birds are brown on the head, neck, and breast.

Bill of moderate length and fairly stout, dark brown in colour and green at the base; iris blood-red; legs and feet grayish-black.

Length about 10; wing 5; tail 2·2; tarsus 1·7; bill from gape 1·2.

Distribution.—A rare but fairly constant migrant to the Island, arriving in October or November, and leaving probably about February. Stray specimens have been recorded from various parts of India and the Malay Peninsula. Its summer quarters are unknown.

Habits.—Rather a mysterious bird; most of the specimens have been obtained in Colombo, where they arrive about the end of October in a very exhausted condition. On arrival they generally seek refuge in bungalows, hiding in any odd corner they can find. When they recover from their journey they make for the hills. The bird is nocturnal in its habits, and frequents sedgy streams and paddy fields up-country. Sometimes it wanders into the jungle far from water.

Amaurornis fuscus (Blanford, Vol. IV., p. 170).

Porzana fusca (Legge, p. 769).

The Ruddy Crake.

Description.—Upper plumage olive-brown; forehead, sides of the head, neck, and lower parts, except the abdomen, vinous chestnut; a trace of white on the throat; abdomen and lower tail coverts brown with whitish streaks.

Young birds are uniformly dusky olive, with the exception of the chin, throat, and centre of the abdomen, which are whitish.

Bill olive-brown; iris orange-red; legs and feet reddish.

Length about 8; wing 4; tail 1·5; tarsus 1·4; bill from gape about 1·0.

Distribution.—Scattered sparingly through the low-country. Most birds are probably migrants, but some undoubtedly breed with us.

The species occurs throughout India and Burma, the range extending through South-eastern Asia and the adjoining islands to China and Japan.

Habits.—Frequents rushy ponds and swamps, hunting for food on floating lily leaves or amongst the vegetation in swamps. It occasionally wanders up-country. The nest is the usual pad of weeds or grass placed either on floating weeds, or amongst the herbage in swampy ground. The eggs three to five in number, measure about 1·2 by ·84, and are of creamy white streaked and spotted with reddish-brown and pale inky purple.

AMAURORNIS PHŒNICURUS (Blanford, Vol. IV., p. 173).

ERYTHRA PHŒNICURA (Legge, p. 786).

The White-breasted Water Hen.

(Plate I., fig. 2.)

Description.—Upper plumage and sides of body slaty black tinged with olive; forehead, sides of face, and lower parts from chin to breast white; abdomen rufescent darkening to chestnut on the vent and under tail coverts.

In young birds the forehead, crown, and upper parts are olive-brown, and the white feathers of the lower parts have dusky tips.

Bill greenish, red at the base; iris brown or brownish-red; legs olive-yellow.

Length 12; wing 6·25; tail 2·5; tarsus 2·25; bill from gape 1·5. Females slightly smaller.

Distribution.—Abundant in the neighbourhood of water all over the low-country and up to about 2,000 or 3,000 feet. Ranges through India and Burma and the greater part of the Oriental region.

Habits.—This bird with its loud cry must be familiar to most people in Ceylon. It often wanders some way from water to feed in the open, but it makes a bee-line for cover at a sharp run whenever disturbed. The nest is a large pad of rushes, grass, or leaves, sometimes on floating clumps of vegetation, sometimes on swampy ground, or occasionally in bushes or reeds a little away above the surface of the water. The eggs are four to seven in number, elongated ovals, obtuse at both ends. They are creamy white in colour with pale

grayish-purple blotches overlaid with markings of deeper red-brown, mostly round the large end, but often longitudinally streaked over the rest of the surface. Average measurements 1·59 by 1·19.

Gallinula chloropus (Blanford, Vol. IV., p. 175; Legge, p. 781).

The Moor Hen or Water Hen.

Description.—Back and wing coverts olive-brown; tertiaries and upper tail coverts rusty-brown; primary coverts and wing quills almost black; head and neck slaty-black shading into slate-gray on breast and flanks; some white streaks on the flanks and a white patch under the tail; middle of abdomen almost always partly white.

Bill yellow at the tip, remainder red; the upper mandible prolonged on the forehead into a red shield rounded at the back; iris red; legs olive-green, with an orange garter just below the feathered portion.

Young birds are lighter above, and the slate-gray of the lower parts is mixed with whitish; bill and shield olive coloured; orange garter absent.

Length 12·5; wing 6·5; tail 2·75; tarsus 1·9; bill from gape 1·1. Females slightly smaller.

Distribution.—This species, which was a great rarity in Legge's time forty years ago, has rapidly increased, and is abundant on the marshes and lagoons of the Hambantota District, where it breeds freely. I have also found it resident on some of the larger tanks in the North-Central Province.

It occurs as a resident or partial migrant throughout India and Burma, and ranges over the greater part of the Old World, being the species so common in the British Isles.

Habits.—Found on reedy tanks and marshes, often in the water, being a good swimmer. In Ceylon I have always found the nest to be a fairly thick platform of rushes, &c., about 6 to 8 inches across, wedged in among the stems of rushes growing in shallow water. The breeding season is about March, and again in July. Eggs vary from five to nine

in number ; oval slightly pointed at one end ; ground colour drab or brownish-stone, sparingly blotched or spotted with chocolate or reddish-brown, and a few paler purplish markings. Average measurements 1·62 by 1·16.

Gallicrex cinerea (Blanford, Vol. IV., p. 176 ; Legge, p. 791).

The Water Cock.

Description.—Males in breeding plumage almost uniformly slaty-black, more or less tinged with gray on the head, neck, and lower parts, and generally with a little white on the abdomen ; back and wings blackish-brown.

Out of the breeding season males assume the same plumage as females, which have the upper parts dark brown, with paler brown edges to the feathers, except on the crown ; lower parts light brown, with fine wavy dark brown bars.

In young birds the barring on the lower parts is less distinct, and sometimes absent.

Bill and frontal shield, which is pointed behind, are red in males ; in the breeding season the shield of the male is lengthened into a horn ; legs red ; iris red. Females have yellowish bills, dusky green legs, and brown irides.

Length : Males, 16·5 ; wing 8·5 ; tail 3 ; tarsus 3 ; bill from gape 1·55. Females, length 14 ; wing 7·0 ; tail 2·8 ; tarsus 2·6 ; bill from gape 1·4.

Distribution.—Found locally in marshy ground throughout the low-country. Common in the damper plains of India and Burma, and extends through South-eastern Asia to Java, the Philippines, and Japan.

Habits.—A long-legged, long-toed rail, rather nocturnal in its habits, and keeping to cover in the thick grass of swamps and wet paddy fields. Mainly a vegetarian, and very good to eat.

The nest is the usual large pile of grass among reeds or on floating vegetation. The breeding season is said to be in July or August. The eggs rather resemble those of the White-breasted Water Hen, but are browner and larger, averaging about 1·7 by 1·27.

PORPHYRIO POLIOCEPHALUS (Blanford, Vol. IV., p. 178; Legge, p. 795).

The Purple Moor Hen or Blue Coot.

Description.—General colour of upper plumage, flanks, and abdomen purplish-blue; head and face grayish; wings and chest greenish-blue; under tail coverts white; unexposed portion of wing and tail feathers black. The bill is stout, the nostrils rounded and not situated in a groove, the frontal shield is square behind; both bill and shield bright red; iris red; legs fleshy red.

Length 17; wing 10; tail 3·6; tarsus 3·4; bill from gape 1·5.

Distribution.—Numerous on the brackish lagoons and fresh-water swamps of the South-east Coast, and found locally inland on large swampy tanks. Occurs throughout India and Burma in suitable situations, and extends westward as far as the Caspian Sea.

Habits.—A conspicuous marsh bird with its bright blue plumage. Rather heavier in build than most rails, with longish legs and bony toes. The flight is awkward, and in flying the legs are extended at full length behind the bird. It often swarms in masses of tangled rushes, and when flushed takes fairly readily to wing. In the Southern Province it breeds freely about February, and again in July.

The nest varies from a large structure of rushes, &c., wedged in bulrush thickets to quite a moderate pad of grass on grassy islets or among floating vegetation.

The eggs, four to eight in number, rather resemble larger editions of those laid by the common Moor Hen, being stone colour, with fairly bold spots of reddish-brown and paler spots of grayish-purple. Average measurements 1·98 by 1·38.

Note.—The Coot, *Fulica atra*, a widely distributed member of the family, has not yet been recorded authentically from Ceylon, but a good lookout should be kept for it.

The species may easily be distinguished by its slaty-black plumage, white bill and shield, and from the fact that the toes are furnished with lobed fringes.

Order **LIMICOLÆ.**

The Waders.

The members of this large order, as their name implies, are mainly birds of the seashore, of sandy wastes, or of marshes.

The formation of the legs and feet is usually adapted for running and wading. The birds seldom perch, and the hind toe in consequence is generally minute and often wanting. The tarsus in most cases is comparatively lengthy, and not only it, but also the lower half of the tibia are naked. The toes are seldom conspicuously webbed, but most species can swim well. Many of the birds are migratory, and the flight of almost all is strong, the wing quills being well developed. The bill shows great diversity. It may be long and straight like the snipe's, pigeon-shaped as in the plover, curve up like the avocet's, or down like the curlew's. It is, however, generally slender, with the nostril carried in a lateral groove. As regards nidification, the eggs are nearly always laid on the ground, with a scanty nest lining or none at all. The young when hatched are covered with down, and can run about forthwith.

The order is divided into five families, one of which, the *Charadriidæ*, is well represented, comprising, as it does, the plovers, avocets, sandpipers, and snipes. The other four are small, and include groups of birds which—though their internal structure shows them to be nearly related to the plovers—often differ considerably in outward appearance, and in several cases point to affinities with other orders. The *Œdicnemidæ*, Stone Plovers, resemble the Bustards; while the Crab Plover, sole representative of the *Dromadidæ*, is distinctly related to the Gulls. The remaining two families are the *Glareolidæ* (Coursers and Swallow Plovers) and the *Parridæ* (Jaçanas).

Family Œdicnemidæ.

The Stone Plovers.

A small family, limited in Ceylon to two species placed in separate genera. They are rather bigger than the ordinary run of plovers, with heavier and stouter bills. The plumage is harsh and stiff. The hind toe is absent; the three front

toes are short and stout, and united by a slight web at the base. The eyes are very large, and the birds are rather nocturnal in their habits.

There is no nest, two eggs as a rule being laid on the bare ground.

Rough Key to Ceylon Stone Plovers.

A.—Length 16 inches. Bill from gape 2 inches in length, and moderately stout.
Œdicnemus scolopax (Stone Curlew).

B.—Length 20 inches. Bill from gape over 3 inches, and large and heavy.
Esacus recurvirostris (Great Stone Plover).

ŒDICNEMUS SCOLOPAX (Blanford, Vol. IV., p. 204; Legge, p. 969).

The Stone Curlew.

Description.—Upper plumage sandy brown or buff, the feathers with blackish shaft-stripes; lores, eyebrow, and a stripe below the eye creamy-white; two white bars across the wing coverts, and between them a band of brownish-black. Wing quills blackish-brown; a white patch on each of the first two or three primaries; tips and roots of the later primaries white, as are the basal parts of the inner webs of the earlier secondaries. Tail ashy-brown with a bold black and a white bar on all but the two middle feathers. Lower parts white to rufous with blackish shaft-stripes on the neck, upper breast, and sides of body. Young birds have irregular darker bandings on wing coverts and tail feathers.

Bill black at the end, yellow at the base; iris large, and bright yellow; legs and feet greenish-yellow.

Length 16; wing 8·5; tail 4·5; tarsus 3·1; bill from gape 2·0.

Distribution.—Thinly though fairly widely distributed round the sandy coasts of the dry zone, and occasionally found inland on sun-baked fallow stretches of paddy land. Occurs throughout India and Burma in suitable localities, its range extending from England southwards to North Africa, and eastwards to Central and South-western Asia.

Habits.—A wary bird, fond of dry open ground. It has the same trick as the Bustard of lying flat on the ground to escape detection. The wild shrill cry is rather like that of the Curlew.

The breeding season is probably about March, and again in July. Two, or occasionally three, eggs are laid in a slight depression of the ground.

The ground colour is buff or olive-green with blackish clouds and blotches, and sometimes paler purplish markings. Average size about 1·90 by 1·40.

Esacus recurvirostris (Blanford, Vol. IV., p. 205; Legge, p. 974).

The Great Stone Plover.

(Plate I., fig. 3.)

Description.—Upper parts ashy-brown, with darker narrow shaft-stripes; base of forehead, lores, orbits, and a stripe behind the eye white. The last-mentioned white stripe is bordered above and below by a black band, which runs round the front of the eye; another dark stripe from the gape of the bill down the cheeks. Greater and median wing coverts lighter than the back and with a pearly tinge; on the lesser wing coverts a dark-brown band edged with white. Wing quills blackish, with a white band on the first three primaries; sixth primary with some white on the inner web, and later primaries white banded with black. All tail feathers, except the middle pair, barred with white, and black at the tip.

Under plumage whitish, more or less tinged with gray on the fore-neck and upper breast; under tail coverts tinged with rufous.

Bill powerful and straight along the ridge, yellow at the base, remainder black; iris very large and yellow; legs and feet pale yellowish-green.

Length 20; wing 10·5; tail 4·75; tarsus 3·25; bill from gape 3·5.

Distribution.—Confined to dry sandy stretches near the shore or round coastal lagoons; may occasionally be found inland round the larger tanks if they have gravelly margins or a small rocky island in the middle. Found throughout India and Burma on the banks of large rivers.

Habits.—The birds are usually met with in pairs, which keep almost entirely to one beat. Like the last species, it is semi-nocturnal. In India this Stone Plover almost always haunts the banks of rivers. In Ceylon it is mainly found on the seashore, and would thus seem in its habits to approach the allied *E. magnirostris*, a littoral species which ranges from Australia to the Andamans. The series in the British Museum included only one skin from Ceylon, but I rather fancy that when a larger series of specimens and eggs from this Island can be compared they will establish a slight racial distinction approaching the larger and darker Australian bird with a higher upper mandible and curved culmen.

The birds breed in March and April, and perhaps again in July, laying two eggs in a slight hollow in the sand or among stones. In shape these are slightly pointed ovals; stone-coloured, scrawled and blotched with umber, the larger blotches being partly overlaid with black. The average size of a small Ceylon series is 2·25 by 1·68.

Family Dromadidæ.

The Crab Plovers.

The family is restricted to a single genus and species occurring on the shores of the Indian Ocean. In outward appearance and habits this bird shows a strong resemblance to the Gulls. The hind toe is fairly well developed; the front toes are long and noticeably webbed; the bill is strong, stout, and longer than the head; the nostrils are oval and placed, not in a groove, but in a small depression. The nidification is unlike that of any other member of the order, a single white egg being laid in a burrow.

Dromas ardeola (Blanford, Vol. IV., p. 208; Legge, p. 991).

The Crab Plover.

Description.—General colour white pied with black, the black being confined to the back, the elongated feathers of the mantle, the greater wing coverts, and the major portion

of the wing quills. There is also a small black speck in front of and behind each eye.

Young birds are gray on the upper parts and streaked with black on the head and nape.

Bill black; iris dark brown; legs and feet grayish-blue; claws black.

Length 16; wing 8·25; tail 2·8; tarsus 3·75; bill from gape 2·75.

Distribution.—Found in small numbers, chiefly on the north coast from Mannar to Trincomalee. Its range extends from the shores of East Africa to those of the Bay of Bengal.

Habits.—A curious bird, confined to the sea coast or shores of salt lakes; as a rule gregarious. Crabs are its main food. The flight and gait are those of a Plover. Breeds about the end of May. The bird digs in a sandy beach a long curved burrow, in which it lays a solitary white egg measuring about 2·50 by 1·75.

Family Glareolidæ.

Coursers and Swallow Plovers.

A family confined to the Old World. In it—with the exception of a genus which does not occur within Indian limits—the nostrils are not pierced through the bill, as in all the other groups of the order, but have a partition between them.

The bill is slight and not grooved. None of the forms are large. The eggs resemble those of Plovers, but are of a more dumpy oval and less pointed at the narrow end. There are two well-marked sub-families.

(*a*) The Coursers (*Cursoriinæ*).
(*b*) The Swallow Plovers (*Glareolinæ*).

Sub-family *Cursoriinæ*.

Genus **Cursorius.**

The Coursers.

Represented in Ceylon by a single species. The Coursers are great runners, and frequent dry plains. The tarsus is longish, and there is no hind toe. In outward appearance they are not unlike small Lapwings, but the bill is pointed, and not swollen at the tip.

CURSORIUS COROMANDELICUS (Blanford, Vol. IV., p. 210 ; Legge, p. 977).

The Indian Courser.

Description.—Upper plumage in general grayish-brown ; forehead and crown rich chestnut, the long crown feathers partly concealing a black patch on the nape. A broad white stripe runs from near the bill over each eye meeting at the nape ; this is bordered below by a black band running through the eye. Chin white, passing into rufous on the throat ; upper neck, all round fore-neck, and breast rufous, deepening into chestnut on the lower breast ; centre of the abdomen black ; the lower abdomen, flanks, upper and under tail coverts white. The sides of the body and axillaries the same gray-brown as the back. Primary coverts and primary quills black ; secondaries grayish towards the ends and tipped with white. All except the two middle feathers of the tail are banded with black and tipped with white, the white increasing towards the sides of the tail, the outer feathers being practically all white.

Females are slightly larger than males.

Young birds are mottled all over above with brown and buff, with some spots as well on the under plumage.

Bill blackish, moderately long, slender, and slightly curved ; iris dark brown ; legs and feet white or whitish-yellow ; claws black.

Length 9 ; wing 6 ; tail 2·25 ; tarsus 2·1 ; bill from gape 1·1.

Distribution.—The north-west coast, from the Jaffna Peninsula to the boundary of the Puttalam District. Occurs through a great part of the Indian Peninsula, except in the north-west.

Habits.—In Ceylon it is restricted to sandy wastes and bare pasturages near the sea. In India it is also found in open sandy or stony plains inland.

Generally seen in small scattered troops running hither and thither in search of insects. It appears to breed about March, and probably later in the year, laying on the bare ground two, or sometimes three, eggs, broad oval in shape, and stone-coloured, with dull black scrawls, mottlings and blotches. Average size about 1·20 by ·97.

Sub-family *Glareolinæ*.

Genus **Glareola.**

The Pratincoles or Swallow Plovers.

A small group of birds, which in outward build and flight much resemble Swallows. The wings are long, reaching when closed well beyond the tail. The bill is short and curved, and the gape wide. The legs are short; the hind toe is fairly well developed, and there is a trace of webbing between the middle and outer toes. The birds are crepuscular in their habits, hawking for flying insects in the evening and early morning, and resting on the ground during the day.

Two species are found in Ceylon.

Rough Key to Ceylon Species.

A.—Tail deeply forked; wing over 7 inches.
G. orientalis (Large Indian Swallow Plover).

B.—Tail only slightly forked; wing under 6 inches.
G. lactea (Small Indian Swallow Plover).

Glareola orientalis (Blanford, Vol. IV., p. 214; Legge, p. 980).

The Large Indian Swallow Plover.

Description.—Upper plumage brown to brownish-olive, tinged with rufous on the back of the neck. Wing quills blackish-brown, the primaries almost black, the tertiaries lighter; shaft of the first primary whitish; upper tail coverts white; tail feathers white at the base with broad brown tips. Lores dusky-brown; chin and throat rufous buff, ringed round by a narrow black band, edged with white on the inside, which runs from the gape. Upper breast olive-brown, passing through rufous on the chest into sullied white on the abdomen and lower tail coverts. The greater portion of the wing lining and axillaries is chestnut.

Young birds have no gorget, and are mottled brown and buff above. The gorget is not assumed until the upper plumage has lost its mottling.

Bill black, vermilion round the gape; iris dark brown; a ring of white skin round the orbit; legs and feet reddish-brown.

Length 9·5; wing 7·4; tail 3; depth of fork 1·0; tarsus 1·3; bill from gape 1·0.

Distribution.—Resident in a few scattered colonies round large tanks, such as Minneri and Kanthalai, and on the shores of lagoons in the Hambantota District. Locally distributed in India and Burma, ranging north-east through China, and south-east to Australia.

Habits.—Already described in my remarks on the sub-family. I have taken the eggs twice, both times in the same locality in the Hambantota District, once in April and once in July. In each case the two eggs were laid on a small disintegrated patch of dry cowdung in dry sandy pasture near a lagoon. They are dumpy, slightly pointed ovals, rather velvety in appearance. The ground colour is drab, fairly evenly blotched with brown-black markings over fainter washy splotches of grayish-purple. Average size 1·20 by ·93.

Glareola lactea (Blanford, Vol. IV., p. 216; Legge, p. 984).

The Small Indian Swallow Plover.

(Plate I., fig 4.)

Description.—Upper plumage pale ashy-gray, darker on the forehead. Primary quills and wing lining black; there is some white on all the primaries, except the first two, the white increasing on the secondaries, which are black only towards the tip. Upper tail coverts white; tail white with a broad black border tipped on all but the two central feathers with white. Chin whitish; throat, foreneck, and upper breast ashy-gray, tinged more or less with rufous; abdomen and under tail coverts white.

Bill black, red at the base, and yellowish round the gape; iris dark brown; a creamy orbital ring; legs and feet brownish.

Length 6·5; wing 5·9; tail 2·0; tarsus ·75; bill from gape ·75.

Distribution.—Fairly common near Hambantota, and found in a few other localities in the dry zone by the coast or

inland round some of the larger tanks. A resident in suitable localities on the plains of India east of the Indus and in Burma.

Habits.—Those of the genus. In Ceylon this species haunts sand banks near the sea, or the sandy shores of inland tanks; in India it is mainly found on the sandy beds of large rivers. With us it breeds about April. Two eggs from Minneri were laid on bare gravelly sand under the shade of a small plant. Clutches in India vary from 2 to 4. The ground colour is pale brownish-buff, rather sparingly speckled with pale gray-purple and light umber. The average of my two Ceylon eggs is 1·02 by ·81.

Family PARRIDÆ.

The Jaçanas.

Genus **Hydrophasianus.**

A family with only one representative in Ceylon, though other genera are met with all over the tropics. They are marsh birds, distinguishable by their feet; all the toes, including the hind toe, being enormously long, and furnished with equally long claws, thus enabling the bird to run easily over floating water leaves. The bill is plover-like.

In the genus *Hydrophasianus*, of which our Water Pheasant is the sole species, the first wing quill is elongated into a curious little lance-shaped tip connected with the rest of the feather by a slender and flexible shaft.

The shape of the fourth quill is also peculiar, running into a point. The genus is further noticeable from the fact that in the breeding season both sexes assume a nuptial plumage with longer tail feathers, and develop a strong sharp spur on the bend of the wing.

HYDROPHASIANUS CHIRURGUS (Blanford, Vol. IV., p. 219; Legge, p. 914).

The Pheasant-tailed Jaçana or Water Pheasant.

Description.—Winter: Upper plumage in general brown, darker on the lower back and rump, and speckled with white on the forehead and crown; a white stripe on the lores and above the eye; behind the eye this stripe becomes a broadening band of yellowish-brown running down the side of the

neck ; below this is a black stripe running from each side of the gape and meeting in a broad band across the breast. The remainder of the lower parts with the outer tail feathers are white. Wing coverts largely white, the inner, median, and greater coverts being barred with brown and buff. First primary black ; second with a white patch on the inner web near the root ; the white gradually increases on the next quills, the secondaries being entirely white.

Breeding plumage : Head, throat, and foreneck white ; the back of the neck glistening golden yellow, bordered on each side by a black stripe, and in front by a black patch on the nape ; back, scapulars, tertiaries, and lower plumage from the neck down chocolate-brown ; tail, upper tail coverts, and rump black ; wing coverts and wing lining white ; wing quills remain as in winter. The tail increases in length from about 4 inches to nearly a foot.

Females are slightly larger than males.

Young birds are like adults in winter plumage, but have a rufous head and rufous edges to the feathers of the upper parts ; the gorget is wanting, the upper breast being speckled brown.

In the breeding season the bill is bluish, the iris brown, and the legs and feet plumbeous black ; in winter the bill is dark brown, paler at the tip, the iris yellow, and the legs greenish.

Length of male in winter 12, in summer 18 ; wing 7·8 ; tail in winter 3·75, in summer 10 ; tarsus 2 ; bill from gape 1·3. Females : length in winter 15, in summer 21 ; wing 9.

Distribution.—Common throughout the low-country wherever there are suitable sheets of water. The species extends all over India and Burma, and eastwards to South China and the Philippines.

Habits.—Frequents tanks and still sheets of water covered with lotus leaves, over which it runs rapidly, feeding on insects, crustaceans, and vegetable matter. The cry rather resembles the mewing of a cat. The breeding season is from about March to June. The nest is generally a blob of floating waterweed, almost awash, but sometimes the eggs are laid on bare floating lotus leaves. They are four in number, peg-top shaped, and in colour a glossy bronze, which becomes lighter as incubation proceeds. Average measurement about 1·44 by 1·06.

Family Charadriidæ.

Plovers, Sandpipers, Snipes, &c.

A large family, comparatively well represented in Ceylon. The forms vary greatly in size, in length of bill and of limb. The tail is always short, the hind toe short or absent, and the wing usually strong. The gape of the mouth is peculiarly narrow, never extending further back than the feathering of the forehead. All of them are ground birds, only a few species ever perching, and those but occasionally. With one exception, a migrant breeding in cold northern climates, the eggs are laid on the ground with little or no nest lining. The eggs are four in number, peg-top shaped and spotted; the ground colour being drab or some approximate tint.

The family as classified by Blanford falls into four fairly well-marked sub-families, which may be distinguished as follows:—

A.—Bill short and, with one exception, pigeon-shaped; the groove from the nostrils extending for not more than half the length of the bill.
Charadriinæ (Plovers).

B.—Bill long, plumage pied.
Hæmatopodinæ (Stilts, Avocets, &c.).

C.—Bill variable; nasal groove extending for more than half the length of the bill; plumage not pied, a distinct summer and winter dress.
Totaninæ (Curlews, Sandpipers, &c.).

D.—Bill long; eyes large, and placed far back; toes without a trace of web.
Scolopacinæ (Snipes).

Sub-family *Charadriinæ*.

The Plovers.

Plovers are birds not so much of the marsh, as of grassy or sandy places. They are often found near water, but not, as a rule, actually in swamps. Many of the smaller species haunt the seashore. The genus *Strepsilas* (the Turnstone) stands apart, in having the bill straight and pointed; whereas in all the true Plovers the bill is shaped like that of a pigeon, with the tip of the upper mandible swollen and the ridge curved at the end.

We have one species of Turnstone in Ceylon, while the true Plovers fall into three groups: the mainly resident Lapwings, with broad wings and a flapping flight; the migratory Golden Plover and its allies, with a speckled upper plumage; and the smaller Sand Plovers, of which some species migrate, while others remain with us all the year.

Ten members of the family come on to the Ceylon list. The four small Sand Plovers are all referable to the genus *Ægialitis*, the remaining six species are divided among as many genera.

Rough Key to Ceylon Charadriinæ.

I.—Bill straight, short, and conical, no swelling on tip.

(*a*) Size small; length 8·5 inches.

Strepsilas interpres (the Turnstone).

II.—Bill pigeon-shaped, slightly swollen at tip.

A.—Wings broad; upper plumage not speckled.

(*a*) A red wattle in front of eye.

Sarcogrammus indicus (Red-wattled Lapwing).

(*b*) A yellow wattle in front of eye.

Sarciophorus malabaricus (Yellow-wattled Lapwing).

(*c*) No wattle.

Chettusia gregaria (Sociable Lapwing).

B.—Upper plumage speckled; wings sharp and pointed.

(*a*) No hind toe; length 9·5 inches.

Charadrius fulvus (Eastern Golden Plover).

(*b*) A small hind toe; length 12 inches.

Squatarola helvetica (Gray Plover).

C.—Small forms under 9 inches; upper plumage not speckled; wings sharp and pointed.

(*a*) No white ring round neck.

(1) Wing 5·5 inches; bill from gape 1 inch or over.

Ægialitis geoffroyi (Large Sand Plover).

(2) Wing 5 inches; bill from gape ·75 inch.

Æ. mongolica (Lesser Sand Plover).

(*b*) A white ring round neck.

(1) No dark band across breast.

Ægialitis alexandrina (Kentish Plover).

(2) A dark band across breast.

Æ. dubia (Little Ringed Plover).

STREPSILAS INTERPRES (Blanford, Vol. IV., p. 223 ; Legge, p. 900).

The Turnstone.

(Plate I., fig. 5.)

Description.—Winter : Top and sides of head brown with darker streaks ; upper back, scapulars, tertiaries, and wing coverts dark brown with slightly paler edges, some of the under scapulars being partly or wholly white ; lower back, rump, and longer tail coverts white ; shorter tail coverts dark brown ; wing quills blackish-brown with white shafts, and some white on the inner webs ; some of the later secondaries almost or wholly white. Tail white at the base, the outer half brown with white edges to all but the central pair of feathers ; the outer pair of feathers almost wholly white. Foreneck and sides of breast brown ; the rest of the lower parts with wing lining white.

Summer : Head, chin, and throat white, with black streaks on the crown ; a black band from eye to eye across the forehead and a black patch below the eye. The back, scapulars, tertiaries, and wing coverts are mingled black and chestnut. A partial collar on the side of the neck, the foreneck, breast, and sides are black ; remainder of lower parts white.

Bill black ; iris brown ; legs and feet orange-red ; claws blackish.

Length 8·5 ; wing 6·2 ; tail 2·5 ; tarsus 1 ; bill from gape 1.

Distribution.—A migrant during the north-east monsoon, fairly common on the coast from Jaffna to Mannar ; rarer on the east coast, but met with as far south as Hambantota ; a mere straggler to the west coast south of Puttalam.

Of almost world-wide distribution, breeding in high northern latitudes and wintering in the south ; not, as a rule, found away from the coast.

Habits.—Found on sandy flats by the sea or round lagoons, hunting underneath stones and shells for insects, and generally going about in small parties. By the time the birds leave the Island, about the end of April, many have almost completely assumed summer plumage.

SARCOGRAMMUS INDICUS (Blanford, Vol. IV., p. 224).

LOBIVANELLUS INDICUS (Legge, p. 962).

The Red-wattled Lapwing (*Did-he-do-it*).

Description.—General colour above light brown, slightly glossed with bronze-green and lilac-red, the latter colour strongest on the wing coverts. Head, neck, and upper breast black with a broad white band running from the eye down the side of the neck to join the white plumage of the lower parts, sides, and flanks. Primary coverts and wing quills black with a white bar across the wing formed by the tips of the greater secondary coverts and the bases of the secondary quills, one or two of the later secondaries being entirely white. Rump and upper tail coverts white. Tail white, the central feathers with the outer half brown, and all the feathers with a broad black cross-band near the tip.

Young birds are brown, not black, on the crown and upper breast, and grayish-white on the sides of the face and throat.

Bill red at the base, black at the tip; eyelids and wattle lake-red; iris reddish-brown; legs yellow.

Length 13; wing 8·5; tail 4·25; tarsus 3; bill from gape 1·4.

Distribution.—Abundant all over the low-country, except in very dry districts, where its place is largely taken by the next species. Not found in Burma or Upper Assam, but ranges through the rest of India westwards to Southern Persia and Arabia.

Habits.—Common on the open ground round every village tank, about the edges of paddy fields, and on grassy land near water. Its cry of Did-he-do-it must be familiar to every one. Generally seen in pairs.

Breeds during dry weather from April till about August, laying four eggs on the bare ground. Their colour is yellowish-stone with blotches of deep brown or black, and under markings of paler purple-gray. Average size 1·68 by 1·20.

Sarciophorus malabaricus (Blanford, Vol. IV., p. 226).
Lobipluvia malabarica (Legge, p. 966).
The Yellow-wattled Lapwing.

Description.—General colour of upper parts, with sides of head, neck all round, and upper breast, light brown ; crown and nape black bordered below by a white stripe round the nape from eye to eye. Chin black ; lower parts from breast downwards, with the sides, flanks, and wing lining, white. Quills and primary coverts of wing blackish-brown ; the primaries white on the inner web near the base ; outer secondaries white at the base, the white increasing towards the later secondaries, which are wholly white ; secondary coverts tipped white. Tail white ; the middle feathers brown on the outer half ; the whole crossed by a black band towards the tip, the band being broad in the middle, and tending to disappear on the outer feathers.

Young birds have paler bands on the brown upper parts and, at first, no black on the head, which becomes more and more mottled with black as maturity approaches.

Bill yellow at base, black at tip ; eyelid and wattle lemon-yellow ; iris silver-gray or light yellow ; legs yellow.

Length 10·5 ; wing 7·75 ; tail 3 ; tarsus 2·4 ; bill from gape 1·25.

Distribution.—Fairly plentiful in the dry coast zone from Jaffna to Mannar ; rare on the east, but commoner round Hambantota. Resident on dry plains throughout India, except in the Western Punjab ; unknown in Burma.

Habits.—Essentially a bird of dry sandy wastes and parched fields. In Ceylon it never goes far inland. The cry is a plaintive " pee-wit." It breeds in June and July, laying on the bare ground four pyriform eggs of buff or pale stone colour blotched with dark brown and pale inky-purple. They are considerably smaller than those of the last species, averaging 1·45 by 1·07.

CHETTUSIA GREGARIA (Blanford, Vol. IV., p. 231; not in Legge).

The Sociable Lapwing.

(Plate I., fig. 6.)

Description.—General tone of upper plumage light ashy-brown, darker on the wing coverts and on centre of lower back. Crown and nape black; forehead and a stripe running over the eye round the nape white; below this a black stripe passes through the eye to the ear coverts. Primary coverts and primaries black; a little white on the bases of all the quills and on the inner border of the last primary; secondaries and outer part of the greater secondary coverts white. Chin white, shading through buff on the throat and sides of the face into ashy-brown on the neck and breast. Abdomen black with a patch of chestnut behind. Wing lining, flanks, vent, lower and upper tail coverts, and greater part of tail white; a black band across the tail near the tip, broad in the centre and disappearing on the outer feathers.

In immature birds the crown is dark brown often streaked with black; forehead and band round the nape buff instead of white. The brown of the upper plumage is darker, and the feathers are edged with rufous buff; breast mottled brown; remainder of lower parts white.

Bill, legs, and feet black; iris dark brown.

Length 12; wing 8; tail 3·5; tarsus 2·4; bill from gape 1·2.

Distribution.—A very rare winter visitor to Ceylon; has been obtained two or three times on the racecourse at Colombo. A migrant, breeding in Eastern Europe and Central Asia, and wintering chiefly in North Africa and North-west India.

Most Indian specimens are in immature plumage.

Habits.—Occurs in small flocks, and is generally found in open country.

CHARADRIUS FULVUS (Blanford, Vol. IV., p. 234; Legge, p. 934).

The Eastern Golden Plover.

Description.—Winter: Upper plumage dark brown or blackish, each feather with yellow spots, which are whitish on the wing coverts. The forehead and an indistinct streak

above the eye fulvous or whitish; sides of head and neck fulvous with brown streaks. Primary coverts and wing quills dark brown with indistinct white edges on some feathers. Tail dark brown mottled with yellow or whitish. Under part sullied white or dull brown, darker and streaked with brown on the breast. Wing lining and axillaries gray-brown.

Summer: All lower parts turn black, except the wing lining and axillaries, which do not change. The brown of the upper plumage becomes darker, and the yellow spots brighter; the forehead and the streak over the eye become pure white.

Bill black; iris dark brown; legs and feet leaden black.

Length 9·5; wing 6·5; tail 2·4; tarsus 1·7; bill from gape 1·1.

Distribution.—Common in suitable places throughout the low-country from end of August to end of April. A migrant, breeding in Siberia and wintering over the whole of Southern Asia and as far south as Australia.

Habits.—Generally found in flocks on bare fields, grassy land round tanks, or sandy pastures near the coast. During the wet weather the birds wander about a good deal. Some specimens on their first arrival in the Island bear traces of the summer plumage, and most birds before they leave have a large amount of black on the breast.

Squatarola helvetica (Blanford, Vol. IV., p. 236; Legge, p. 929).

The Gray Plover.

Description.—Winter: Dark brown above, with pale edgings to the feathers. Forehead, lores, sides of head, and neck dirty white streaked with brown. Wing coverts edged and notched with pearly-white; primary coverts and wing quills black-brown, with some white on the webs and shafts. Upper tail coverts and tail white with darker bars; the barring more marked on the tail. Lower parts white or whitish, streaked with brown on the foreneck and breast.

Summer: The lower parts become black from the chin to the upper abdomen; lower abdomen, flanks, thighs, and lower tail coverts pure white. The upper parts are brown-black marked and barred with pure white.

Immature birds are spotted with golden buff above like a Golden Plover.

Bill black ; iris dark hazel ; legs and feet gray-black.

Length 12 ; wing 8 ; tail 2·9 ; tarsus 1·8 ; bill from gape 1·3.

Distribution.—An occasional and irregular winter visitor, specimens having been obtained at various points on the coast from Jaffna to Colombo. Breeds in the far north, wintering chiefly near the sea in India and Burma.

Habits.—Generally found in small flocks frequenting sandy beaches, tidal flats, and the shores of lagoons. In other respects the habits are similar to those of the Golden Plover.

ÆGIALITIS GEOFFROYI (Blanford, Vol. IV., p. 237 ; Legge, p. 939).

The Large Sand Plover.

Description.—Winter : Upper plumage brown, the feathers with slightly paler edges and narrow darker shaft-stripes ; the forehead and eyebrow white or whitish ; a dark brown band from the lores passes under the eye to the ear coverts ; the greater wing coverts with white tips ; the primary coverts and wing quills brown, with a little white on the outer webs of the inner primaries and on the tips and shafts of the secondaries. The lateral tail coverts are edged with white ; the tail feathers brown tipped with white, the outermost pair being almost entirely white. The lower parts are white, with a more or less perfect band of brown across the breast.

Summer : The upper plumage turns paler brown with a rufous tinge. The forehead is white below and black above ; a broad black stripe runs from the bill through the lores to the ear coverts ; the crown, sides of neck, hind neck, and a band across the upper breast pale rufous.

Bill black ; iris brown ; legs and feet grayish-green, gray, or yellowish-black.

Length 8·5 ; wing 5·5 ; tail 2·2 ; tarsus 1·5 ; bill from gape 1·1.

Distribution.—A migrant found on the coasts of the dry zone from Mannar round by Jaffna to Hambantota. Breeds in Japan and Eastern China, wintering on the shores of the Indian Ocean from South Africa to Australia.

Habits.—Frequents the seashore, tidal flats, and the sandy stretches round lagoons, often in company with the next species. Some immature birds in winter plumage remain with us throughout the year.

ÆGIALITIS MONGOLICA (Blanford, Vol. IV., p. 238 ; Legge, p. 943).

The Lesser Sand Plover.

(Plate II., fig. 7.)

Description.—Similar to the last species in either plumage, but smaller and with a shorter bill.

As a rule, in the winter plumage the upper surface is darker brown, and in summer the western race which visits India has the forehead wholly black or with only a little white. The Chinese race has more white on the forehead and a brighter pectoral gorget.

Bill, iris, and feet as in *Æ. geoffroyi*.

Length 7·5 ; wing 5 ; tail 2 ; tarsus 1·2 ; bill from gape ·75.

Distribution.—Plentiful all round the coast line of the dry zone during the north-east monsoon.

Breeds in Central and Northern Asia and in Alaska ; winters round the shores of the Indian Ocean from South Africa to Queensland. Numbers of immature birds in winter plumage remain with us throughout the year.

Habits.—Like the last species, may be found on sandy or muddy flats by the shore and round the margins of lagoons, often in large scattered flocks.

ÆGIALITIS ALEXANDRINA (Blanford, Vol. IV., p. 240).

ÆGIALITIS CANTIANA (Legge, p. 947).

The Kentish Plover.

Description.—Winter : Upper plumage in general mud-brown. Forehead, eyebrow, a ring round the neck, and all the lower parts, with the wing lining and axillaries, white ;

a brown patch on each side of the breast, extending sometimes nearly to the middle ; lores and a stripe through the eye and round the nape a richer brown than on the back. Wing quills blackish-brown, the inner primaries with a white patch on the outer web, and the secondaries with white tips and borders. The four central tail feathers are blackish-brown, the next pair white on the tips and outer borders, the two outside pairs entirely white.

Breeding plumage. Male : A broad black patch appears above the white forehead ; remainder of crown and nape tinged with rusty red. A band from the lores to the ear coverts, and the patch on each side of the breast black. Female : Lacks the black patches on the front of the crown, while the loral band and breast patches are rusty brown instead of black. The rufous tinge on the head is less pronounced than in the male.

Young birds have paler edges to the feathers on the upper parts.

Tropical birds are smaller than northern specimens.

Bill black ; iris brown ; legs and feet dusky gray or blackish.

Length 6·5 ; wing 4·1 ; tail 1·9 ; tarsus 1 ; bill from gape ·7.

Distribution.—Found all round the coast ; most plentiful in the north and about Hambantota ; some birds are resident, but their numbers are largely reinforced during the north-east monsoon by migrants. Occurs throughout the Indian Empire, chiefly near the sea. The species ranges through Europe, Africa, most of Asia, and Australia, but many of the birds which winter in warmer climates breed in the north.

Habits.—Mainly a bird of the sea coast, preferring sandy shores rather than mud flats. Has been found breeding in June and July on sandy wastes near Hambantota, but some birds at the breeding season retire inland to nest round Minneri and Kanthalai tanks. Ceylon birds appear to lay only two or three eggs, which are stone-coloured with rather scratchy black markings and a few pale gray-purple spots. Average measurement 1·18 by ·87.

ÆGIALITIS DUBIA (Blanford, Vol. IV., p. 241).

ÆGIALITIS CURONICA (Legge, p. 952).

ÆGIALITIS JERDONI (Legge, p. 956).

The Little Ringed Plover.

Description.—General colour above brown, darkest on the wings and tail, the wing quills and the tip of the tail being almost black. The forehead, the fore part of the crown, and the sides of the head from the bill to the ear coverts are black, with a white band across the forehead from eye to eye, and a white border behind the black of the crown and ear coverts. The chin, throat, and a collar all round the neck are white; behind this is a collar of black, broadest on the breast. The remainder of the lower parts and the wing lining are white. The later primaries and the secondaries are tipped with white, the white increasing on the later secondaries; the two outer tail feathers are almost entirely white, the remaining feathers, with the exception of the central pair, tipped with white.

Bill black; iris dark brown; eyelid yellowish; legs and feet dusky yellow.

Length 7; wing 4·5; tail 2·5; tarsus 1; bill from gape ·6.

Note.—By many Indian ornithologists this species is divided into two: a larger migrant form (*Æ. curonica* of Legge) and a smaller resident species (*Æ. jerdoni* of the same author). Dr. Sharpe, in the British Museum Catalogue, unites the two forms, and is followed by Blanford. The matter is still a moot point I believe. The resident form is noticeably smaller, with a wing measurement of 4·0, has more yellow at the base of the bill, and a broader naked yellow ring round the eye.

Distribution.—The migrant race visits the coast in the north of the Island during the north-east monsoon, is a winter migrant to the whole of the Indian Empire, and occurs all over Europe, Asia, and North Africa. The resident form is found sparingly round Kanthalai and Minneri tanks, and on the sand banks in the lower reaches of the Mahaweli-ganga and its larger tributaries. I have also seen it near Hambantota.

Habits.—Sometimes seen away from water in dry or sandy fields, but generally found on sandy margins of large tanks or in river beds. With us migrant birds appear to frequent sandy wastes near the coast. Resident birds appear to nest about June, the eggs being slightly smaller than those of *Æ. alexandrina*, averaging about 1·14 by ·84.

Sub-family *Hæmatopodinæ*.

Stilts, Oyster-catchers, and Avocets.

A group consisting of three widely-spread genera: *Hæmatopus* (the Oyster-catchers); *Himantopus* (the Stilts); and *Recurvirostra* (the Avocets), together with one curious central Asian bird *Ibidorhyncus* (the Ibis Bill). The last-named genus does not occur in Ceylon; in each of the other genera we have a single species. All three are birds of medium size found by the water's edge, and feeding on molluscs, crustacea, worms, &c. Two of them are rare winter visitors to our shores, the other—the Black-winged Stilt—is fairly common and largely resident. All of them have the front toes webbed to a certain extent, a pied plumage, long pointed wings, and a long bill. The shape of the bill, however, differs greatly, affording an easy means whereby the three forms may be distinguished.

Rough Key to Ceylon Hæmatopodinæ.

A.—No hind toe; bill straight, strong, chisel-tipped, and longer than tarsus.

Hæmatopus ostralegus (the Oyster-catcher).

B.—No hind toe; bill straight, slender, pointed, and shorter than tarsus.

Himantopus candidus (the Black-winged Stilt).

C.—A small hind toe; bill curving upwards, thin, flexible, and pointed.

Recurvirostra avocetta (the Avocet).

HÆMATOPUS OSTRALEGUS (Blanford, Vol. IV., p. 245 ; Legge, p. 987).

The Oyster-catcher.

Description.—Head and neck, upper back, scapulars, and tertiaries black ; lower back, rump, tail coverts, and under plumage from the lower neck white. The primary coverts and primary quills are black, with some white on the latter ; there is also some white on the edge of the wing, and a white wing band formed by the tips of the median coverts, the outer secondary coverts, and the inner secondary quills. The tail is white with a broad black band at the tip.

Young birds are browner, and have a patch of white on the throat.

Bill orange-red at the base, yellower and more dusky at the tip ; iris red, orange, or browny-red ; legs and feet brownish-purple, the toes slightly webbed at the base, and with broad soles.

Length 16 ; wing 10 ; tail 4 ; tarsus 2·1 ; bill from gape 3 to 3·25.

Distribution.—A rare and occasional visitor during the north-east monsoon to the coast from Jaffna to Puttalam. Found during the winter on the coasts of India and Burma, but not common, except in the north-west. Found by the sea in most parts of Europe and Asia, breeding in the north and wintering in the south.

Habits.—Usually seen in small troops, which keep largely to the shore, feeding between high and low water marks on shellfish, &c. Especially fond of rocks uncovered by the tide. A very wary bird.

HIMANTOPUS CANDIDUS (Blanford, Vol. IV., p. 247 ; Legge, p. 919).

The Black-winged Stilt.

(Plate II., fig. 8.)

Description.—Adult male : Head, neck, lower parts, lower back, and rump white, the crown and nape often being tinged with gray. The upper part of the back, the wing coverts, and wings, together with the wing lining, glossy green-black ;

tail white or grayish. Females have the black of the upper parts replaced by brown, except on the wing quills.

Young birds are blackish on the crown and grayer on the hind neck. Probably only quite old birds have the head pure white.

Yearling birds are still lighter brown on the back, with pale edges to the feathers ; the head and hind neck are gray-brown.

Bill black ; iris red ; legs and feet lake-red or pinkish-red with black claws.

Length 15 ; wing 9·25 ; tail 3·25 ; tarsus 5·0 ; bill from gape 2·85.

Distribution.—Fairly common in the north of the Island and down the east coast as far as Hambantota. Occurs throughout India and Burma, extending through Southern Europe, all Africa, and Southern Asia.

Habits.—Most of our birds appear to be resident. During the wet season they may be seen far inland at the edges of tanks in the Northern and North-Central Provinces. They breed from April to June in fairly large colonies round certain lagoons all down the east coast and by a few tanks, such as Minneri and Kanthalai. The nest is the usual depression in the ground near the water's edge ; it is sometimes lined with a few rushes, a little grass, or with waterweeds. The eggs, three or four in number, are drab or stone-coloured blotched with black. They much resemble the eggs of the Red-wattled Lapwing. Average size 1·64 by 1·19.

Recurvirostra avocetta (Blanford, Vol. IV., p. 248 ; Legge, p. 925).

The Avocet.

Description.—General colour white, with the following parts brown in winter and black in summer :—The forehead, crown, nape, hind neck, the upper part of the mantle, including the shorter scapulars, together with a band on the wing formed by the median coverts, the greater part of the primary quills, and some of the tertiaries. In the winter the hind neck is white, and the tail tinged with brownish-gray.

Bill black ; iris reddish-brown ; legs and feet bluish-gray.

Length 18; wing 9; tail 3·5; tarsus 3·3; bill from gape 3·25.

Distribution.—A very rare straggler in winter; has been obtained near Jaffna, and I believe that I once saw one near Hambantota. A winter visitor to India, commoner in the north, and unknown in Burma. Found all over temperate Europe, Africa, Northern and South-western Asia, breeding in the north of its range.

Habits.—Generally found about mud flats and sand banks, in estuaries, or by the shores of salt lagoons.

Sub-family *Totaninæ*.

Curlews, Sandpipers, and Stints.

A large sub-family, all the members of which are migrants, with a distinct summer and winter dress, visiting us in the winter months and breeding mainly in the far north. In some species, however, more or less numerous immature specimens loiter, *i.e.*, do not go north to breed, but remain in the Island during the summer months in a bachelor state and winter dress.

The plumage is generally some shade of gray or brown above; paler and often white underneath; never pied, but often streaked.

The bill is slender, usually long, and provided with well-developed nerves, giving the organ a keen sense of touch—a necessity for birds which obtain their food mainly by probing in mud and soft sand in search of worms or other similar small forms of life. This is especially the case with the Stints.

No less than seventeen species are found in Ceylon, distributed among seven genera. These genera fall into two groups: those which have some trace of webbing at the base of the front toes and those which have none. To the former category belong five genera. The first of these, *Numenius* (the Curlews), fairly large birds with long curving sickle-shaped bills, gives us two species. *Totanus* (the Sandpipers) is well represented in Ceylon by seven species, the smaller of which are so familiar to snipe shooters under the name of Snippets. The genus *Limosa* (Godwits), finds its way into the Ceylon list owing

to stray specimens of one species having been recorded from the north of the Island. The remaining genera—*Terekia* (Avocet Sandpiper) and *Pavoncella* (Ruff and Reeve)—are each confined to a single species, of which rare stragglers have been obtained within our limits.

The two genera devoid of webbing between the toes are: First, *Tringa* (the Stints), out of which five species visit us. These are all small birds about the size of a sparrow. Three of them swarm about the flat shores of our lagoons, but two are excessively rare. Second, *Calidris* (the Sanderling), another single species, placed in a separate genus by reason of its having no hind toe, and only once recorded from Ceylon.

Rough Key to Ceylon Totaninæ.

I.—Toes partially webbed.

A.—Bill curved downwards, long; wing over 9 inches. Genus *Numenius*.

(*a*) Crown streaked, wing about 11·5.
Numenius arquatus (Curlew).

(*b*) Crown brown with a pale broken band down centre, wing about 9·5.
Numenius phæopus (Whimbrel).

B.—Bill straight, long, and with a blunt point; wing 7·5 or over. Genus *Limosa*.

(*a*) Tail half white, half black.
Limosa belgica (Black-tailed Godwit).

C.—Bill curved upwards, twice as long as tarsus, which is short. Genus *Terekia*.
Terekia cinerea (Avocet Sandpiper).

D.—Bill about same length as tarsus, slender, straight (except in one species), the tip of upper mandible hard and slightly bent down. Genus *Totanus*.

(*a*) Small forms, wing not over 5 inches, legs greenish.

(1) Rump not white.
Totanus hypoleucus (Common Sandpiper).

(2) Rump white.
Totanus glareola (Wood Sandpiper).

(*b*) Medium forms, wing 5 to 6 inches, legs olive or green.

(1) Lower back brown.
Totanus ochropus (Green Sandpiper).

(2) Lower back white.
Totanus stagnatilis (Little Greenshank).

(*c*) Wing over 6 inches, legs red, rump white.

(1) Secondary quills white.
Totanus calidris (Redshank).

(2) Secondary quills brownish barred with white.
Totanus fuscus (Spotted Redshank).

(*d*) Wing over 6 inches, rump white, bill slightly curved up, legs greenish.
Totanus glottis (Greenshank).

E.—Wing 6 inches or over, bill noticeably shorter than tarsus, rump and lower back brown. Genus *Pavoncella*.
Pavoncella pugnax (Ruff and Reeve).

II.—No trace of web between toes.

A.—No hind toe. Genus *Calidris*.

(*a*) Plumage pale, length 7·5 inches.
Calidris arenaria (Sanderling).

B.—A hind toe. Ceylon forms all under 9 inches in length. Bill slender. Genus *Tringa*.

(*a*) Bill straight ; shafts of all primaries partly white.

(1) Tarsus gray.
Tringa minuta (Little Stint).

(*b*) Bill straight ; shafts of all primaries, except first, brown.

(1) Tail all brown ; mid toe and claw 0·9 inch.
Tringa subminuta (Long-toed Stint).

(2) Outer tail feathers white ; mid toe and claw 0·75 inch.
Tringa temminckii (Temminck's Stint).

(*c*) Bill curved downwards towards tip.

(1) Upper tail coverts chiefly white.
Tringa subarquata (Curlew Stint).

(2) Upper tail coverts blackish-brown.
Tringa platyrhyncha (Broad-billed Stint).

NUMENIUS ARQUATA (Blanford, Vol. IV., p. 252).

NUMENIUS LINEATUS (Legge, p. 906).

The Curlew.

(Plate II., fig. 9.)

Description.—General colour of upper parts light brown, the feathers with darker shaft-stripes, which are broader on the back than on the head and neck ; some of the larger scapulars with dark arrowhead bars ; wing coverts with paler edges to the feathers ; primary coverts and primaries brown-black with white tips, except on the outer primaries ; white mottling on the inner web of the outer and on both webs of the inner primaries ; secondaries brown barred with white ; tertiaries ash-brown with dark brown shaft-stripes and crossbars. Lower back and rump white, the middle feathers with a black shaft-stripe expanding on the tip into a broad spot. Upper tail coverts white with dark spots ; tail ashy-brown with dark crossbars. Chin and throat whitish ; the foreneck reddish-buff or brownish, and the remainder of the lower parts white ; the feathers on the neck, breast, and flanks with dark shaft-stripes.

In summer the whole plumage is darker ; the shaft-stripes are everywhere broader, and extend further down on the abdomen.

Bill dark brown or blackish, the lower mandible being fleshy-white near the base ; iris brown ; legs and feet blue-gray.

Length about 23 ; wing 11·5 ; tail 4·5 ; tarsus 3·4 ; bill from gape 5 to 6 or over.

The birds vary considerably in size, and females are larger than males.

Distribution.—Fairly common on the north coast during the north-east monsoon, rarer on the east coast, and a mere straggler in the south and west. A winter visitor to the Indian Empire. The species breeds in temperate zone of the Old World, wintering in Africa and Southern Asia.

Habits.—Frequents shallow tidal flats, low shores round lagoons, or marshy land near the coast. In the north of the Island it may be seen in large flocks on favourite feeding grounds.

Numenius phæopus (Blanford, Vol. IV., p. 253 ; Legge, p. 910).

The Whimbrel.

Description.—Upper parts in general brown with paler edges to the feathers, most noticeable on the wing coverts. Forehead and crown darker with an indistinct paler line down the centre ; a pale band with narrow dark streaks from base of bill over the eye to the nape ; lores and ear coverts dark brown. Primary coverts and primaries blackish-brown, tipped, except on the outer primaries, with white ; inner webs of all quills and both webs of inner quills notched with white. Lower back and rump white with brown drops. Upper tail coverts barred brown and whitish ; tail ashy-brown with darker crossbars. Chin and throat white ; foreneck and breast whitish with darker shaft-stripes ; remainder of lower parts white, barred with brown on the flanks, wing lining, axillaries, and lower tail coverts.

In winter the barrings and streaks on the lower back and under parts are less distinct than in summer.

Bill black, the under mandible much paler near the base ; iris dark brown ; legs and feet blue-gray.

Length 17 ; wing 9·5 ; tail 3·75 ; tarsus 2·3 ; bill 3·25.

Females are slightly larger than males.

Distribution.—Occurs during the north-east monsoon at various places round the coast. A winter visitor to the Indian coasts. Breeds in Europe and Northern Asia, extending in winter from North Africa to Australia.

Habits.—Much the same as those of the last species, but this bird is not often seen in flocks, and is more fond of rocky shores. Immature specimens sometimes loiter, as I once shot one near Hambantota in July.

LIMOSA BELGICA (Blanford, Vol. IV., p. 254).
LIMOSA ÆGOCEPHALA (Legge, p. 832).
The Black-tailed Godwit.

Description.—Winter : General colour above ashy-brown, paler on the head and neck, and darkening towards the rump, which is blackish-brown. There is an indistinct whitish eyebrow and a whitish spot under the eye ; a white band along the tips of the greater wing coverts ; primary coverts and primaries blackish-brown, with some white on the inner webs of all and on the outer webs of the inner primaries ; secondaries white with a broad black tip, which diminishes on the inner feathers, the outer webs of the inner secondaries being entirely white. Upper tail coverts and base of tail white ; the outer half of the tail blackish, but lighter at the tip. Chin, throat, and under parts whitish, darkening on the foreneck and breast to grayish-brown.

Summer : Head, neck, breast, and back rufous, streaked with black on the crown and nape, mottled with black on the back, and barred with dusky black on the breast ; the bars are continued on the abdomen and sides of the body.

Bill fleshy-red, dusky at the tip ; iris dark brown ; legs and feet blackish.

Length about 17·5 ; wing 8·5 ; tail 3 ; tarsus 3 ; bill 3 to 4·8.

Specimens vary greatly in size and in length of bill, females are generally larger than males.

Distribution.—A pair was once obtained at Point Pedro. Common in Northern India in winter ; rare in Burma, Assam, and Southern India. Breeds in temperate Europe and Asia, wintering from Southern Europe and North Africa eastwards to Australia.

Habits.—May be looked for on the tidal flats along the north coast, as possibly a few stragglers now and then visit the Island during the winter months. In India it is found inland on the edges of tanks and swamps.

TEREKIA CINEREA (Blanford, Vol. IV., p. 258 ; Legge, p. 836).

The Avocet Sandpiper.

Description.—Winter : Upper parts, including tail, light ashy-brown, with darker shaft-stripes ; forehead and eyebrow whitish ; lores brownish. There is an indefinite dark brown band along the lesser wing coverts ; outer wing coverts and primaries dusky brown ; secondaries brown edged with white ; outer tail feathers mottled with white. Lower parts white ; the foreneck and sides of the breast more or less streaked and washed with gray.

Summer : The black shaft-stripes are strongly developed on the scapulars, and in general are more conspicuous ; the sides of the head, the neck, and breast are more noticeably streaked with a shade of brown.

Bill blackish-brown ; iris brown ; legs and feet orange-yellow.

Length 9·5 ; wing 5·1 ; tail 2·2 ; tarsus 1·1 ; bill from gape 2.

Distribution.—A rare straggler recorded from the coast in the Mannar District and Southern Province. Breeds in North-eastern Europe and Northern Siberia, wintering in East Africa, Southern Asia, and Australia. Occurs locally on the coasts of the whole Indian Empire.

Habits.—A curious bird, easily distinguished by its pale plumage, long bill curving upwards, relatively short legs, and orange feet. It generally associates in small troops of five or six, and may be looked for on tidal flats and muddy shores of lagoons.

TOTANUS HYPOLEUCUS (Blanford, Vol. IV., p. 260).

TRINGOIDES HYPOLEUCUS (Legge, p. 867).

The Common Sandpiper.

Description.—Upper parts, including head and tail, slightly glossy olive-brown, with darker shaft-stripes to the feathers ; scapulars, tertiaries, wing coverts, and middle tail feathers with a darker border near the tip, which is edged with white. Primary coverts and primaries dark brown, the coverts tipped

with white ; part of the inner web of all primaries, except the first, white ; secondaries white with a broad outer dusky band, which gradually disappears on the inner feathers. Outer tail feathers barred brown and white. There is an indistinct white eyebrow ; the cheeks and sides of the neck and breast are streaked grayish-brown ; lower parts whitish with some darker shaft-streaks on the foreneck.

In summer the upper parts lose the olive tinge and become darker with bolder shaft-stripes and crossbars. The foreneck and breast are more distinctly streaked with brown.

Bill deep brown above, tinged with yellow at the base ; iris brown ; legs grayish-green.

Length 8 ; wing 4·25 ; tail 2·25 ; tarsus ·95 ; bill from gape 1·1.

Distribution.—Common throughout the low-country during the north-east monsoon, occasionally found as high up as Nuwara Eliya.

Common throughout India in the winter, but less abundant in Northern India than *T. ochropus ;* breeds in the temperate regions of the Old World, migrating in the winter as far as South Africa, Southern Asia, and Australia.

Habits.—Usually solitary or found in pairs, and fonder of the seashore, the gravelly borders of tanks, and the sides of streams than of paddy fields and swamps. One of our earliest migrants, many birds arriving during August. It often perches on fences or low boughs near the water.

Totanus glareola (Blanford, Vol. IV., p. 261 ; Legge, p. 857).

The Wood Sandpiper.

(Plate II., fig. 10.)

Description.—Winter : Upper parts bronze-brown ; the crown and hind neck with faint paler edges to the feathers ; a whitish streak from the bill to above the eye. On the back, scapulars, wing coverts, rump, and tertiaries the feathers have more pronounced white edges and spottings of white and deep brown. The upper tail coverts are white, the middle tail feathers light brown barred with dark brown ; the remainder

of the tail barred brown and white, the brown disappearing on the outside feathers. The lesser wing coverts, primary coverts, and wing quills dark brown; the secondaries and later primaries tipped with white. Foreneck and upper breast light ashy with darker brown streaks; rest of lower parts white with a few black markings on the lower tail coverts.

Summer: The upper plumage is more distinctly variegated dusky brown and white; the head and neck are streaked with white; the breast with distinct dark spots.

Bill greenish at the base, blackish at the tip; iris deep brown; legs yellowish-olive.

Length 8·5; wing 4·8; tail 2; tarsus 1·5; bill from gape 1·3.

Distribution.—Abundant all over the low-country; common throughout the Indian Empire; breeds in Europe and Northern Asia, wintering from Africa eastwards to Southern Asia and Australia.

Habits.—The species is found in swarms all over the paddy fields and marshes of the low-country from September to April. It arrives earlier than the Snipe and leaves a little later, collecting in large flocks before departure. It is also fairly common on salt marshes, tidal flats, and the low shores round lagoons. This and the next species but one, *i.e.*, *T. stagnatilis*, are the birds usually known to Snipe shooters as Snippets.

Totanus ochropus (Blanford, Vol. IV., p. 262; Legge, p. 862).

The Green Sandpiper.

Description.—Winter: Upper surface brown with a tinge of olive; paler on head and neck; the feathers of the scapulars, wing coverts, and tertiaries edged with alternating pale and dark spots. The outer wing coverts, the primaries, and secondaries unrelieved dark brown; tail white barred with brownish-black, the bars disappearing towards the outside feathers; upper tail coverts white. There is an indistinct white streak on the eyebrow; the chin and throat are whitish; the sides of the head and of the neck with the upper breast

streaked with brown. Remainder of lower parts white; the axillaries and wing lining dusky brown barred with white.

Summer: The crown and hind neck are much streaked with white; the back is spotted with white, and the brown streaks on the sides of head and neck and on the upper breast are broader and more conspicuous.

Bill deep brown, greenish round the nostrils and at the base of the lower mandible; iris hazel-brown; legs and feet dingy green, grayish, or bluish.

Length 9·5; wing 5·5; tail 2·5; tarsus 1·3; bill from gape 1·5.

Distribution.—Sandy beds of rivers in the northern half of the Island; also on streams up-country. Common in Northern India, rarer in Burma and Southern India. Occurs throughout the Old World, breeding in the north and wintering in the south.

Habits.—Not a very common bird with us, and seldom seen away from the beds of streams, though in Northern India it frequents marshes or even paddy fields. It is a wary bird, with a much louder note than that of the last species. About our earliest migrant, arriving in August and not leaving till May.

Totanus stagnatilis (Blanford, Vol. IV., p. 263; Legge, p. 844).

The Marsh Sandpiper; Little Greenshank.

Description.—Winter: General colour above ashy-brown, the feathers with paler edges and inconspicuous darker shaft-stripes. The wing coverts and primaries are dark brown; greater coverts, later primaries, and secondaries edged with white, lower back and rump white; upper tail coverts white, sometimes barred with brown; tail white irregularly barred with brown, the central feathers and the outer webs of the rest tinged with ashy-brown. The forehead, lores, cheeks, and under parts white, with brown streaks on the sides of the upper breast, neck, and of the head behind the eye.

Summer: The general tone of the upper plumage is ashy-gray tinged with brown; there are conspicuous black angular

patches on the feathers of the back and black arrowheads on the tertiaries. The foreneck and upper breast are marked with brown spots, which turn to irregular bars on the sides of the body.

Bill dark brown, the basal portion of lower mandible greenish; iris hazel-brown; legs and feet bluish-green or yellowish.

Length 10; wing 5·5; tail 2·3; tarsus 2·15; bill from gape 1·7.

Distribution.—Extremely common, mainly near the coast in the north and east of the Island. Occurs only locally in India and Burma, and generally inland. Its summer haunts lie further south than those of most Sandpipers, extending from South-east France, through Central Asia, to Southern Siberia. It winters in Africa and Southern Asia as far eastwards as the Malay Archipelago.

Habits.—In Ceylon this species may be found in numbers by every lagoon, salt marsh, and tidal flat along the coast of the dry zone. It also frequents paddy fields in districts near the sea, and occurs inland round such tanks as Kanthalai. Some immature birds remain with us throughout the year.

Totanus calidris (Blanford, Vol. IV., p. 264; Legge, p. 852).

The Redshank.

Description.—Winter: Upper plumage light ashy-brown; the wing coverts with white edges and irregular dark bars; the lower back and rump white; upper tail coverts and tail white barred with brown, the central feathers tinged with ashy-brown towards the tip. The primary coverts and primaries are dark brown; the inner margins of the primaries are mottled with white; the tips and the inner webs of the later primaries and the exposed portion of all the secondaries are white, showing a large clear white area on the expanded wing. Forehead and lores brown; a white streak from the bill to the eyebrow; sides of face, foreneck, and upper breast white streaked with brown; remainder of lower parts white with a few streaks on the flanks and lower tail coverts.

Summer: Upper plumage brown, tinged in parts with rufous and streaked with dark brown; scapulars and tertiaries with dark shaft-stripes and herring-bone bars. The feathers of the lower plumage, except on the abdomen, are boldly streaked and spotted in the centre with blackish-brown.

Young birds resemble adults in winter plumage, but are more marked on the upper parts, where the feathers have reddish-brown edges; the wing coverts and tertiaries are marked with fulvous; the foreneck, breast, and flanks are streakily marked with ashy-brown.

Bill black, reddish at the base; iris brown; legs and feet orange-red.

Length 11; wing 6·25; tail 2·5; tarsus 1·9; bill from gape 1·9.

Distribution.—Moderately common on the coast from Mannar round by Jaffna to Hambantota. Rare on the west coast. Scattered through India and Burma in suitable localities; found over most of Europe, Africa, and Asia, breeding in the temperate zone and wintering further south.

Habits.—Generally seen in small troops on the muddy shores of estuaries or lagoons near the cover of bushes or mangroves. A very shy bird with a loud call and a swift twisting flight, especially when fired at.

Totanus fuscus (Blanford, Vol. IV., p. 265; Legge, p. 848).

The Spotted Redshank.

Description.—Winter: Upper plumage ashy gray-brown; lower back and rump white; upper tail coverts barred black and white; tail ashy-brown with broken bars of dark brown and white on the edges. Scapulars, wing coverts, and tertiaries dusky, edged and notched with white, the tertiaries with imperfect black bars. Primary coverts and primaries dark brown, the inner borders of primaries mottled with white, the later primaries and secondaries brownish, barred and tipped with white. Lores ashy-brown, eyebrow white; sides of face, foreneck, and upper breast indistinctly streaked

with ashy-gray ; there are dusky bars on the flanks. Chin, throat, and remainder of lower plumage white.

Summer : The brown of the upper plumage becomes dusky black spotted and mottled with white on the edges of the feathers. The head, neck, and lower parts gradually become sooty gray, with narrow white fringes to the feathers on the body ; the under wing coverts and axillaries remain white.

Young birds resemble adults in winter plumage, but have more white spots on the edges of the upper plumage, and are broadly barred with dull brown on the lower parts.

Bill black, the basal half of lower mandible orange-red ; iris brown ; legs and feet orange-red in winter, dark red in summer.

Length 13 ; wing 6·75 ; tail 2·4 ; tarsus 2·3 ; bill from gape 2·5.

Distribution.—Has once been procured in the Jaffna Peninsula. A common winter visitor to Northern India, rare in Burma, and the south ; breeds in the far north of Europe and Asia, migrating in winter to the shores of the Mediterranean and to Southern Asia.

Habits.—May be looked for in the same localities as the last species. Like many other of our rare migrants, it may occasionally visit the Island unnoticed.

Totanus glottis (Blanford, Vol. IV., p. 266 ; Legge, p. 840).

The Greenshank.

Description.—Winter : General colour of upper parts ashy-brown ; the top and sides of the head and sides of the neck much streaked with white ; back, wing coverts, scapulars, and tertiaries with dark shaft-stripes and black and white edges to the feathers, the scapulars and tertiaries in some cases being imperfectly barred with black on their margins. Lower back, rump, and upper tail coverts white. The tail is barred with brown, most strongly on the central feathers, which are ashy-brown at the tip. The primary coverts and primaries are blackish-brown, the later primaries and secondaries narrowly edged with white. The forehead, eyebrow, the sides of the face in front of the eye, and the lower plumage white. There

is a patch of streaky brown on the lores at the base of the lower mandible. The wing lining and axillaries are barred with brown.

Summer: The whole head and neck are streaked with blackish-brown; the feathers of the back and scapulars have conspicuous broad black centres; the foreneck and sides of the breast are spotted with dark brown, a few spots extending to the middle of the breast.

Bill olive-brown, darker at the tip and slightly curved upwards; iris brown; legs and feet yellowish-green.

Length 14; wing 7·5; tail 3·25; tarsus 2·5; bill from gape 2·5.

Distribution.—Widely distributed round the coast, commonest in the north and east. Occurs throughout the Indian Empire. Breeds in Northern Europe and Siberia, wintering from Southern Asia to China and Australia.

Habits.—Keeps chiefly to tidal flats, the shores of lagoons, and wet fields near the sea, but I have seen it in paddy fields 30 miles inland in the south of the Island. It is never very numerous. A good many immature birds remain during the south-west monsoon.

Pavoncella pugnax (Blanford, Vol. IV., p. 268).

Machetes pugnax (Legge, p. 873).

The Ruff and Reeve.

Description.—Winter: Both sexes—forehead, lores, and cheeks whitish speckled with dusky brown; sides of head and neck speckled with brown; the upper parts to the tail ashy-brown, with dusky brown centres and whitish fringes to the feathers; greater wing coverts tipped with white; primary coverts and wing quills dark gray-brown, the secondaries with white tips. The outermost upper tail coverts are white. The lower parts are white with a varying amount of gray or brown diffused over the foreneck and upper breast.

In summer the males grow yellow tubercles on the face, develop enormous ruffs, and assume a fancy dress on the head, breast, and ruff. The colours may be any combination of white, glossy metallic black, chestnut, or orange-buff. The back, scapulars and inner wing coverts are sprinkled with hues

to correspond. Females in summer have the feathers of the upper plumage velvet black, fringed with sandy-buff; the tertiaries are boldly marked with buff and black in irregular bars; the foreneck and breast are mottled with black.

Young birds are mostly ashy-gray, tinged with buff on the lower parts, while the tertiaries are not barred; otherwise they resemble females in summer.

Bill dark brown, paler at the gape; iris brown; legs and feet fleshy-yellow to yellowish-brown.

Males: length 12; wing 7·3; tail 2·75; tarsus 1·9; bill 1·5. Females are smaller: length 10; wing 6.

Distribution.—One specimen was obtained forty years ago in the Hambantota District, and in February, 1914, I saw three birds near Hambantota and secured one for the Museum. Common in Northern India during the winter. Rare in Burma and the south. Breeds in temperate Europe and Asia, migrating to Africa and Southern Asia as far east as India.

Habits.—Should be looked for round unfrequented lagoons from November to March. It may occasionally visit us and pass unnoticed among the swarms of other waders. It can be distinguished from Sandpipers of the same size by its dark lower back and rump.

Calidris arenaria (Blanford, Vol. IV., p. 270; Legge, p. 1220).

The Sanderling.

Description.—Winter: Upper parts light gray tinged with brown, each feather with darker shaft-stripes and paler edges. Forehead, face, and lower parts white. The wing coverts and quills are blackish-brown; across the wing there is a white band formed by the tips of the greater coverts. The basal portion of the inner web of all the quills and the same part of the outer web of the later primaries is white; quill shafts white. The hind neck is lighter and the rump darker than the back. The rump is white at the sides; the central tail feathers are ashy-brown, black at the tip with white shafts and margins; the rest of the tail feathers are grayish-brown edged with white and with some white on the inner webs.

Summer : The upper parts are rufous cinnamon with black centres and pale ashy edges to the feathers. The foreneck and breast are rufous mottled with black. Remainder of lower parts white.

Young birds are blackish, with pale gray edges to the feathers of the crown and upper back. The scapulars, wing coverts, and tertiaries are much mottled with white ; the lower parts are white.

Bill black ; iris deep brown ; legs and feet black, there is no hind toe.

Length 7·5 ; wing 4·75 ; tail 2 ; tarsus 1 ; bill from gape 1·1.

Distribution.—A specimen was once obtained from a flock on an islet in Negombo lagoon. This bird is found on the coast of India, but is rare, except in Sind and Baluchistan. It occurs nearly all over the world, breeding in arctic regions and migrating south in winter.

Habits.—Usually met with in small flocks round flat shores, often in company with other waders, especially Sand Plovers and Stints.

Tringa minuta (Blanford, Vol. IV., p. 273 ; Legge, p. 884).

The Little Stint.

Description.—Winter : Upper plumage brown tinged with gray, each feather with broad black shaft-stripes ; the forehead, eyebrow, lower cheeks, and under parts white ; the sides of the neck and of the breast brownish with darker streaks. The wing coverts and tertiaries are darker with pale edges to the feathers ; the greater coverts have broad white tips ; wing quills dark brown with white shafts ; secondaries white at the base, the white predominating on the inner secondaries. The middle of the lower back, rump, and tail coverts are blackish-brown, the sides white ; the tail is dark brown in the centre, lighter smoky brown at the sides.

Summer : Upper parts rufous with black centres to the feathers ; foreneck and upper breast tinged with rufous and spotted with dark brown.

Young birds have the upper plumage blackish with rufous borders and white edges to the feathers; the lower parts are tinged with dingy buff on the neck and breast, but not spotted.

Bill black, straight; iris brown; legs and feet black or deep lead colour.

Length 6; wing 3·95; tail 1·6; tarsus ·8; middle toe and claw ·75; bill from gape ·7.

Distribution.—Common all round the coast, except from Negombo to Tangalla; sometimes found inland round larger tanks. Abundant in suitable localities throughout India west of the Bay of Bengal. Breeds in Northern Europe and Siberia, wintering in Africa and South-western Asia.

Habits.—Feeds in large flocks on flat sandy or muddy shores; in Ceylon it is commonest on the coast or round lagoons. A few immature birds stay with us through the summer.

Tringa subminuta (Blanford, Vol. IV., p. 275; Legge, p. 889).

The Long-toed Stint.

Description.—Winter: The plumage is similar to that of *T. minuta*, but is darker; the head and neck are more spotted with black, while the lower throat and foreneck are noticeably streaked and mottled with brown. The shaft of the first primary is dirty white, of the remainder pale brown.

In summer also the colouration resembles that of the last species, but in both stages this species may be distinguished by the long middle toe and claw, which together measure 0·9 to 1·0 inch as against ·75.

Bill olive-brown; iris brown; legs and toes olive-yellow or brownish.

Length 6; wing 3·7; tail 1·5; tarsus ·8; bill from gape ·75.

Distribution.—Fairly common on the coast in the north-west, north, and east of the Island. Common in Bengal and Burma during the north-east monsoon. Breeds in Eastern Siberia, migrating to South-eastern Asia and Australia for the winter.

Habits.—Feeds in small parties on salt marshes or on the ooze round lagoons; occasionally found in paddy fields near the sea, as at Galle, or even further inland. A good many barren birds remain with us through the summer months. As usual, the birds which thus loiter are in winter plumage, though birds which migrate have often assumed most of their summer dress before leaving.

Tringa temminckii (Blanford, Vol. IV., p. 75; Legge, p. 892).

Temminck's Stint.

Description.—Winter: Upper plumage ashy-gray with indistinct darker shaft-stripes, the colour becoming deeper towards the rump. The wings and central feathers of the tail are dark brown; the inner primaries, secondaries, and greater wing coverts are tipped with white; shaft of the first primary white, of remainder pale brown. The two outer feathers on each side of the tail are pure white, as are the sides of the rump and upper tail coverts. The lores are brown edged above with a faint white streak; chin, throat, and lower parts white with a broad band of brownish-gray on the lower foreneck and chest.

Summer: The upper plumage is darker and mottled with black and the edges of the feathers are more or less tinged with rufous; the pectoral band is marked with small dark spots.

Bill black; iris brown; legs and feet greenish-olive.

Length 6; wing 3·75; tail 2; tarsus ·65; middle toe and claw ·75; bill from gape ·65.

Distribution.—Obtained once near Trincomalee by Captain Legge. Common in Northern India, rare in the south and Burma. Breeds in the extreme north of Europe and Asia, wintering in Southern Europe, North Africa, and Southern Asia.

Habits.—Those of the Little Stint, with which it associates. Quite possibly it visits the Island in small numbers regularly, passing unnoticed among the swarms of the commoner species.

TRINGA SUBARQUATA (Blanford, Vol. IV., p. 278; Legge, p. 879).

The Curlew Stint.

Description.—Winter: General colour of upper parts ashy-brown with slightly darker shaft-stripes; most of the wing coverts have paler edges and the greater coverts have white tips; primary coverts, primaries, and secondaries dark brown; the inner primaries and secondaries edged with white on the outer web; the secondaries are also white at the base, the white increasing on the inner feathers. Lower back and centre of rump dark brown with paler edges; upper tail coverts and sides of the rump white. The tail is ashy-brown fringed with white. The lores are dusky and bordered above by a white streak running from the bill over the eyes. Sides of head and neck brownish with darker streaks; lower neck and chest tinged with gray and streaked with brown; remainder of lower parts white.

Summer: Upper plumage rufous chestnut mottled with black and whitish-buff; lower parts reddish-chestnut with faint hoary margins to the feathers, most conspicuous on the abdomen.

The young resemble old birds in winter plumage, but the lower parts are almost all white, and the feathers of the upper parts are fringed with buff or whitish.

Bill black and curving at the tip, the groove from the nostrils distinctly marked for over half the length of the bill; iris brown; legs dusky gray.

Length 8·5; wing 5·1; tail 1·85; tarsus 1·2; bill from gape 1·5.

Distribution.—Abundant all round the coast of the dry zone. Common on the coasts of India; rare inland. Breeds in the far north of Siberia, wintering in Africa, Southern Asia, and Australia.

Habits.—Found on sandy shores and salt marshes, and in great numbers round lagoons; seldom seen inland. It may be met with in small troops associating with other Stints, or in large flocks of its own species. Immature birds in considerable numbers stay in the Island during the summer. Mature birds often change to full summer dress before they leave in May.

TRINGA PLATYRHYNCHA (Blanford, Vol. IV., p. 279).

LIMICOLA PLATYRHYNCHA (Legge, p. 896).

The Broad-billed Stint.

Description.—The colouration is similar to that of the last species, but the bird is slightly smaller. The shaft-stripes of the upper plumage are more developed, while the rump, upper tail coverts, and tail are blackish-brown with paler edges. The under parts are white with a few narrow dark streaks on the foreneck and upper breast. In the summer the upper parts are velvety black with narrow whitish or buff edges; the crown is almost unstreaked, and there are narrow rufous borders to the tertiaries. The throat, the sides of the neck, the foreneck, and upper breast are tinged with rufous and spotted with dark brown. In both stages the bird may be recognized by the bill. The ridge between the nasal grooves is not continued far down the upper mandible, which is flattened out for about two-thirds of its length.

Bill brownish-black; iris dark brown; legs olive-brown.

Length 7; wing 4·2; tail 1·5; tarsus ·08; bill from gape 1·3.

Distribution.—Another rare straggler noted from Point Pedro and the Hambantota District. Possibly not so rare as would appear, as it may pass unnoticed among commoner species. Scattered locally over the Indian and Burmese coasts. Breeds in the north of Europe and Asia, wintering round the Mediterranean and in Southern Asia.

Habits.—May be looked for among flocks of other Stints on sandy or muddy flats by the sea and round lagoons. It seldom ventures inland.

Sub-family *Scolopacinæ*.

Woodcocks and Snipes.

These are a group of birds with well-marked external characteristics familiar to every sportsman. The bill is long and slender, well provided with nerves, slightly swollen at the tip, and, save in the case of the aberrant genus *Rostratula*, straight and pitted. The eyes are large and set far back in the

head. The tarsus is of moderate length, the front toes bear no trace of webbing, the hind toe is present but small. The plumage of the upper parts is of richer colour and more heavily mixed with black than is the case among the *Totaninæ*. All the species are more or less nocturnal in their habits.

The sub-family is divided into three genera :—

1. *Scolopax* (the Woodcocks), in which the legs are feathered to the tarsal joint, and the crown is banded across with black. Only one species, the typical Woodcock, occurs in Ceylon, being occasionally recorded from the hill districts.

2. *Gallinago* (the Snipes).—In this genus the leg is naked for some little way above the tarsal joint, and the crown is streaked lengthwise by pale bands. Five species find their way into the Ceylon list, but only one—the Pin-tailed Snipe—is common ; the others are all rare stragglers.

3. *Rostratula* (the Painted Snipes).—A curious genus which differs from the others in many ways. The bill is slender, but not so long as usual, slightly bent downwards at the tip, and not pitted. The birds are resident, whereas all our other members of the sub-family are migratory. The flight is weak, the wing quills are short and broad, and marked with beautiful buff-coloured ocellate spots. The female is larger than the male, with a well-marked and more gaudy attire ; accordingly young birds resemble the more soberly clad male in their plumage. Only one species occurs in the Island.

Rough Key to Ceylon Scolopacinæ.

I.—Bill straight ; crown barred crosswise ; legs feathered down to tarsal joint. Genus *Scolopax*.

Scolopax rusticula (Woodcock).

II.—Tibia partly naked, head and back with pale stripes engthwise. Genus *Gallinago*.

A.—Bill over 2 inches, a pale stripe down middle of crown.

(*a*) Length about 12 inches, abdomen barred throughout.

Gallinago nemoricola (Wood Snipe).

(*b*) Middle of abdomen not barred, save in exceptional specimens. Length about 10·5 inches.

(1) Secondary quills with noticeable white tips. No pin feathers in tail.

Gallinago cœlestis (Common or Fantail Snipe).

(2) Pin feathers in tail, secondaries with narrow inconspicuous white tips or none.

Gallinago stenura (Pin-tailed Snipe).

B.—Bill under 2 inches; no pale band down middle of crown; back glossed with green and purple.

Gallinago gallinula (Jack Snipe).

III.—Sexes different in plumage; bill curved downwards at the tip; wing quills with ocellate buff spots. Genus *Rostratula*.

Rostratula capensis (Painted Snipe).

SCOLOPAX RUSTICULA (Blanford, Vol. IV., p. 283: Legge, p. 806).

The Woodcock.

(Plate II., fig. 11.)

Description.—Upper plumage blackish-gray mottled with black and rufous; forehead and fore part of crown grayish; the top of the head and the nape black with two tawny crossbars; a dark broad stripe from the gape of the bill to the eye and another down the cheek; the rest of the head and neck buff with black spots. The wing coverts and tertiaries are barred with dusky brown and rufous; the primary coverts, primaries, and secondaries are black-brown notched with rufous. The rump and upper tail coverts are barred black and rufous; tail black, the outer webs of the feathers with rufous markings and the tips dark gray above, silvery white underneath. The chin is more or less white; the lower parts whity-brown barred across with dark brown.

Bill dark brown, fleshy-brown near the base; iris dark brown; legs and feet grayish-drab or lead colour.

Length 14; wing 7·75; tail 3·25; tarsus 1·5; bill from gape 3·00.

Distribution.—An occasional migrant to the higher hills. Breeds in the Himalayas above 10,000 feet, visiting in the winter the lower valleys and the South Indian and Burmese hills.

Habits.—May be found occasionally in the hills from November to February. The birds generally keep to damp forest near water, where the ground is soft.

Gallinago nemoricola (Blanford, Vol. IV., p. 285; Legge, p. 814).

The Wood Snipe.

Description.—Upper plumage black, the wing coverts spotted and barred with tawny buff, and the scapulars with broad tawny edges; head and neck brownish-black; a light stripe down the centre of the head imperfectly developed; a dark band from the gape of the bill to the eye, and another across the cheek. The sides of the head and the neck all round are dull buff streaked with black; lower back and rump marked with narrow bars of whitish or brownish buff brightening to rufous on the upper tail coverts. The six central feathers of the tail are black; their ends are rufous with a slight black crossbar and pale tips. The outer tail feathers are barred with dull rufous and brown, and are pale-tipped. The primary coverts, primaries, and secondaries are dark brown. Breast and abdomen grayish-white barred with dull brown; wing lining and axillaries grayish-brown barred with white.

Bill reddish-brown, pale at the base underneath; iris dusky brown; legs plumbeous green.

Length 12; wing 5·5; tail 2·2; tarsus 1·5; bill from gape 2·5.

Distribution.—Its occurrence in Ceylon is a little doubtful, no Ceylon specimens are on record, but Neville states that it has been found near Nuwara Eliya. It ranges through the Himalayas, where it breeds at considerable elevations; in winter it descends lower, and occasionally visits the hills of Southern India and Burma.

Habits.—Should be looked for in damp spots on the outskirts of forest in the higher hills.

GALLINAGO CŒLESTIS (Blanford, Vol. IV., p. 286).

GALLINAGO SCOLOPACINA (Legge, p. 821).

The Common or Fantail Snipe.

Description.—This species in plumage closely resembles the next, *G. stenura*, but may be distinguished as follows :—The tail has no pin feathers ; on the axillaries the white bars are broader than the brown : the bill of the present species broadens slightly towards the tip, that of the Pin-tailed Snipe does not ; the outer web of the first primary is whitish instead of brown ; the secondary quills have fairly conspicuous white tips.

Length 10·5 ; wing 5·00 ; tail 2·25 ; tarsus 1·25 ; bill from gape 2·6.

Distribution.—A very rare migrant during the north-east monsoon. It is said to have been seen at Nuwara Eliya, and two specimens were obtained at Tamblegam, near Trincomalee. In Northern India it is the predominant Snipe, but in Southern India and Burma it is rare, being largely replaced by the Pintail Snipe. It breeds in Europe and Central and Northern Asia, wintering in Southern Europe, North Africa, and Southern Asia.

Habits.—Similar to those of the next species.

GALLINAGO STENURA (Blanford, Vol. IV., p. 289 ; Legge, p. 816).

The Pintail Snipe.

Description.—General colour of upper plumage black ; the top of the head with a broad pale band down the centre, and another on each side just over the eye ; a dark brown band from the bill to the eye ; the sides of the head streaky whitish and brown. The broad tawny edges of the scapulars form two long bands down the back. The primary coverts, primaries, and secondaries are black-brown, the later primaries and the secondaries faintly tipped with white ; tertiaries barred black and tawny ; rump and upper tail coverts barred with rufous or dark buff ; the ends of the tail feathers are

rufous-yellow fringed with black and have pale edges; the pin feathers, which are often hidden under the tail coverts, usually number six on each side and are brown with white tips. The chin is whitish; the neck all round and the upper breast dull buff streaked with dark brown. The remainder of the lower parts is generally white, the flanks being barred with brown, while the lower tail coverts are buff with dark brown markings. The wing lining and axillaries are coloured dusky brown and white in bars of equal width.

Bill blackish, paler at the tip, and olive-green underneath at the base; iris deep brown; legs and feet olive-green.

Length 10·5; wing 5·25; tail 1·8; tarsus 1·25; bill from gape 2·5.

Distribution.—The only snipe which visits the Island in any great numbers. Abundant all over the low-country during the north-east monsoon, and more or less plentiful in up-country paddy fields and swamps. Common in Southern India, Assam, and Burma, but rarer in the west and north. Breeds in Eastern Siberia, and winters throughout South-eastern Asia and the Malay Archipelago.

Habits.—The earliest birds arrive on the western side of the Island at the end of August or the beginning of September; in the north, east, and south-east they are not generally found till a few weeks later. The birds begin to leave again about mid-April, and few are left by the end of the month. Some immature individuals may stay with us during the south-west monsoon, and in the Colombo Museum there is a fully-formed egg taken from the oviduct of a bird shot late in the season, showing that occasional and probably slightly wounded stragglers may breed in the Island. Snipe keep to soft and muddy ground, and are most abundant in large paddy fields near jungle and in the marshy surroundings of tanks. They move about from field to field a good deal, preferring, as a rule, those in which the crop has grown fairly thick, but not too high. To some extent they are nocturnal, and in the low-country during the heat of the day they lie up in the edge of the jungle round the fields, or in any little shady retreat that may be handy.

GALLINAGO GALLINULA (Blanford, Vol. IV., p. 292; Legge, p. 828).

The Jack Snipe.

Description.—Crown and nape black in the centre with a few rufous specks, and bordered on each side with broad buff stripes from the bill to the nape; a dark band from the bill to the eye and a dark cheek stripe; sides of the head speckled whitish; hind neck fulvous brown mottled with black and traces of whitish. The back and scapulars are black with a metallic gloss of green or purple, and mottled with rufous; a broad edge of rich buff on the outer webs of the scapulars forms a band down each side of the back; upper tail coverts and tail brown bordered with buff. The wings are brown, the lesser wing coverts with whitish and the median coverts with rufous-buff edges; secondary quills with white tips. The chin is whitish; the foreneck and upper breast brown streaked with white and black; lower breast and abdomen white; under tail coverts striped with brown.

Bill brown at the sides, black at the tip, elsewhere yellowish; iris dark brown; legs grayish-green.

Length 8·5; wing 4·25; tail 2; tarsus 0·9; bill from gape 1·6.

Distribution.—An occasional visitor to the extreme north of the Island. A fairly common migrant in Northern India; rare in Southern India and Burma. Breeds in the Arctic Circle of Europe and Asia, wintering in Southern Asia and the countries bordering the Mediterranean.

Habits.—In general, a solitary bird, frequenting damp marshy ground, where the grass is thick.

ROSTRATULA CAPENSIS (Blanford, Vol. IV., p. 293).

RHYNCHÆA CAPENSIS (Legge, p. 800).

The Painted Snipe.

Description.—Male: Crown olive-black with a buff band down the centre; a ring round the eye and a stripe behind it are also buff; lores brown; sides of head streaked white and brown. The upper surface is ashy-brown glossed with olive and marked with fine wavy bars of dusky black and broader bars of greenish-black; the buff outer borders of the scapulars

form a pale streak down each side of the back. The tertiaries and wing coverts are marked with buff bars and buff black-bordered spots; wing quills bluish-gray barred and blotched with black and spotted with oval buff markings; rump, upper tail coverts, and tail blue-gray barred with black, and with buff spots on the coverts and tail. The chin is whitish; sides of neck, foreneck, and upper breast streaky brown and white; remainder of lower parts white, with a white band running from the breast up each shoulder; the sides of the breast bordering this white band are deep brown.

Female: The lores and cheeks are rufous, passing into chestnut on the throat and round the neck. There is a broad black pectoral gorget. The wing coverts lack the buff spots, and beneath the scapulars is a tuft of pure white lanceolate feathers. Young birds resemble adult males.

Bill dusky green, reddish at the tip; iris olive-brown; legs olive-brown.

Distribution.—Resident throughout the Island, but moves about a good deal, being commonest in the west during the north-east monsoon. Found all over India south of the Himalayas and in Burma; ranges almost throughout Africa, Madagascar, and Southern Asia.

Habits.—In its ways this species resembles the Rails more than the other Snipes. It skulks about in damp ground, where the grass and rushes are thick, or hides in damp corners of paddy fields. It is heavy on the wing, and generally difficult to flush. As a rule, not more than a pair are met with together. It breeds in its haunts from November to May, but mostly in March. The nest is a slight depression in moist ground, lined with grass or rushes. The four eggs are stone-yellow boldly blotched with black, and measure about 1·35 by ·98.

Order **GAVIÆ.**

Gulls, Terns, and Skuas.

The *Gaviæ* constitute an order which is closely related to the preceding *Limicolæ*. It has been shown that in all probability the Gulls and their allies sprang from the common ancestors of the Plovers and Snipes, and are in fact aberrant Plovers, to

which other aberrant Plovers, such as the Pratincoles and Crab Plovers, show considerable affinity, all being specialized offshoots from the same main stem.* In details of anatomy the two orders display marked resemblance, the *Gaviæ*, however, being modified in outward form to fit them for their sea-faring life. Their wings are long and pointed, giving their flight speed and endurance ; their legs are short ; the front toes are webbed, while the hind toe is small and set on the foot at a higher level than the others ; the bill varies in the families and sub-families of the order.

In their nidification also these birds resemble the Waders ; their eggs are of much the same character, being marked by spots of two different hues, and laid on the ground with little or no nest. The young are hatched covered with down, and are able to run about at once, though for a few days they are fed by their parents.

The classification of the order varies considerably among different authors. By Dr. Blanford the Indian members are divided as follows :—The Skuas are placed by themselves in one family *Stercorariidæ ;* the Gulls *Larinæ*, the Terns *Sterninæ*, together with the Skimmers *Rhynchopinæ*, of which no species occurs in Ceylon, form three sub-families of a second family *Laridæ*.

The two families are outwardly distinguished thus :—

1. In the *Laridæ* the bill has no cere, *i.e.*, membrane of skin covering the base of the bill from the forehead to the nostrils, while the claws are only moderately curved and not sharp.

2. In the *Stercorariidæ* the bill is furnished with a cere, and the claws are powerful, boldly curved, and sharp.

Family Laridæ.

As stated above, the Ceylon *Laridæ* fall into two sub-families, which may be distinguished by the shape of the bill :—

A.—*Larinæ*.—The Gulls have the upper mandible longer than the lower and curved at the tip.

B.—*Sterninæ*.—The Terns have both mandibles of equal length.

* Mr. R. P. Lowe "On the Crab Plove" *Ibis*, April, 1916, p. 337.

Sub-family *Larinæ*.

Gulls.

Gulls are in general birds of the sea, though many of them are also found on inland waters, and some of them breed far from the coast. They are fairly stout in build ; the wings are long, and when closed project beyond the tail ; the tarsus is shortish, and the feet large ; the front toes are fully webbed ; the bill is of moderate length and fairly strong, the upper mandible being curved downwards at the tip into a moderate hook. They habitually rest on the surface of the water, sitting very buoyantly. Often, however, they take to the land, and can walk well. Their food consists mainly of dead fish, floating garbage, and crustacea.

The sub-family is not well represented in Ceylon. Only one genus occurs within Indian limits, and of this genus only two species visit us. Neither of them breeds anywhere near the Island, and one of them visits us only as a very occasional storm-driven straggler.

Rough Key to Ceylon Larinæ.

A.—Length 26 ; wing 19.

Larus ichthyaetus (the Great Black-headed Gull).

B.—Length 17 ; wing 13.

Larus brunneicephalus (the Brown-headed Gull).

Larus ichthyaetus (Blanford, Vol. IV., p. 299 ; Legge, p. 1046).

The Great Black-headed Gull.

Description.—Adult summer plumage : The whole of the head, including the nape and throat, jet-black, contrasting sharply with the neck and lower parts, which, together with the tail coverts and tail, are white. There are two minute patches of white, one above and one below each eye. The mantle down to the rump, with the wing coverts and tertiaries, are pale slate-gray ; first five primary quills white crossed near the tip by a bar of black ; first quill also black along most of the outer web ; later primaries gray on the inner web, white on the outer web and tip ; secondaries mostly gray.

Winter : The lower neck becomes white right up to the chin, and the upper part of the head and nape white streaked with brown-black.

Young birds are very differently coloured. The upper plumage to the rump is mottled brown with paler edges to the feathers ; tail coverts and upper part of the tail white ; the end of the tail blackish-brown faintly tipped with white ; under parts white, the sides of the neck and upper breast more or less mottled with pale brown ; wing quills dark brown, the secondaries with a narrow white edge. As the bird grows older the mantle gradually changes to gray.

Bill yellow with a black band halfway between the nostrils and the tip, tip and gape dull crimson ; in young birds the bill is dark horn-colour ; iris deep brown ; legs and feet dull yellow.

Length 26 ; wing 19 ; tail 7·5 ; tarsus 3·00 ; bill from gape 3·5. Specimens vary in size, and females are smaller, wing about 18.

Distribution.—An occasional storm-driven visitor during the north-east monsoon. Not uncommon in Northern India and parts of Burma, otherwise rare. Breeds in Central Asia, migrating in winter to Southern Asia and North-east Africa.

Habits.—In Ceylon may be looked for on the coast, during stormy weather, from about November to March.

Larus brunneicephalus (Blanford, Vol. IV., p. 301; Legge, p. 1049).

The Brown-headed Gull.

Description.—Adult in summer : The whole of the head and upper neck hooded with brown, which darkens on the nape, contrasting sharply at the point of junction with the white of the lower neck ; the lower parts, rump, and tail are also white ; mantle pearl-gray. The first five primary quills are white at the base with the outer portion black, the amount of black decreasing in length from the first to the fifth quill ; the first and second quills have a large white patch near the tip ; later primaries mostly gray ; the secondaries the same colour as the mantle.

In winter there is no brown hood, the head being white mixed with a little brown in front of the eye and behind the ear coverts.

Young birds are mottled brown above, the colour gradually changing to the pearl-gray of the adult. The primaries are largely brown-black ; the outer third of the tail is of the same shade tipped with white.

In adults the bill, eyelids, and feet are coral-red ; the iris varies from white to brownish.

In young birds the bill is yellowish-red, blackish at the tip ; legs and feet reddish-yellow.

Length about 17 ; wing about 13 ; tail 5·25 ; tarsus 2 ; bill from gape 2·25. Females are smaller.

Distribution.—Abundant round the coast in the north of the Island from October to April. Rarer in the south, but recorded from Galle, Colombo, and Hambantota. Found all round the coasts of India and Burma ; also inland on large rivers and lakes. Breeds in Central Asia.

Habits.—Occurs generally in flocks, and in Ceylon does not appear to fly inland. Its habits are those of the family.

Sub-family *Sterninæ*.

Terns.

The Terns are among our most pleasing birds, and the commoner species are equally familiar sights round the coast or on inland tanks. Their wings are very long and pointed, the flight is buoyant and graceful, the birds constantly flying over the surface of the water, into which they dip their bills while on the wing to scoop up their food, chiefly small fish or little floating forms of animal life. They seldom alight on the water, and swim far less than many birds whose toes are not webbed. The bill is straight, or very gently curved, and usually slender, while the mandibles are equal, or nearly equal, in length. The legs and feet are generally small.

The Indian members of the sub-family are divided into four genera, distinguished, as shown in the key below, chiefly by the shape of the tail, the nature of the webbing between the

toes, and the character of the bill. Of the four genera, two—*Hydroprogne* and *Anous*—each give us a single species; *Hydrochelidon* furnishes us with two, one of which is common on inland waters, the other rare. Of the genus *Sterna*, we have no less than twelve species. Two of these can be distinguished at once by the colour of their upper plumage, which is sooty-brown instead of some shade of pearly-gray; the remaining ten have to be differentiated mainly by their wing measurements and the colour of their bills and feet. In consequence the key may not seem very simple in its working, but it should be borne in mind that the gray-mantled species usually met with are either the three largest or the two smallest. Of the five medium-sized species, only one—*S. dougalli*—is in any degree common, the other four are rare, two being rather doubtful inclusions in the Ceylon list.

Rough Key to Ceylon Sterninæ.

I.—Medium size; wing 8 to 9 inches; webs deeply scalloped between the toes; tail short and only slightly forked. Genus *Hydrochelidon*.

(*a*) Bill from gape 1·6; in winter the black spots on the crown extend forward of the eyes; in summer the wing lining remains white.

Hydrochelidon hybrida (the Whiskered Tern).

(*b*) Bill from gape 1·3; in winter the black spots on the crown do not generally extend forward of the eyes; in summer wing lining turns black.

Hydrochelidon leucoptera (White-winged Black Tern).

II.—Tail forked, but very short; bill powerful; webs fully developed; size large. Genus *Hydroprogne*.

(*a*) Wing 15·5; bill red.

Hydroprogne caspia (Caspian Tern).

III.—Tail deeply forked, the outer pair of feathers noticeably longer than the rest; bill fairly slender; webs well developed. Genus *Sterna*.

1. Back gray.

A.—Large size; wing over 11·5 inches; tarsus blackish.

(*a*) Bill black; wing 12·5 inches.
Sterna anglica (Gull-billed Tern).

(*b*) Bill yellow, under 3 inches; wing 12 inches.
Sterna media (Smaller Crested Tern).

(*c*) Bill yellow, about 3·5 inches; wing 14 inches or over.
Sterna bergii (Large Crested Tern).

B.—Medium size; wing 8 to 11·5 inches.

(*a*) Bill yellow and stout; legs red; wing 11 inches.
Sterna seena (Indian River Tern).

(*b*) Bill orange-yellow and slender; legs orange-red; wing 9 inches.
Sterna melanogaster (Black-bellied Tern).

(*c*) Bill coral-red in summer, duller in winter, about 2 inches; legs and feet same colour as bill.
Sterna fluviatilis (the Common Tern).

(*d*) Bill black always, about 1·75 inches; legs and feet blackish.
Sterna longipennis (Nordmann's Tern).

(*e*) Bill orange-red, black at the tip; legs and feet scarlet; outer tail feathers practically all white.
Sterna dougalli (Roseate Tern).

C.—Small size; wing about 7 inches.

(*a*) In adults shafts of all primaries, in young shaft of first primary, white.
Sterna sinensis (White-shafted Ternlet).

(*b*) Shaft of first three primaries blackish.
Sterna saundersi (Black-shafted Ternlet).

2. Back dark brown.

(*a*) Wing 10 inches.

Sterna anæstheta (Panayan Tern).

(*b*) Wing 11·5 inches.

Sterna fuliginosa (Sooty Tern).

IV.—Tail not forked, but wedge-shaped; webs well developed; plumage dark. Genus *Anous*.

(*a*) Size medium; wing 10·5 inches; plumage blackish-brown.

Anous stolidus (the Noddy).

HYDROCHELIDON HYBRIDA (Blanford, Vol. IV., p. 307; Legge, p. 996).

The Whiskered Tern.

Description.—Summer: A black cap on the forehead, crown, and nape; below this a white streak runs from the gape of the bill to the nape; upper parts ashy-gray; chin white to pale gray, gradually darkening through slate-gray on the breast to sooty-black on the abdomen and flanks; vent, under tail coverts, and wing lining white. The primaries in fresh plumage are frosted, otherwise darker than the gray of the upper plumage.

Winter: Upper parts lighter gray than in summer; all the lower part, including the wing lining, are white. The forehead is white, the crown white with streaking black spots, which begin at a point a little forward of the eye and increase on the nape, which is bordered behind by a more or less imperfect white collar.

Young birds are mottled brown on the crown and mantle, the plumage gradually changing towards the gray of the adult.

Bill blood-red; iris brown; legs and feet dull red; claws black.

Length 10; wing 8·75; tail 3·25; tarsus 0·9; bill from gape 1·6.

Distribution.—Common all round the coast, also on marshes, tanks, and paddy fields inland, chiefly in the northern half of the Island. Abundant throughout India and Burma. Occurs

throughout temperate Europe, all Africa, and Southern Asia to Australia. Many birds are migrants in the southern part of their range, but some are resident.

Habits.—Found more in marshes, paddy fields, and round tanks or lagoons than by the open coast. Like gulls in England they often follow the plough. Many of our birds are migrants, seen only during the north-east monsoon. Some birds stay, chiefly immature individuals in winter dress, but others are in full summer plumage, so that the nest and eggs may yet be found in Ceylon.

The birds breed in colonies on beds of water-lilies or other floating plants in large swamps; the nest is a fairly large structure of reeds or straw. The eggs are generally three, pale olive or greenish, with blotches of purple-gray and brown. Average size about 1·50 by 1·10.

Hydrochelidon leucoptera (Blanford, Vol. IV., p. 308; Legge, p. 1000).

The White-winged Black Tern.

Description.—In winter plumage closely resembles the previous species, but is slightly smaller; the bill is smaller and darker, and on examination of the series in the British Museum the forepart of the head appears to be whiter, the black spots of the crown seldom coming further forward than the eye. In summer the species is at once recognizable, as the head and neck, the back, and the under parts as far as the vent, together with the wing lining, are black. The coverts on the edge of the wing are white, as are the rump and the upper and lower tail coverts; tertiaries dark gray; remainder of wing lighter gray, except for the first few primaries, which are often sooty-brown, where the frosting has worn off.

Young birds are mottled with dark brown on the crown and mantle, and have whitish upper tail coverts.

Bill livid red in summer; blackish-red in winter; iris dark brown; legs vermilion.

Length 9·5; wing 8·25; tail 2·8; tarsus ·75; bill from gape 1·3.

Distribution.—Until recently only a few specimens have been recorded from Ceylon, but in April, 1914, at Topawewa and Minneri in the North-Central Province, and in April, 1915, near Hambantota, I found a fair number of specimens flying among flocks of the previous species. At that time of year the birds were changing to summer dress, and the black wing lining at once betrayed them. It is possible that being mainly migrants, and almost indistinguishable from the Whiskered Tern in their winter dress, they often pass unnoticed. The species is common in certain localities in Burma, but extremely rare in India west of the Bay of Bengal. It ranges through temperate Europe and Asia in summer, wintering southwards from Africa to Australia.

Habits.—Those of the last species, with which it associates. As it has been obtained in the Island in May, July, and October, it is quite possible that if ever *H. hybrida* is found breeding in Ceylon, this species may be found nesting in the same colony. The eggs are very similar, but slightly smaller and darker.

HYDROPROGNE CASPIA (Blanford, Vol. IV., p. 309).

STERNA CASPIA (Legge, p. 1008).

The Caspian Tern.

Description.—Summer: The forehead, crown, and nape are glossy green-black; remainder of the upper parts and the wings pearl-gray; primaries when fresh are frosted, getting darker as the frosting wears off; rump and tail pale gray; entire under plumage white.

In winter the black cap becomes white, thickly streaked with black, and behind it is a white collar.

Young birds resemble adults in winter dress, but have more black round the eye; the mantle and tail are mottled and barred with rusty black, and the primary quills black frosted with gray.

Bill stout, coral-red; iris dark brown; legs and feet black.

Length 20; wing 15·5; tail 5·5; depth of fork 1·25; bill from gape 3·5.

Distribution.—Fairly common on the north coast during the north-east monsoon ; rarer elsewhere. A few birds remain in the north to breed. Locally found in many parts of India and Burma. Occurs throughout the whole of the Old World, except in the extreme north, also in North America and Australasia.

Habits.—Found in Ceylon chiefly on lagoons near the coast. When fishing it flies with its large bill pointing downwards, and covers its beat with a regular and powerful flight. Mr. H. Parker found a few birds breeding in June on sand banks off the island of Mannar. One or two eggs were laid in shallow hollows scratched in the sand. Colour grayish-white with markings of grayish-purple and dark brown ; average size 2·43 by 1·70.

Sterna anglica (Blanford, Vol. IV., p. 311 ; Legge, p. 1011).

The Gull-billed Tern.

Description.—Summer : A black cap on the head from the forehead to the nape, coming as far down as the lower edge of the eye ; the nape is crested ; remainder of upper plumage pearl-gray ; the wing quills are frosted when fresh, smoky-brown as the frosting wears off ; lower parts, including wing lining, white.

In winter the black cap becomes white streaked with black, otherwise there is no change. Young birds are gray or gray and white on the crown, and the primaries are usually darker. Very young birds are partly brown on the back.

Bill black ; legs and feet black, sometimes tinged reddish ; iris hazel-brown.

Length 15 ; wing 12·5 ; tail 5·25, depth of fork 1·5 ; tarsus 1·4 ; bill from gape 2.

Distribution.—Common during the north-east monsoon on lagoons and estuaries from Mannar round through Trincomalee to Hambantota ; rare on the west and south-west coast ; occasionally found inland on the larger tanks. Common in winter throughout India, and found on the coast in Burma. Occurs from the east coast of North America, throughout temperate and Southern Europe and Asia, to North Africa and Australasia.

Habits.—Frequents sheets of fresh water and brackish lagoons rather than the open coast. Most of our birds are migrant, but some remain all the year. The majority of these are immature specimens in winter plumage, but some, as Capt. Legge noticed, were in breeding dress, so a lookout may be kept for breeding birds. The eggs are of the usual type, and measure about 2 by 1·46.

STERNA MEDIA (Blanford, Vol. IV., p. 313 ; Legge, p. 1030).

The Smaller Crested Tern.

(Plate II., fig. 12.)

Description.—Summer : A black cap from the forehead to the nape coming as far down as the lower edge of the eye ; the crest also is jet-black ; back, wings, and tail pearl-gray. The lower parts and a collar round the neck are white. The outer tail feathers are sometimes whitish ; the primary quills when fresh are frosted silver-gray on the outer web ; the inner webs are brownish-gray near the shaft, otherwise white.

In winter the nape and a band from it to the front of the eye remain black ; the feathers of the crown are black with white borders ; the forehead and lores are white.

Young birds bear the winter dress of adults, with some brown on the lesser wing coverts, the tertiaries, and tail.

Bill yellow ; iris brown ; legs and feet black, the soles pale yellow.

Length about 16·5, less in winter plumage, when the tail is shorter ; wing 12 ; tail in summer 6·75, in winter may be only 5 ; depth of fork 2–3 ; tarsus 1·00 ; bill from gape 2·8.

Distribution.—Common all round the coast during the north-east monsoon. A migrant species common in winter on the coast of India, but rarer in Burma. Extends from the shores of the Indian Ocean to the Mediterranean, breeding on sand banks in the Persian Gulf and Red Sea.

Habits.—This species frequents lagoons and sheets of open water near the sea as well as the open coast, but it never goes far inland. It often associates in large flocks, and may be met with several miles out at sea.

STERNA BERGII (Blanford, Vol. IV., p. 314; Legge, p. 1026).

The Large Crested Tern.

Description.—Though this bird may be distinguished by its larger size, the colouration is the same as in the last species, save that the forehead is white in summer and the crest more distinct, and that at all seasons the mantle is much darker gray with a smoky-brown tinge.

Young birds have a good deal of brown on the upper parts, and the wing quills are mostly smoky-brown.

Bill pale yellow; iris dark brown; legs and feet black, tinged at times with red; soles yellowish.

Length about 21; wing 14·5; tail 6·5–8; tarsus 1·3; bill from gape 3·6.

Distribution.—Found all round the coast, especially during rough weather. Fairly common round the coast of India; rarer in Burma. Ranges from the west coast of South Africa, along the shores of the Indian Ocean, to Polynesia and the China Sea. The race found in Ceylon and round the Bay of Bengal has lately been sub-specifically distinguished as *Sterna* (*Thalasseus*) *bergii edwardsi*.

Habits.—A maritime species, which may often be seen in fine weather fishing miles out at sea. Rough weather drives it to the shore, but it seldom goes inland. It has been found breeding in June on rocks off the south coast and on sand banks between Mannar and India. The eggs, one to three in number, are pinkish-buff or green-gray blotched with black or reddish-brown and inky-gray.

STERNA SEENA (Blanford, Vol. IV., p. 315; Legge, p. 1003).

The Indian River Tern.

Description.—Summer: A cap of glossy green-black on the head from the forehead to the nape, extending down the side of the head to a little way below the eyes; a small white patch under each eye; remainder of upper plumage dark pearl-gray, becoming paler on the rump and tail; wing quills in fresh plumage frosted white on the outer webs; under parts and wing lining delicate pale gray, which passes into white at the line of junction with the black cap and on the under tail

coverts. In winter, after the moult, the forehead becomes dull white, the crown gray; the crown then gradually passes through a streaky black stage into the full summer plumage.

In the young the feathers of the upper parts are smoky-gray with a brown inner and a whitish-buff outer border.

Bill in summer orange; iris brown; legs orange-red. In winter plumage the bill and legs are duller.

Length 15 to 18; wing 11; tail 6–9·5; depth of fork 5–6; tarsus ·8; bill from gape 2·3.

Distribution.—Rather a doubtful inhabitant. Layard stated it was common in the north, but no one else appears to have met with it. A resident species on large rivers throughout India and Burma, extending as far east as Singapore.

Habits.—A river species, which should be looked for on the sand banks of our largest rivers and round our larger tanks.

Sterna melanogaster (Blanford, Vol. IV., p. 316).

Sterna melanogastra (Legge, p. 1006).

The Black-bellied Tern.

Description.—Summer: The forehead, crown, and nape down to the lower edge of the eye black; the lores, chin, cheeks, and throat white or nearly white; the upper parts ashy-gray with a brown tinge on the wings; the wing quills have the usual frosting, becoming dusky brown where it has worn off; the tail is paler than the back; the outer web of the outer tail feathers is white. The lower neck is pale gray, passing on the breast through chocolate to black, which continues from the lower breast to the tail coverts; wing lining white.

In winter the lower parts are white, and the cap white streaked with black.

Half-grown birds are mottled with brown and buff on the upper parts.

Bill orange-yellow; iris brown; legs and feet orange-red.

Length 13; wing 9; tail 5; depth of fork 3·5; tarsus ·55; bill from gape 1·8.

Distribution.—Another rather doubtful inhabitant reported by early observers from the north of the Island, but probably

in mistake for *H. hybrida*. No authentic specimens appear to have been obtained. Found by rivers and tanks throughout India and Burma, but rarer in the south than in the north.

Habits.—Those of the last species. The only likely place in the Island for these two Terns is on the broad sandy reaches of the lower Mahaweli-ganga and in the adjoining marshes.

Sterna fluviatilis (Blanford, Vol. IV., p. 318; Legge, p. 1015).

The Common Tern.

Description.—Summer: A black cap from the forehead to the nape, extending down the side of the head to the lower edge of the eye; back and wings ashy-gray. The first primary has the outer web black and the portion of the inner web next the quill blackish, the remainder of the inner web white; the black decreases on the second and inner primaries. The rump, upper tail coverts, and the inner webs of the tail feathers are white; the outer webs of the tail feathers gray. The lower lores, cheeks, chin, throat, wing lining, and under tail coverts are white or nearly white; breast and abdomen pale vinous gray.

In winter the forehead is white or mottled, and the crown streaked with black; lower parts whitish.

Immature birds have a whitish forehead, a sooty-black nape, a dirty white collar round the neck, and a dark gray band along the wing coverts. Very young birds are also mottled on the mantle.

Bill of adult coral-red in summer, duller in winter; young birds have a blackish bill; iris brown; legs and feet the same colour as the bill.

Length 14; wing 10·5; tail 6·5; depth of fork 3–5; tarsus ·8; bill from gape 2.

Distribution.—An occasional migrant during the north-east monsoon to Ceylon and India, most of the birds being immature. Found throughout the temperate parts of Europe, Asia, and North America.

Habits.—Similar to those of the Gull-billed Tern. It is only occasionally seen in Ceylon, but in October, 1874, Capt. Legge found it plentiful near Trincomalee.

STERNA LONGIPENNIS (Blanford, Vol. IV., p. 319 ; see Legge, p. 1016).

Nordmann's Tern.

Description.—Similar to that of *S. fluviatilis*, save that the bill and feet are always blackish and slightly smaller, the bill in the present species being only 1·75 from the gape as against 2.

Distribution.—One example shot by Capt. Legge at Trincomalee in June, and classified by him as *S. fluviatilis*, is now in the British Museum, and has been assigned to the present species, which ranges from North-eastern Asia to New Guinea, and has been obtained in the Malay Peninsula.

STERNA DOUGALLI (Blanford, Vol. IV., p. 319 ; Legge, p. 1033).

The Roseate Tern.

Description.—Summer : A black cap from the bill to the upper part of the hind neck, coming down the sides of the head to the lower edge of the eye ; remainder of the hind neck white, shading into the pearl-gray of the upper plumage ; primary quills a little darker with some black ; all the primaries and secondaries have a white inner border. The tail is a little paler than the back, and the long outer tail feathers are almost white throughout. The under parts are white with a roseate tinge.

In winter the top of the head forward of the eyes is white with black spots, while the rosy hue almost disappears from the under parts. Immature birds resemble adults in winter, but the black cap is tinged with brown ; the upper parts are white banded with brown, and the darker parts of the primaries are dark gray instead of black.

Bill in summer orange-red at the base, remainder black, in winter almost all black ; iris dark brown ; legs and feet coral-red or scarlet.

Length about 15 ; wing 8·75 ; tail 5·5–7·5 ; depth of fork 4–5 ; tarsus ·85 ; bill from gape 1·90.

Distribution.—Occasionally seen in fairly large numbers at various points on the coast. Occurs in the Andamans, but

scarcely anywhere else on the Indian coast. Ranges all along the temperate and tropical shores of the Atlantic and round parts of the Indian Ocean.

Habits.—A Sea Tern rarely seen away from the coast, seldom even haunting lagoons. Mr. H. Parker once found a colony breeding in June on sand banks in the Gulf of Mannar. The eggs were one or two in number, brownish or greenish-gray, blotched with dark brown and inky gray. Average measurement 1·58 by 1·12.

Sterna sinensis (Blanford, Vol. IV., p. 320 ; Legge, p. 1019).

The White-shafted Ternlet.

Description.—Summer : An arrow-shaped white patch on the forehead running back above the eye ; below this a black band from the bill to the eye ; the crown down to the lower edge of the eye and the nape black. The upper plumage pearl-gray, darker on the wings, and paling to white or whitish-gray on the upper tail coverts and tail. The outer web and half the inner web of the first two primaries black or dark gray, the quill shafts and the inner half of these feathers white. The under plumage is white, sometimes tinged with gray.

In winter the white patch on the forehead is broader and the tail shorter.

Young birds on the crown are grayish streaked with black, which increases towards maturity ; the black band from the bill to the eye is wanting, and the primaries are grayer ; only the shaft of the first primary is white, those of the later primaries are grayish or brownish.

Bill in summer yellow with a black tip, in winter brown ; iris hazel-brown ; legs and feet in summer orange-yellow, in winter dusky yellow.

Length about 10, when the tail is fully developed ; wing 7 ; tail 3·5–5·5 ; depth of fork 2–3·4 ; tarsus ·65 ; bill from gape 1·7.

Distribution.—Common round the coast of the dry zone, rare on the west coast south of Puttalam. Found on the east coast of India and in Burma, extending eastwards to Japan and Australia.

Habits.—Occurs on the open coast and on lagoons near the sea. During the breeding season some birds move inland to breed on the shores of large tanks, such as Minneri, where the water is not choked with weeds and the shores are gravelly ; it also breeds on the sandy shores of lagoons. The breeding season is from June to August ; the nest is a shallow depression in gravel or sand with little or no lining. The eggs are two or three in number ; the colour is pale brownish-buff marked with deep brown and inky gray. Average size about 1·25 by ·94.

Sterna saundersi (Blanford, Vol. IV., p. 321 ; Legge, p. 1023).

The Black-shafted Ternlet.

Description.—Similar to that of the last species, but slightly smaller ; the shafts of the first three wing quills are dusky brown or black, whereas in *S. sinensis* the first quill shaft is clear white ; the mantle is paler, and the tail grayer ; the bill is more slender, and even less slightly curved.

Length about 8·5 ; wing 6·75 ; tail up to 3·0 ; depth of fork 1·0 ; tarsus ·6 ; bill from gape 1·6.

Distribution.—Not so common as the last species, but more widely distributed round the coast. Its range extends along the coasts of the Indian Ocean from South Africa to Burma.

Habits.—Similar to those of the last species. It has been found breeding in company with it in June on the south-east coast. The eggs are slightly longer, but narrower.

Sterna anæstheta (Blanford, Vol. IV., p. 323 ; Legge, p. 1040).

The Panayan Tern.

Description.—A white arrowhead patch on the forehead extending above the eyes and bordered below by a black band from the eye to the bill ; the crown, nape, and sides of the head behind the eyes are black ; hind neck grayish-white ; rest of upper parts dark grayish-brown ; primaries are darker brown than the back, with some whitish-gray on the inner

webs. The long outside pair of tail feathers are white, darkening to gray-brown on the inner webs towards the tip. The cheeks and lower parts are white, with a sooty tinge on the breast, abdomen, and flanks. In winter for a short while the feathers of the lores and crown are mottled with white.

Immature birds are whiter on the head, the feathers on the back are grayer with whitish edges, and there is less white on the outer pair of tail feathers.

Bill, legs, and feet black ; iris deep brown.

Length 14·5 ; wing 10 ; tail 6–7, depth of fork 3–4 ; tarsus ·8 ; bill from gape 2.

Distribution.—Numerous on the coast at intervals, especially after high winds ; found all round the Indian and Burmese coasts and on the outlying islands, its range extending throughout the tropics.

Habits.—An oceanic species, often seen far from land, and breeding on islands, such as the Laccadives. During high winds they appear on shore, probably having been driven by the weather from the open sea.

Sterna fuliginosa (Blanford, Vol. IV., p. 324 ; Legge, p. 1036).

The Sooty Tern.

Description.—Similar to that of the last species, but larger and darker. The white arrow-shaped patch on the forehead is broader, but does not run so far back, stopping above the middle of the eye, while the black stripe in front of the eye runs down more obliquely to near the gape of the bill. The upper plumage is sooty-black, the lower parts white with a grayish tinge on the abdomen and lower tail coverts. In winter the lores and crown become flecked with white.

Immature birds are sooty-brown above, the feathers with white tips, which are broadest on the wing coverts and tertiaries ; the under parts are slightly paler brown than the upper plumage, the vent being grayish.

Bill, legs, and feet black ; iris almost black.

Length 17 ; wing 11·5 ; tail 6·5–7·5 ; depth of fork 3·5–4·5 ; tarsus ·9 ; bill from gape 2·3.

Distribution.—Has been recorded two or three times from the coast near Colombo, and is occasionally met with on Indian shores. Its range is the same as that of the Panayan Tern, but it keeps even more to the open sea, breeding on oceanic islands.

ANOUS STOLIDUS (Blanford, Vol. IV., p. 325 ; Legge, p. 1043).

The Noddy.

Description.—Forehead and crown pale gray, passing through gray-brown on the nape into the dark smoky-brown of the upper and lower parts. The lores are black, gradually paling into lead-brown on the cheeks and throat. The wing quills and tail feathers are darker than the body.

Immature birds are paler brown, with a grayish-brown forehead and neck.

Bill black ; iris deep brown ; legs and feet dark flesh colour or reddish-brown, the webs paler.

Length 16 ; wing 10·5 ; tail 6 ; tarsus 1·0 ; bill from gape 2·3.

Distribution.—An oceanic bird, occasionally seen on the seas round Ceylon, and once obtained on the beach near Colombo. It also occurs in the Bay of Bengal, and breeds on the Laccadives in February. The range extends all round the tropics.

Family STERCORARIIDÆ.

The Skuas.

The Skuas are a family of marine birds, with a piratical manner of existence. They obtain their living chiefly by chasing other sea birds on the wing, forcing them to drop any food which they have secured, and bearing off the booty thus relinquished. They also harry colonies of breeding birds, stealing the eggs and fledglings.

As I have shown above in my remarks on the order, the chief external differences between Skuas and Gulls lie in the bill and claws. The hind toe is small ; the front toes are long and fully webbed ; the wing is long and pointed ; the tail is longish and rounded, and the two middle tail feathers are noticeably longer than the rest.

Skuas breed in the cold regions of both hemispheres, at other times they range far into the tropics. Several species occasionally visit Indian seas, but apparently only one large form, of which the classification is a little open to doubt, has been obtained in Ceylon.

STERCORARIUS ANTARCTICUS (Blanford, Vol. IV., p. 330, footnote ; Legge, p. 1050, footnote).

The Antarctic Skua.

Description.—Upper parts dark brown, darkest on the crown ; the under surface slightly paler ; the neck and mantle feathers have paler shaft-stripes ; the primaries are white at the base and black towards the tips.

Immature birds are paler brown throughout, with light shafts to the neck feathers and grayish edges to the feathers of the under surface.

Bill black ; iris brown ; legs and feet black.

Length 24 ; wing 16·5 ; tail 6·5.

Distribution.—A fine immature specimen with its wing clipped was brought alive to Capt. Legge by a native, who said it had been caught near Chilaw. As it seemed very tame, he was doubtful of the authenticity of the record. Since then, however, two more immature large dark Skuas have been shot in Ceylon. One was found in an exhausted state after a storm at Trincomalee ; the other was killed while swimming in the sea at Negombo. Both these later specimens have been referred tentatively to the present species. The usual range of this Skua is from the Antarctic Ocean to the Cape of Good Hope and Australia.

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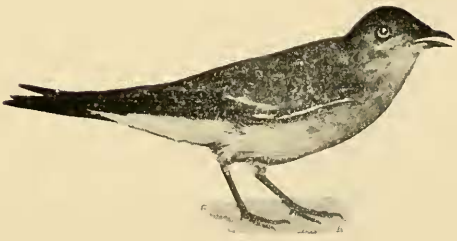

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FIG. 1.—RALLINA SUPERCILIARIS.
FIG. 2.—AMAURORNIS PHŒNICURUS.
FIG. 3.—ESACUS RECURVIROSTRIS.
FIG. 4.—GLAREOLA LACTEA.
FIG. 5.—STREPSILAS INTERPRES.
FIG. 6.—CHETTUSIA GREGARIA.

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FIG. 7.—ÆGIALITIS MONGOLICA.
FIG. 8.—HIMANTOPUS CANDIDUS.
FIG. 9.—NUMENIUS ARQUATA.
FIG. 10.—TOTANUS GLAREOLA.
FIG. 11.—SCOLOPAX RUSTICULA.
FIG. 12.—STERNA MEDIA.

? EQUUS ZEYLANICUS.

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(With two Plates.)

I.—Introduction.

At a meeting of the Ceylon Natural History Society held on Friday, December 17, 1915, Dr. Joseph Pearson exhibited two teeth of a horse (a canine and the first upper left molar), which were recovered from a bed of gray sandy clay at a depth of 23 feet below the surface, and about 13½ feet below mean sea level, in a trench opened by the Colombo Drainage Works at Wellawatta.

Wellawatta is a southern suburb of Colombo, and is situated about 4 miles south of the Fort. The trench was opened between the main road and the railway line; it ran more or less parallel to both, and was approximately 200 yards from the sea at the point where the teeth were obtained. The section exposed above the teeth was as follows :—

	Feet.
Vegetable earth	4
Vegetable earth and sea sand ..	4
Clean sand	5½
Coral fragments	1½
Gray sandy clay	8½

The bottom of the gray sandy clay was not reached. As may be expected, lateral variations along the section were to be seen; thus, the stratum of clean sand passes horizontally into sandstone, while coral fragments give place to solid reef near Wellawatta station. The teeth were discovered at a depth of 8 feet below the stratum of coral fragments, and were fortunately saved by a kangany, who had the intelligence to realize the remarkable nature of the find.

On the supposition that horses were unknown in Ceylon before the days of European occupation, the occurrence of the teeth in the gray sandy clay could only be accounted for by postulating some exceptional circumstances of natural

burial ; for, since it was evident that the strata had not been disturbed, the possibility of burial in a refuse pit or of deliberate interment was out of the question. The fragmentary nature of the coral stratum above the teeth was not at first realized, and the hypothesis advanced at the meeting of the Ceylon Natural History Society, already referred to, was that the teeth had been carried to their position in the section by means of a mud stream (the gray sandy clay) which flowed into a kind of cavern, the roof of which was formed of coral rock.

Apart from the improbability of this explanation arising from the difficulty of accounting for the cavern in the first place, the discovery of the fact that the coral stratum was a fragmentary and not a solid one gave the deathblow to the cavern theory, and substantiated the opinion—which I had reason to confirm when subsequently visiting the site with Dr. Pearson—that the teeth were, geologically speaking, *in situ*. There is no *a priori* reason why the remains of a horse introduced by Europeans should not be found under circumstances similar to those pertaining to the Wellawatta remains. One has only to postulate certain land movements within the last few centuries, and the occurrence of the fossil remains of a modern horse may easily be accounted for. But the question is essentially geological, and the answer must be determined by evidence afforded by the recent marine and estuarine deposits around the coast. It was with due regard to these that I stated my opinion that the remains are those of a creature whose advent long antedated the European occupation of the Island, and in all probability the Sinhalese invasion of Lanka.

Some exception has been taken to my use of the term "fossil." The following quotation from Sir Archibald Geikie will serve as my justification :—

> The term "fossil," meaning literally anything "dug up," was formerly applied indiscriminately to any mineral substance taken out of the earth's crust, whether organized or not. Ordinary minerals and rocks were thus included as fossils. For many years, however, the meaning of the word has been so restricted as to include only the remains or traces of plants and animals preserved in any natural formation, whether hard rock or loose superficial deposit. The idea of antiquity or relative date is not necessarily involved in the conception of the term. Thus, the

bones of a sheep buried under gravel and silt by a modern flood, and the obscure crystalline traces of a coral in ancient marshes of limestone are equally fossils.*

It should be noted that by no means are all fossils petrified. Indeed, at a guess, I should say that at least 50 per cent. are not.

The object of this paper is to show reason for the opinion, already stated, that the teeth discovered during excavation carried out by the Colombo Drainage Works are not those of a modern horse, but that they are to be regarded as evidence of the former existence of *Equus* in Ceylon during a remote—and, as I shall hope to show, a prehistoric—period.

I have to thank Dr. Pearson for the loan of the teeth and for information concerning them ; Mr. Paul Pieris for historical facts ; Mr. A. de Courcy Carson for some geographical information ; Mr. G. F. Walton for a detailed drawing of the trench ; and Mr. G. W. Sturgess, Government Veterinary Surgeon, for the loan of a horse's skull.

II.—Historical Aspect.

The question naturally arises, Is there any historic or traditional evidence to prove that horses existed in this Island before the first European occupation ?

In late mediæval times the horse could not be counted as a member of the Ceylon fauna, for Knox, speaking of the Sinhalese in the seventeenth century, says : " Lions, Wolves, Horses, Asses, Sheep, they have none."† But some Europeans in the country possessed steeds it would seem,‡ for the same author says of the French Embassador : " He rode up from Cotiar on Horseback." §

That the Sinhalese have been acquainted from the earliest times with the horse there can be no doubt, since they have their own name for it, as have the Tamils ; nor, since the antiquity of the horse in India is unquestionable, is this to be wondered

* Text book of Geology, London, 1903, Book V., Vol. II., pp. 824, 825.

† Robert Knox : " An Historical Relation of Ceylon," London, 1681, p. 20.

‡ In the time of Knox the Portuguese were already breeding horses on the island of Delft.

§ Op. cit., p. 184.

at.* There are, however, very few place names in this country which record the former existence of this creature. The writer is only aware of three, though there may be others : *Kuthiraimalai* (*T.* the horse mountain) on the north-west coast of the North-Western Province, identified with the Hipporus of Pliny by some authors, is well known ; two others, as I am informed by Mr. Carson, are to be found in the North-Central Province : one, *Kuthiraikattamoddai* (*T.* the post where the horse was tied), is situated some 6 miles south of Vedivaittakalla ; and the other, *Asvayobendakanda* (*S.* the hill where the horses were tied), is near the north-eastern boundary of the Province.†

Ancient records, however, are more productive, and from them a good deal of evidence may be obtained to show the former existence of the horse in Ceylon. Mr. Paul Pieris was good enough to go into the matter for me, and the following excerpts from the *Mahawansa* are taken at his suggestion :—

1. (*Mahawansa, ed. 1889, p. 34*) King Pandava sends wedding presents (from Madura, South India) to Wijayo, *circ.* 500 B.C. :—

The king Pandava having consulted with his ministers (decided that) he should send him (Vijaya) his own daughter Vijayá ; and for the retinue of that (king) one less than seven hundred daughters of his nobility.

"Those" (said he) "among you who are willing to send your daughters to renowned Síhala, send them. Let them be quickly ranged before their doors, decorated in their best attire" Having bestowed many presents on their fathers, he, with their concurrence, assembled the maidens (at the palace), and causing his own daughter to be decorated with every description of gold ornaments befitting her sex and exalted rank, he bestowed on her, as dowry, elephants, horses, chariots, and slaves. With eighteen officers of state, together with ‡*seventy*-five menial servants §(*being horse-*

* In the history and ancient mythical lore of the Hindus many references to the horse may be found ; take, for instance, Dasharatha's horse "sacrifice" mentioned in the *Rámáyana*. The horse is often referred to, and sometimes plays a conspicuous part in the mythology of India.

† Since writing the above I have been informed of another place-name of interest in the present connection : Mavittapuram (Skt. the city of the abandoning horse) near Kankasanturai in the Northern Province.

‡ Sixty.

§ Omit this. The other reading gives "one thousand artisans from the eighteen classes (or castes)."

keepers, elephant-keepers, and charioteers), the monarch despatched these (maidens), bestowing presents on them. All these persons having embarked in a vessel, from the circumstance of great concourses of people landing there, the port (at which they debarked) obtained the name Mahátittha.

2. (*Page 53*) Dewanan Piya Tissa's chariot was sent to convey Mihindo to Anuradhapura :—*

In the morning the king sent his chariot. The charioteer, who repaired (to Mihintalé), said unto them (the théras), "Ascend the carriage that we may proceed to the town." "We will not" (replied the priests) "use the chariot; do thou return, we shall go hereafter." Having sent away the charioteer with this message, these truly pious personages, who were endowed with the power of working miracles, rising aloft into the air, alighted in the eastern quarter of the city, on the site where the first dágoba (Thúpârâma) was built.

3. (*Page 91*) A description of the breaking in of a horse by a Sinhalese boy, *circ.* 200 B.C. :—

He, leaping on the charger, pressed him into full speed in a ring. (The animal) presented the appearance of one continuous horse in every part of the circus. Poising himself by his own weight on the back of the flying steed, the fearless youth repeatedly untied and rebound his scarf.

4. (*Page 41*) An incident which shows that the Yakkos kept horses :—

A certain yakkhiní named Cetiyá† (*the widow of Jutindhara, a yakkha, who was killed in a battle fought at Sirivatthupura*), *having the form and countenance of a mare, dwelt near the marsh of Tumbariyangama, at the Dhumarakkha mountain.* A certain person in the prince's retinue having seen this beautiful (creature), white, with red legs, announced the circumstance to the prince, saying "There is a mare of such a description." The prince set out with a rope to secure her.

From excerpt 4 we gather that the aboriginal, or at any rate pre-Aryan, inhabitants of the Island kept horses.

The case of Ceylon, then, may be similar to that of America, where the indigenous *Equus* became extinct, and was replaced in historical times by a modern horse of Hindu or European introduction.‡

* Tissa reigned from 307 B.C. to 267 B.C.

† Who dwelt at Dhumarakkha mountain was wont to walk about the marsh of Tumbariyangama in the shape of a mare.

‡ I am informed by Mr. Pieris that references to the horse are scattered through Sinhalese literature from the earliest times of the Portuguese period.

III.—Geological Aspect.

The coast of Ceylon is fringed with littoral deposits, which, though geologically recent, are of remote antiquity when regarded from the point of view of human affairs. They consist of ancient unconsolidated beaches, sandstones, raised coral reefs, leaf beds, submerged coastal flats, &c., and plateau gravels. The last of these, as the present writer has been able to show, contain stone tools belonging to a primitive stage of culture. The coast deposits, which may in part be correlated with some high-level gravels terracing the main river valleys, indicate cycles of upheaval and depression, which have influenced wide stretches of country.

There can be no doubt that Ceylon and India have been connected by a land bridge in the past. It is probable, too, that this connection has been established and broken more than once. Minor movements have also affected the coast at various times, and are doubtless still proceeding. There is no evidence to show that they were violent; indeed, they are best regarded as discontinuous and slow. Land bridges have, of course, influenced the distribution of animals and plants, and by means of such connections came many of the indigenous creatures of this country, not excepting man himself. It is not possible within the limits of the present paper, nor is it desirable, to consider the recent geological history of Ceylon in detail. Suffice it to say that evidence enough exists to show that the coastal belt is constantly subject to slow fluctuations of level; and that whereas the most ancient movements which affected this country were epeirogenic (or mountain forming) in type, those of more recent date were orogenic (or continent forming), that is, general and widespread in effect. It is hoped that at some future date occasion will be found to publish an account of the later geological history of Ceylon, and the influence of land movements upon our flora and fauna; meanwhile the reader must be asked to take the above statement for granted, subject to forthcoming proof.*

* The most recent contribution to this subject is a paper by Mr. W. E. Wait, "The Distribution of Birds in Ceylon and its Relation to recent Geological Changes in the Island."—*Spolia Zeylanica*, Vol. X., Part XXXVI., December, 1914, pp. 1–32.

Fringing the western and southern coasts of this country is a well-marked "reef" of sandstone containing the fossil remains of existing species of mollusca. This rock is exposed in many places, generally between high- and low-water levels, and will serve as a good geological datum. It is often very hard, and is locally used as building stone. The consolidation of this rock probably took place after the loose sand was elevated above sea level; the cement is carbonate of lime, as was probably derived from marine shells. It is an interesting fact that whereas the fossils belong to recent species, they indicate a distribution somewhat different from that which obtains to-day. At Chilaw, for instance, *Cyprœa* is a very common fossil genus, but the only *Cyprœas* which I was able to discover on the present beach at Chilaw were derived from the sandstone. *Cyprœa*, however, is common as a living form further north—on the western shores of the Calpentyn Peninsula, for example. After elevation the sandstone was evidently depressed, for in many places a sea-worn surface may be exposed under more modern accumulations. The rock is of no great width, and passes inland into unconsolidated sand, with which it is doubtless contemporaneous. Both the sandstone and the soft sand are overlain by other beach or swamp accumulations and blown sand of later date. The hard rock was probably formed on flats above high-water level, just as similar rocks are tending to form at the present day (*i.e.*, on the eastern shores of the Puttalam lake). That between the time of its consolidation and the present day it was depressed below the surface of the sea is evident, not only from the erosion of its surface, but also from the fact that dead corals, now above water, may often be seen adhering to it.

The earth movements chronicled by the coastal sandstone were of the nature of vertical uplifts and depressions; but, as may be expected over so large an area as the western and southern coast belts, local tilting has occurred. From the mouth of the Kelani-ganga to Chilaw the slightest perceptible tilt to the west is to be seen, while near Galle the dip is much more apparent. On the whole, however, tilting is very slight, and for all practical purposes may be ignored. A glance

at the section (Plate II.) will show the relationship of the sandstone to the beds above and below it. This section is generalized, but, although compiled from many observations taken along the coast, is especially designed to illustrate the Wellawatta exposures.

Underneath a thin layer of blown sand is a deposit of vegetable earth indicative of a land surface; below this a layer of vegetable earth and sea sand—a record of swamp conditions; below that again comes a thick layer of sea sand with marine shells overlying a reef, or a stratum of coral fragments. The coral rests upon the coarse gray sandy clay which yielded the fossil teeth. The depth of the sandy clay in the Wellawatta district is unknown, as its bottom has never been found; it probably rests on the ancient crystalline rocks, which are exposed in a cliff to the east of the generalized section.

The gray sandy clay deposit is of special interest, inasmuch as it exactly resembles the material which forms the coastal flats in the northern part of the Island. These represent, in my opinion, accumulations which were formed on shallow sea floors away from the sorting influence of the waves. In composition they are an admixture of sand and mud with small quartz pebbles and shells, generally unbroken. Most of the molluscan species are small, but fairly large shells are not uncommon. The flats are only covered (if at all) by exceptional tides. They are for the most part dry, and support a scanty vegetation of succulent and herbaceous plants. Thorny scrub and *ranawara* bushes find a footing on any patches of blown sand or ancient beach which may here and there be found upon the surface. They form a fair grazing ground for cattle, and footprints show that deer, pig, buffalo, leopard, elephant, and other creatures of the neighbouring jungle resort to these open spaces; while, as I have observed in some localities, jackal and hare seem particularly fond of them. I have many times found the remains of wild creatures upon such ground as this, and here, as in many other places, scattered teeth are of fairly common occurrence.

At the moment of writing my camp is pitched by just such a flat as this (at Palavi, Northern Province), and as I have in

my possession a sample of the deposit from which the fossil teeth were obtained, a comparison between it and the sediments of the flat is easy. In the hand specimens the two would be quite indistinguishable were it not for some difference in the contained molluscan species. Mineralogically the samples are identical, but a slight difference exists between the proportions of the minerals present, as may be expected from the difference of local geology. The gray sandy clay from Wellawatta, for example, is richer in heavy minerals (ilmenite, zircon, &c.) than that of Palavi; but the deposits of some other flats south of Palavi yield concentrates comparable in bulk with those of the Wellawatta stratum.

The gray sandy clay is a typical "flat" deposit. It is formed in quiescent places, and is characteristic of large sweeping bays; it is commonly associated with coral reefs. The deposit is sufficiently definite and distinct in type to be entitled to a special name; it has no specific place in geological nomenclature as far as I know, nor do I intend to christen it; it will be convenient, however, to call it by its Tamil equivalent *kadu-suli* (கடுசுளி).* The deposit composing the coastal flats is a *kadu-suli*, so is the gray sandy clay from Wellawatta. The striking similarity of the two sediments is the strongest possible argument in favour of a common origin. In all probability the Wellawatta *kadu-suli* was laid down in a bay, the span of which was defined on the north by a rocky headland, which now supports the battery, and on the south by a similar prominence—the site of the present Mount Lavinia Hotel.

As we have seen, the coast of Ceylon is subject to fluctuations of level. It is not possible to say with certainty whether the land is stationary or sinking or rising at the present time;

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* The present day mud flats are almost confined (on the western coast of the Island) to the sea-board of what may be called the Tamil country (*i.e.*, the Northern Province and the northern part of the North-Western Province). The Tamils, however, seldom use the term *kadu-suli* (sea mud), as *suli* suffices for most varieties of clay and slush. Curiously enough the Sinhalese have a saying in which "sea mud" (*mude-mada*) is used in the exemplary sense for a thing unheard of: කලාමැදිරියා කැවාම අහසෙ තරුයි මුදෙ මඩයි ඕනෑ වෙයයි—"Just as one needs stars from heaven and mud from the sea to cure a fire-fly's bite."

but some curious hydrographical phenomena, the facts of subterranean erosion, the rapid denudation of the coast, and the abrupt ending of shallow platforms under the sea suggest that the land is being slowly submerged. If such is the case, and if depression continues for a sufficiently lengthy period, fresh sediment will be distributed over the coastal belt ; fresh *kadu-suli* may be deposited upon the flats, and the bones and teeth of animals lying on the ground will be covered by deposits similar to those on which they rest. So will these accumulations grow till a change of conditions (the result of depth attained or some other circumstance) necessitates a change of material precipitated. Thus, a bed of clay may be covered by a layer of sand, or coral reef submerged in mud.

In the light of these considerations we may interpret the exposures of the Wellawatta trench, but before doing so it will be as well to consider the section in general (Plate II.). The points A, B, C, and D vary considerably in relative position along the coast. A is the modern shore line, B is the edge of the coastal plane, C is the edge of an ancient beach, and D is the junction of the coastal plane with the Archæan crystalline rocks which form the main mass of the Island.

In places where coastal erosion is rapid (southern part of the Western Province and Southern Province) A, may coincide with one or more of the other points. In many localities in the south (Dondra Head, for example) all four are coincident. Near Wellawatta A and B are close together, C is about a quarter of a mile from B, while D is situated some considerable distance inland. When A, B, C, and D coincide little or no evidence of land movements is observable, the best conditions for geological observations are obtained when all four points are well separated. A, B, C, and D are situated on shore lines.

Besides the deposits of the Wellawatta section enumerated in the Introduction, two others are to be considered. The first of these is the plateau gravel which caps the low hills in various localities ; the second is an ancient beach which occurs between points C and D.

The plateau gravel was deposited before the minor configurations of the solid land were developed, and the relationship

of the ancient and modern beaches with the deposits below them to the inlets of the coast shows these sediments to be younger than the plateau gravel. Moreover, since the gravel has yielded Stone age relics, it must be inferred that the coastal deposits have accumulated during the human period, that is to say, within (? Pliocene), Pleistocene, and Holocene times.*

From a comparison of the *kadu-suli* of the northern flats with buried teeth-yielding deposit exposed at Wellawatta, one may reasonably infer that the creature of which the relics once formed part, met its death, as many others have subsequently done, on the open plains by the ocean. Since that time the coast has been depressed in relation to the sea to a depth of over 20 feet. There can be no doubt that this did not take place during the European occupation of the Island, for the sandstone, which we have taken as our geological datum, is certainly more recent than the gray sandy clay, and was used by the Portuguese and Dutch in the construction of their buildings. Nor is it likely to have occurred during any period of the Sinhalese occupation, for, although minor oscillations may be inferred from some legends in the *Mahawansa*,† no depression of anything like 20 feet can be admitted within the historical period, inasmuch as the

* The tertiary periods arranged in a descending order of antiquity read as follows:—Holocene; Pleistocene; Pliocene; Miocene; Oligocene; Eocene. The nomenclature refers to the percentage of certain living species present. The Holocene period, in which we are now living, begins with the newer Stone age, and is characterized by an almost entire absence of extinct species.

† A minor movement or, more probably, an abnormal wave like that of 1907, is recorded in the *Mahawansa* (Wijesinha's translation, 1889, Part II., p. 84) as follows:—

[1] *Tissa, the sovereign of Kalyáni, had a brother named Uttiya, who, terrified* at the resentment borne to him on the king's detection of his criminal intercourse with the queen, fled from thence. This prince, called Uttiya, from his grandfather (king of Anuradhapura), established himself in another part of the country (near the sea). From that circumstance, that division was called by his name. The said prince, entrusting a secret letter to a man disguised in the garb of a priest, despatched him to the queen. (The messenger) repairing thither, stationed himself at the palace gate; and as the sanctified chief théra daily attended the palace for his repast, he also unobserved entered (with that chief priest's retinue) the royal apartment. After having

[1] "Now there was a sovereign of Kalyáni called Tissa, a Kshatriya, whose brother Uttiya, terrified," &c.

stupendous effects gradually arising from such a movement could hardly fail to find recognition again and again in early writings unless the movement was extremely local.

All the evidence goes to show that the more recent oscillations of Ceylon have been of a widespread character. The distribution of the sandstone, already briefly discussed, is a case in point. A depression of 10 feet, if at all general, would submerge hundreds of thousands of acres; while a drop of 20 feet would make an enormous difference to the country. Since, however, such depression has occurred within the human period, one may safely conclude that the event belonged to pre-historic days, nor can its protracted nature be reasonably questioned. At any rate, it is certain, from geological evidence, that the sinking of the ancient coastal flat was far from cataclysmic, and the present writer ventures to think that the few thousand years which have elapsed since civilization first found its way to this Island are insufficient for the completion of a movement—or series of movements—which the geology of the coast records.

But there is time enough and to spare for these happenings within the " human period " of Ceylon, for it can be shown that early man existed in the country more or less contemporaneously with the Palæolithic people of Europe, and there is nothing extravagant in the statement that man was probably living in Ceylon a hundred thousand years ago.

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taken his repast with the théra, on the king's leaving the apartment in attendance (on the théra), this disguised messenger catching (at last) the eye of the queen, let the letter drop on the ground. By the noise (of its fall) the king's (attention) was arrested. Opening it and discovering the object of the communication, the monarch misled (into the belief of the chief priest's participation in the intrigue), became enraged with the théra; and in his fury putting both the théra and the messenger to death, cast their bodies into the sea. The dévatás, [2]*to expiate* (this impiety), submerged that province by the overflow of the ocean. This ruler of the land (to appease the dévatás of the ocean) quickly placing [3]*his own lovely daughter Suddhadevi* in a golden vessel, and inscribing on it " a royal maiden," at that very place launched her forth into the ocean. The king (of Mahágáma) Kákavanna raised to the dignity of his queen-consort her who was thus cast on shore [4]*on his dominions*. Hence (from the circumstance of her being cast on shore near a vihara), her appellation of Vihára Dévi.

[2] " incensed at."
[3] " his daughter Devi, a princess of great beauty and purity."
[4] " near the Lanka vihara."

The geological interpretation of the Wellawatta sections appears as follows :—

On a pre-historic flat bordering the sea an indigenous horse met its death.* Subsequent slow depression of the land resulted in the burial of such organic remains as might be strewn upon the surface of the flat, under deposits akin to those upon which they were resting. The flat, which partly filled a large bay (see p. 269), was bounded on the west by a coral reef. As the land sank the reef grew, till the quiet conditions which allowed of coral growth and the accumulation of *kadu-suli* no longer obtained. Possibly an ancient reef or rock-bar out at sea, serving in times of greater elevation to protect the shore from the onslaught of the waves, was now too far submerged to function as a break-water. Whatever the cause may have been, conditions changed ; the coral reef was denuded, and fragments of the mass were strewn across the surface of the *kadu-suli*. The land continued to sink, and sand was deposited seawards of the reef, above it, and above the gray sandy clay. Then a period of elevation set in and continued till the top of the sand appeared above sea level. Some of the upper layers were afterwards consolidated by lime-charged waters, and partially, perhaps, by efflorescence from the coral below, slight depression again took place, and swamps (to which the vegetable earth and sand bears testimony) appeared along the coast. Depression then continued, and marine deposits crept further inland. While the hardened sandstone out at sea supported coral growth (see p. 267), at length the downward movement was complete and the land rose again in a slow discontinuous way, thus giving rise to shore lines C, B, and A. When the coast had extended to B, swamps appeared along the plain, and were afterwards replaced by jungle. The present beach and blown sand are the youngest deposits in the series. In a sense the vegetable earth is their contemporary ; it should be noted, however, that this bed has a double history, for, although organic matter accumulates *pari passu* with the dunes, and has been accumulating since

* Indigenous for reasons set forth under the heading of Palæontological Evidence.

the beginning of the jungle phase, the stratum itself, as such, is older; it is, as it were, a reservoir for decaying plants. All fresh material added is younger (and if it falls upon the surface is separable from the mass); but much of the organic contribution takes the form of decaying roots, which penetrate and add to a bed which is older than the ancient beach at C.

Such, then, appears to be the history of the more recent deposits of the coast. There is nothing remarkable in this succession of movements; a similiar story may be read round almost every coast line of the world—a fact which has been more or less realized ever since the publication of Leopold von Buch's classical researches on the Baltic and elsewhere.*

IV.—Palæontological Evidence.

If the Wellawatta horse is to be considered as a contemporary of early man, certain structural differences may be expected between it and the modern *Equus caballus*, but I am not aware that any great difference necessarily exists. The question arises, too, Was the horse introduced by early man from India, or was it part of the indigenous fauna of Ceylon? This is a question to which no definite answer can be given; but it seems unlikely that Stone age tribes would have deliberately brought the creature to this country, for the domestication of the horse by so primitive a people as that announced by the plateau antefacts must be considered doubtful. In the absence of evidence to the contrary one must assume that horses reached the Island, as the elephants and other large mammalia did, of their own accord by means of a land connection. That pre-historic Ceylon did know the horse is probable, as we have seen, from the *Mahawansa* (excerpt 4).

It has been suggested that the discovery of a couple of teeth is not enough to establish the existence of ancient horses in the Island; but the objection is hardly valid, for although there can be no doubt that elephants have inhabited the forests since pre-historic days, no well-authenticated discovery of their fossil remains has been recorded, despite the fact that the officers of the Mineral Survey have paid special attention

* "Reise durch Norwegen und Lapland." 1810.

to alluvial deposits ever since the inauguration of the Department in 1903. The same remark applies to other mammalian relics which might be expected to occur in river gravels and valley silt. The fact is that conditions are not conducive to the preservation of bones.*

There is no obvious reason why horses should not have found their way to Ceylon in Pliocene or Pleistocene times, for as Dr. Smith Woodward says : " The earliest remains of one-toed horses hitherto discovered occur in the lower Pliocene Siwalik Formation of India ; "† and on the same authority we learn that horses appeared in Europe during upper Pliocene and in America during Pleistocene times.‡ Quite recently equine remains have been obtained from some later tertiary beds of China.

By the kindness of Mr. Sturgess, I have been able to compare the Wellawatta teeth with those of the modern horse. I have also been able to compare the grinding tooth with a photograph and description of the upper fourth premolar of a new fossil species from Ho-nan (China), recently published by Hikoshichiro Matsumoto in the Science Reports of the Tôhoku Imperial University, Sendai, Japan.§ Specific distinctions between ancient horses are liable to raise vexed questions, for " None of these species, old world or new, are easily to be separated from *E. caballus*, but many names have been given to them. It is, of course, perfectly conceivable that they may have differed among themselves, as much as do the existing zebras and asses, the separation of which would be hardly possible did we know their bones only." ||

Woodward, speaking of Pleistocene horses, remarks : " A large proportion of the remains can scarcely be distinguished from the corresponding parts of the existing *E. caballus*."¶

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* If I recollect rightly, however, Dr. Kelaart somewhere speaks of elephant remains in the leaf beds of the Getaheta Valley. I do not know on what authority.

† " A Guide to the Fossil Mammals and Birds " ..... British Museum. London, 1904, p. 24.

‡ *Loc. cit.*

§ Second Series (Geology), Vol. III., No. I., pp. 29, 30.

|| Beddard, F. E. : " Mammalia." Cambridge Natural History, Vol. X., 1902, p. 240.

¶ " Outlines of Vertebrate Palæontology." London, 1898, p. 338.

Nevertheless, teeth are generally considered a fairly safe guide,* and the Japanese author above named does not hesitate to found a new species (*E. leptostylus*) upon some peculiarities of dental structure.

Hikoshichiro Matsumoto says on page 2 of his paper :—

"The Pliocene horses of the old world, such as *E. stenosis*, *E. quaggoides*, and *E. sivalensis*, are characterized by the very small anterior inner pillar and the more or less *Hipparion*-like plication of the enamel of the upper premolars and molars, while the majority of the large Pleistocene horses, such as *E. spelœus*, *E. ferus*, *E. mosbachensis*, *E. germanicus*, *E. abeli*, as well as '*E. caballus* foss.' of auct., &c., are characterized by the large and long anterior inner pillar and the less complex plication of the enamel of the same. Between these two groups I distinguish two lines of intermediation. The first, being represented by *E. plicidens* and *E. sussenbornensis*, has the premolars and molars, of which the anterior inner pillar is large and short, and the plication of the enamel is very complex and rather *Hipparion*-like. The second, being represented by Boule's '*E. cf. stenosis*'† and the present species, has premolars and molars of which the anterior inner pillar is small and short and the plication of the enamel is rather simple."

Let us examine the Wellawatta molar in the light of these remarks with a view to determining where it may be placed in the above scheme of classification.

The tooth is one that belonged to a full-grown horse, and is well worn at the grinding surface. It is quite unmineralized, but has lost its organic content, as may be shown by its adhesiveness to a moistened surface—the tip of one's tongue, say. It is short and remarkably squarish in section ; its weight is 49·72 grammes. The canine, which calls for no

* Speaking of the lakes (or crescents) observable in the teeth of the *Equidæ*, Professor Flower says ("The Horse," London, 1891, p. 126): "The sinuosities of their enamel margins, which are sometimes extremely complex, present great variations in different species, as also do the indentation in the edges of the sinus which runs forward from the inner side of tooth between the two internal columns, the form of the folds at the bottom of which constitutes the only easily recognizable distinction between the molar teeth of the common horse and the ass." This distinction which I have been able to observe through the kindness of Mr. J. D. Brown, C.C.S.—who in his interest in the matter procured for me the skull of a donkey—is as follows :—The spur which projects into the bay between the two inner pillars (internal columns) is hardly represented at all, while the inlet immediately posterior to the spur runs up to meet the anterior crescent. (Compare with this statement character 6 of the table and diagram.)

† Les Chevaux Fossiles de Grottes de Grimaldi. Ann. Pal., V., 1910, p. 113, text fig. 1.

further remark save that its size (74 mm. outside curve, 13 mm. widest part, and 42 mm. greatest circumference) declares its possessor to have been a stallion, weighs 8·19 grammes.* When due allowance is made for unequal wear, certain peculiarities, more or less distinctive of the Wellawatta molar, are to be noted ; these, together with the corresponding characters of *E. leptostylus* and *E. caballus*, are set forth in tabular form below.

The first ten characters of the upper left P. M. 4 of *E. leptostylus* are taken from Hikoshichiro Matsumoto's description, while the others under the same heading are to be observed in the plate accompanying the same publication. In Plate I. of this paper the more important structures of the teeth are drawn to a magnification of two diameters.

In no instance is there complete agreement between the three teeth.

With regard to one character (16), (B) and (C) are alike in their difference from (A) ; in three characters (1, 2, and 7) (B) approaches (C) more closely than it does (A) ; in four characters (4, 5, 6, and 12) (B) is more or less intermediate between (A) and (C) ; in six characters (3, 8, 9, 10, 11, and 15) (B) shows more resemblance to (A) than to (C) ; while in two characters (13 and 14) (B) is peculiar.

The upper left last premolar of *E. leptostylus* is more akin in structure to the first upper left molar of *E. caballus* than it is to its homologue in the latter species, inasmuch as last upper left premolar of the modern horse is longer in proportion to its width and has more marked and more complicated plications than either the corresponding tooth of *E. leptostylus* or its own first molar. On the other hand, the Wellawatta cheek tooth resembles the collateral grinder of *E. caballus* more closely than it does any other tooth of the modern horse. What degree of correspondence exists between the upper left first molar of *E. leptostylus* and the upper left first molar of *E. caballus* we do not know, but we see from analogy that the plications of the former were simpler than those of

* One of the minor difficulties of the " cavern " theory was to explain how two teeth of such very different size and weight should have remained together during the movements of the mud stream.

the latter. Moreover, we know from observations that the same general statement holds good where we substitute the Wellawatta horse for *E. leptostylus*. But the Wellawatta horse cannot be placed in either of Hikoshichiro Matsumoto's lines of intermediation ; for this very simplicity which allies it with line 2 separates it from line 1, while the long and comparatively large anterior inner column excludes it from both,* it obviously belongs to the group of " Pleistocene horses," as might be expected from the geological evidence.

Geological evidence alone, however, would be incapable, in the present instance, of proving the teeth any more recent than Pliocene ; for, while a strong presumption exists in favour of a Pleistocene date, the fact that the relics are younger than the implements of the plateau gravels cannot, while the antiquity of man is disputed, be held to preclude the possibility of a greater age.†

V.—Conclusion.

The Wellawatta teeth, when considered in relation to the historical, geological, and palæontological evidence bearing upon them, must be taken to indicate the existence of horses in Ceylon during pre-historic days. The individual proclaimed by these relics exhibits the characters of a group of Pleistocene horses, while a number of features (simplicity of the crescents, narrowness of the anterior inner column, &c.) serve to distinguish it from the modern *E. caballus*. Whether it is sufficiently distinct from the present day horse on the one hand, or from certain extinct species on the other, to entitle it to a specific name of its own, must be left to the decision of Naturalists who possess a more intimate knowledge of the palæontology of the horse, and are more fortunately placed with regard to recent literature than the present writer.

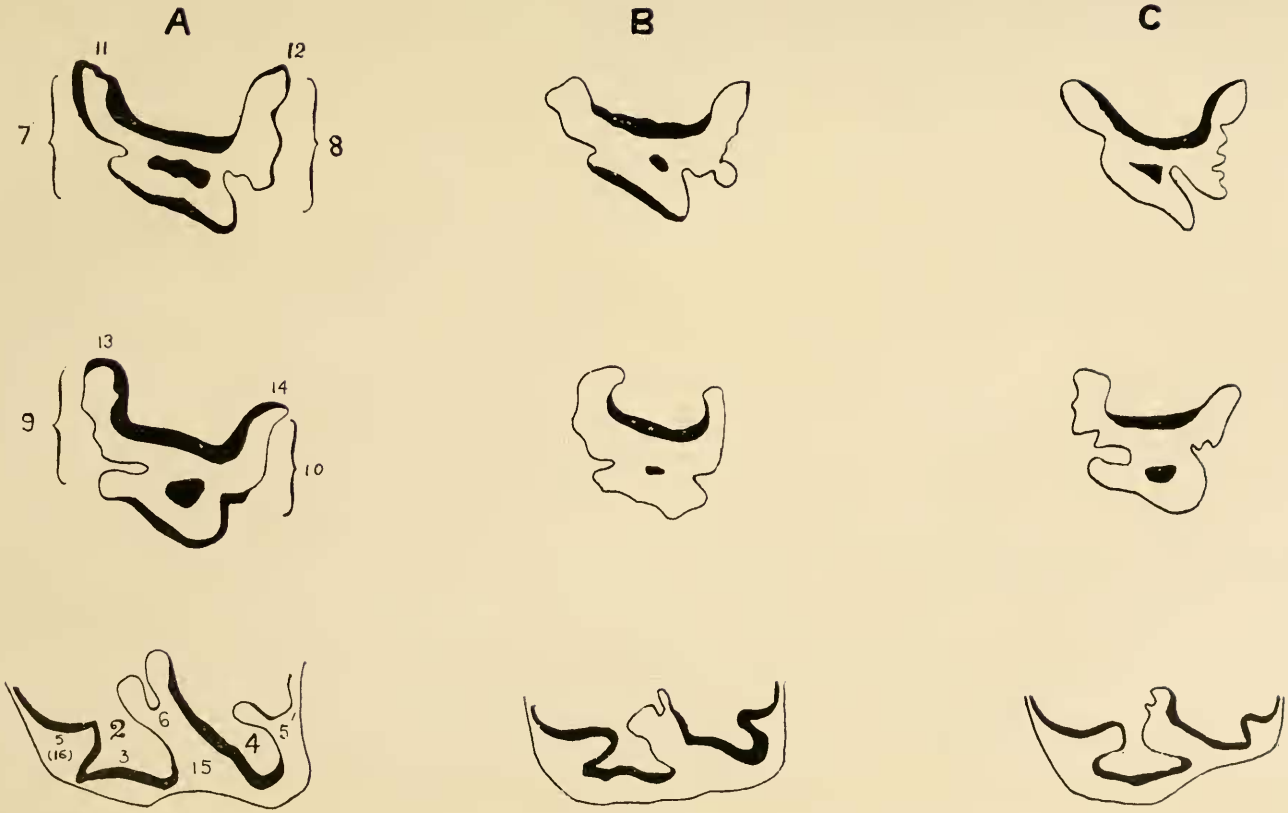
* The quotient of " length of pillar " into " length of tooth " in the three cases is as follows :—A = 2·90, B = 2·37 nearly, C = 2·28 nearly.

† Dr. Fritz Noetling, in a paper " On the Occurrence of Chipped (?) Flints in the Upper Miocene of Burma " (Rec. Geol. Survey, India, Vol. XXVII., Part 3, 1894, pp. 101–103), records some flaked stones which have been recognized by some authorities as the handiwork of man. Since the publication of his paper, Dr. Noetling has found reason to regard the beds containing the supposed antefacts as older Pliocene ; and it may be noted that savants are not wanting who maintain that Pliocene man in Europe is a proved fact. Some controversial papers concerning Dr. Noetling's discovery will be found in " Natural Science " and elsewhere.

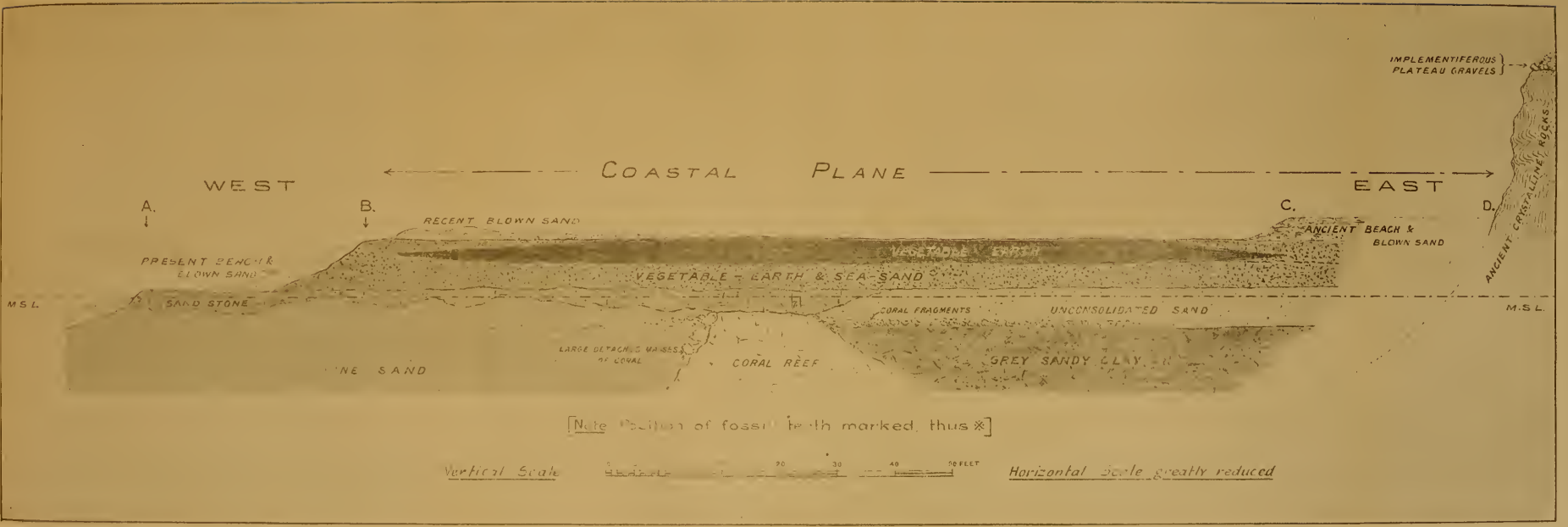
Comparative Table of the more important Characters of the upper left P. M. 4 of (A) *Equus leptostylus*, and the upper left M. I. of (B) the Wellawatta Horse, and (C) *E. caballus*. (See Plate I.)

Parts.	Character No.	(A) *E leptostylus* (upper left P. M. 4).	(B) The Wellawatta Horse (upper left M. I.).	(C) *E. caballus* (upper left M. I.).
Folds	1	The anterior middle and outer folds are well developed and wide, each having a distinct vertical median furrow	Not quite so wide	Much as in (B)
Pillars	2	Anterior inner pillar very small and short, measures 10 mm. in length and 5 mm. in width at the grinding surface	Longer in proportion to length of tooth than in (A). Length 11 mm.; width 4½ mm.	Longer in proportion to length of tooth than in (B). Length 11 mm.; width 5 mm.
	3	Anterior inner pillar is not rounded, but irregularly triangular, with concave inner side in section	Distinct concavity on inner side	Rounded
	4	Posterior inner pillar also very small and short, with perfectly rounded posterior border	Rather small and short; well rounded exterior border	As in (B), but exterior border somewhat subangular
	5 (and 5[1])	Neither of the pillars reaches the boundary of the tooth proper; the bays just anterior to the anterior pillar and posterior to the posterior pillar yielding a comparatively large surface for cement.	Much as in (A), but bay posterior to posterior pillar smaller (in proportion) than in (A)	As in (B), but bay posterior to posterior pillar not so deep as in (B)
	6	Simple spur projects into bay between two inner pillars	As in (A), but spur not so large in proportion to bay	Spur extremely small; is accompanied by a small fold to the inner side
Crescents	7	Anterior border of anterior crescent has one conspicuous fold	One conspicuous fold and one very feeble, one accentuated by uneven wear of the tooth	As in (B), but minor fold very slight
	8	Posterior border of anterior crescent has one conspicuous double fold and two rather feeble ones	Double fold highly conspicuous, one well marked, one fairly well marked, and one very feeble fold	One very conspicuous single fold; one well-marked double fold; two well-marked single fold
	9	Anterior border of posterior crescent has one very conspicuous and two very feeble folds	As in (A)	One highly conspicuous, one conspicuous, one very feeble, and two long gentle folds
	10	Posterior border of posterior crescent has one rather conspicuous single fold (the additional fold which appears in the original photograph and in the diagram is presumably only apparent, and is due to the foreshortening of a worn surface)	One fairly conspicuous single fold	One conspicuous double fold
	11	Anterior horn of anterior crescent is wide and squarish, but not angular, it is directed	Wide and squarish; points outwards and forwards	Wide and tending to pointed. Points forwards and outwards
	12	Posterior horn of anterior crescent tending to pointed	Much as in (A)	Rather more pointed
	13	Anterior horn of posterior crescent is club-shaped and laterally directed. The apex is anterior.	Crescentric in shape. Apex is posterior	As in (A), but less club-shaped
	14	Posterior horn of posterior crescent points outwards and backwards	Points laterally	Much as in (A)
Bays	15	Bay between anterior and posterior inner pillars widens towards its mouth	As in (A), but not so marked	Bay narrows towards its mouth
	16	Bay anterior to anterior inner pillar is angular	Bay is rounded	As in (B), but with squarish tendency.

Note.—The numbers in column 2 correspond with the numbers in Plate I.



A comparative diagram of the crescents (top and middle row) and anterior and posterior pillars (bottom row) of (A) the fourth left upper premolar of *Equus leptostylus*. (B) the first left upper molar of *? Equus zeylanicus*, and (C) the first left upper molar of *Equus caballus* (top and middle rows × 2, bottom row × $\frac{4}{3}$).



A GENERALIZED GEOLOGICAL SECTION OF THE WEST COAST OF CEYLON.

NOTES.

Cassia nodosa tree defoliated by caterpillars of Catopsilia pomona, Fabr.—Having heard that caterpillars were devouring the foliage of certain trees in the Victoria Park, I decided to collect specimens and, if possible, to take a photograph of the affected tree. The ground all round the tree was one mass of struggling green. Perched on all the adjoining branches were crows (*Corvus splendens*) which were devouring the caterpillars wholesale, and except for them much damage would have been caused. I collected some of the caterpillars and bred them in captivity. They were full grown, and pupated in three days, the butterflies were the ordinary *Catopsilia pomona*, Fabr. The tree adjoining the one which was eaten was in blossom and of the same family, a few branches showed signs of the pest, but the gardener timely intercepted the spread of them. I understand that all this damage was caused by the caterpillars to the tree in two days.

Colombo, May, 1916. C. C. SOLOMONS

A similar incident to the one described by Mr. Solomons took place at the Royal Botanic Gardens at Peradeniya this year. The same thing has happened for several years in succession, I understand, on practically the same date. Unfortunately, when my attention was drawn to the outbreak, the caterpillars were so well grown that nothing could be done to save the trees. Thousands of the caterpillars were ascending and descending the trunks and crawling about the grass and neighbouring bushes. No birds were observed to be eating them this year, but in the 1914 outbreak king crows (*Dicrurus leucopygialis*, Blyth) were seen feeding on the caterpillars both on the ground and on the trees, and crows fed eagerly on the pupæ, doing, in fact, some damage to the trees by breaking small branches, &c., to get at them.

Strange to say, the only trees seriously attacked were those bordering the Palmyra Avenue, others in private gardens near by not being touched apparently. The outbreak does not appear to have done any serious damage to the affected trees, however, as they are coming into new leaf and flowering vigorously now.

Peradeniya, May 22, 1916. G. M. HENRY.

Flight of Brana callopasa —A very unusual sight attracted my attention whilst out collecting Cicadas. The lamp on the gate leading to the Museum was besieged by what I at first thought to be a swarm of bees, but on closer inspection they proved to be moths (*Brana callopasa*, Wlk.). The lamp was covered with the moths which were about ten deep. The next morning I found every one had flown away.

Colombo, May, 1916. C. C. SOLOMONS.

Nacaduba dana, De Niceville.—This butterfly is new to the Ceylon lists. It is allied to *N. ardates*, but can at once be distinguished by—

(1) Much lighter blue on upperside.
(2) Basal pair of strigæ on underside of forewing not produced below median vein.
(3) Two minute equal-sized black spots, one each in interspaces (1) and (2) of the underside of the hindwing.

The last is the most useful distinction, as all the other *Nacaduba* of Ceylon have a *large* black spot in interspace (2).

Mr. Mackwood has compared it with specimens of *N. dana* from Burma and finds it identical.

The male is found in the Haldummulla district settled on wet roads, chiefly in April and November. The female is very rare.

Haldummulla, April 6, 1916. W. ORMISTON.

Terias rotundalis.—Moore in his "Lepidoptera of Ceylon" describes and figures this species. Subsequent authors have treated it as a variety of *Terias silhetana*, partly, I believe, because they have never seen a specimen, and partly owing to Moore's reputation for splitting the butterflies into unnecessary species.

Mr. Mackwood, who is by far our greatest authority on the subject, has for many years insisted on its specific rank.

I saw my first specimens in February last, when I was lucky enough to catch one in the Kottawa forest, near Galle. Mr. Mackwood gave me another specimen from Ratnapura, and I found one in the Museum collection from Peradeniya labelled *Teria silhetana*.

I give a short description :—

Male (I have not examined a female yet).—Wings short and more rounded than in *silhetana* or *hecabe*, hence the name *rotundalis*.

Upperside : Colour a *very bright* citron-yellow. Black border very similar to *T. silhetana*, but of a far more intense black. Not sharply angulated on vein 7 as in *T. andersoni*.

Lower Wing : Narrow terminal border intense black, broader anteriorly, extended along veins near apex as a fine streak.

Underside : Can be distinguished at once from *T. silhetana* by having *only one streak in cell*, whereas *silhetana* has invariably *three*. Narrow black border to upperwing, extended as a triangular black patch down each vein from 4 to 11. In place of the pre-apical red patch in *hecabe* and *silhetana*, there is a slight dusting of *intense black* scales.

Lower Wing : Markings as in *silhetana*, but narrow black border from vein 7 to tornus, slightly thickened at end of each vein. General colour of underside quite as bright as upper, not paler as in *T. andersoni*.

Sexual mark similar to *silhetana*.

Thorax and abdomen much blacker above than in any other Ceylon *Terias ;* yellow below. Antennæ longer in proportion to size than in *silhetana*.

Habits : So far as is known is found in the forests of the wettest zone. The Peradeniya specimen is probably an accidental visitor.

Haldummulla, April 6, 1916. W. ORMISTON.

PROCEEDINGS OF THE CEYLON NATURAL HISTORY SOCIETY.

Fourteenth General Meeting.

The Fourteenth General Meeting of the Society was held in the Colombo Museum Library on October 20, 1915, with Dr. A. Nell in the Chair.

Dr. Pearson gave a few notes on the colouration of animals, after which Rev. Father M. J. Le Goc, O.M.I., delivered a lecture on "Social Life among Ants."

Fifteenth General Meeting.

The Fifteenth General Meeting of the Society was held in the Colombo Museum Library on December 17, 1915, with Dr. Joseph Pearson in the Chair.

The Chairman proposed alterations to rule 9. There were two alterations of the same rule, and he combined both in one resolution. (*a*) Instead of the first sentence, read "The subscription to the Society shall be Rs. 5 per annum, which will fall due on January 1 of each year." (*b*) Instead of last sentence, read "In the case of new members, the subscription will fall due on the date of election, and such election will not be confirmed until the first annual subscription or life-membership subscription is paid."

The Ven. the Archdeacon said he understood the alterations proposed were the raising of the subscription from Rs. 3 to Rs. 5, and in the case of new members their subscriptions fall due on the date of election. Was the Committee authorized to confirm the election? The Chairman said in future, if the proposed rule was adopted, no elected member would be considered a member of the Society until he had paid his subscription. The subscription of Rs. 3 was only a temporary measure, as they did not know exactly how the finance of the Society would stand. He thought that Rs. 5 per annum would meet the case. Eighty-seven members who had been elected had not paid their first subscription. Under the proposed rule it would be easy for members to forward cheque for Rs. 10, subscription for two years.

Mr. Macready seconded the proposition.

Mr. Holsinger proposed an amendment that the two parts of the resolution be taken separately.

The Ven. the Archdeacon seconded. Carried.

The Ven. the Archdeacon suggested a verbal alteration in the second part of the Chairman's resolution. Instead of the words "will not be confirmed" he suggested the words "will not be complete."

Mr. C. T. Symons seconded.

The two proposals embodying the amendments were put to the meeting and carried.

The Chairman next proposed new rule for foreign members as follows :—

Non-residents of the Island who are distinguished men of science, and who have made important researches in Natural History, particularly of Ceylon and the surrounding seas, may be elected as foreign members without payment of fee or subscription. Such foreign members will have all the privileges of an ordinary member, except that they cannot serve on the Council of the Society. Ordinary members of the Society will be eligible for election as foreign members after having given up residence in Ceylon, but no part of a life-member's subscription will be refunded.

The Ven. the Archdeacon seconded. Carried.

Mr. C. T. Symons then read a paper on "The Habits of some Gregarious Shore Crabs." The Chairman having offered some remarks on the Paper, next explained a few exhibits which were put on view.

Sixteenth General Meeting.

The Sixteenth General Meeting of the Society was held in the Colombo Museum Library on January 28, 1916. His Excellency Mr. R. E. Stubbs presided.

Dr. W. J. Dakin, Professor of Biology, University of Western Australia, delivered a lecture, illustrated by lantern slides, on "Whaling in Australian Waters." Dr. Pearson offered a few comments.

Seventeenth General Meeting.

The Seventeenth (Fourth Anniversary) General Meeting of the Society was held in the Colombo Museum Library on March 28, 1916, at 5.15 P.M., with Dr. A. Nell in the Chair.

The report of the Honorary Secretaries and Treasurers and the accounts for the past year were adopted and passed unanimously.

A vote of thanks was passed to Mr. J. F. Sibbald for kindly auditing the accounts.

The following were elected as Office-bearers for 1916 :—

Patron.

His Excellency Sir John Anderson, G.C.M.G., K.C.B.

President.

The Hon. Mr. R. E. Stubbs, C.M.G., F.Z.S.

Vice-Presidents.

F. M. Mackwood, Esq.
Sir S. D. Bandaranaike, Kt., C.M.G.
Dr. A. Nell, M.R.C.S., L.M.S.
Dr. Joseph Pearson, D.Sc., F.R.S.E., F.L.S.

Council.

T. Petch, Esq., B.A., B.Sc.
O. S. Wickwar, Esq.
The Ven. the Archdeacon of Colombo.
The Hon. Mr. Harry Creasy.
The Rev. Father M. J. Le Goc.
C. F. S. Baker, Esq.

Joint Honorary Secretaries and Treasurers.

W. A. Cave, Esq.
C. T. Symons, Esq., B.A., F.R.G.S.

The following amendments to rule 21 relating to the election of foreign members was carried unanimously. The rule will now read :—

Non-residents of the Island who are distinguished men of science, and who have made important researches in Natural History, particularly of Ceylon and the surrounding seas, may be elected *on the recommendation of the Council* as foreign members without payment of fee or subscription. Such foreign members will have all the privileges of an ordinary member, except that they cannot serve on the Council of the Society. Ordinary members of the Society will be eligible for election as foreign members after having given up residence in Ceylon, but no part of a life-member's subscription will be refunded (words italicized constituting the amendment).

Under rule 21 the following foreign members were then elected :—

E. E. Green, Esq., late Government Entomologist.
Dr. A. Willey, F.R.S., Professor of Zoology, McGill University, Montreal.
Dr. J. C. Willis, late Director of Royal Botanic Gardens, Peradeniya.
Dr. N. Annandale, Superintendent, Indian Museum, Calcutta.
Professor Herdman, F.R.S., Professor of Zoology, University of Liverpool.
Professor J. Stanley Gardiner, F.R.S., Professor of Zoology, University of Cambridge.

Dr. Pearson then gave a lecture on the subject of Jelly Fishes, and several specimens were exhibited.

NOTES ON CEYLON WATER BIRDS.

Part II.

By W. E. Wait, M.A., M.B.O.U.

(*With a Plate.*)

THE present paper is the second instalment of the rough draft for the handbook on the birds of Ceylon. It comprises the remainder of the water birds, including the Pelicans, Cormorants, and allied species ; the Ibises, Storks, and Herons ; the Flamingoes ; the Geese, Ducks, and Grebes.

Order **STEGANOPODES.**

Pelicans, Cormorants, &c.

Birds of the present order are readily distinguished by having all four toes webbed, the hallux or hind toe, which is long, being turned inwards and forwards and connected with the three front toes. In their structure the *Steganopodes* show a connection with the birds of prey, and differ widely from the Gulls and Waders. Their nestlings when hatched are helpless, and remain for some time in downy plumage, during which stage they are fed by their parents.

Of the five families into which the order is divided, four contain but a single genus ; the fifth consists of two genera, each raised to the rank of a sub-family. These five families differ considerably in outward appearance, but all are fish feeders. The Pelicans and Cormorants are found equally on inland waters and round the coast ; the Frigate Birds, Gannets, and Tropic Birds are marine, and mainly oceanic.

The families may be differentiated as follows :—

A.—Tail rounded ; bill long, flattened, and provided underneath with an enormous pouch.

Pelecanidæ (Pelicans).

B.—Tail forked ; the web between the toes deeply scalloped ; bill straight and sharply hooked at the tip.

Fregatidæ (Frigate Birds).

C.—Tail rounded, the feathers very stiff ; bill slender, either hooked or pointed ; plumage mainly black.

Phalacrocoracidæ (Cormorants and Darters).

D.—Tail long and wedge-shaped ; bill stout and pointed ; nostrils almost invisible externally.

Sulidæ (Gannets).

E.—Tail long, the central feathers greatly exceeding the rest ; bill stout and pointed, the nostrils plainly visible.

Phaëthontidæ (Tropic Birds).

Family Pelecanidæ.

Genus **Pelecanus.**

Pelicans.

The Pelicans are a familiar group of large birds with enormous bills, which are adapted for fishing. The upper mandible is very long and flattened, and terminates in a strong "dertrum," or nail, at the tip. At each side, running down the length of the bill, there is a narrow groove from the nostrils, which are very small and placed at the base. The lower mandible is a mere flexible pointed arch forming a rim to the large pouch of naked skin, which is used as a net to scoop up fish. The wings are long and ample. Pelicans are found in warm climates all round the world, frequenting marshes, rivers, lagoons, or sometimes the sea. They can both fly and swim well, but do not dive, and are bad walkers, not often seen on land. Only one species is found in Ceylon.

PELECANUS PHILIPPENSIS (Blanford, Vol. IV., p. 335).
PELECANUS PHILIPPINENSIS (Legge, p. 1198).

The Spotted-billed Pelican.

Description.—Breeding plumage : mainly white, the feathers of the crown and neck short and rather fluffy, with dark bases ; there is a slight crest and a sort of mane, brownish in colour, down the hind-neck ; the scapulars and feathers of the wing coverts and upper tail coverts have black shafts ; the lower back, flanks, vent, and lower tail coverts are tinged vinaceous pink. The primaries and primary coverts are dark brown ; outer half of secondaries brown ; tail lighter brown, the feathers white at the base.

Adults out of breeding plumage and immature birds lack the rosy tint on the lower back, flanks, and under parts. The feathers of the head and neck are white with black bases ; wings and tail brown ; under parts whitish-brown. The lesser wing coverts are short, instead of being long and pointed.

Bill flesh-coloured, with bluish spots on the sides of the upper mandible ; pouch dull purple with blue-black markings ; iris pale yellow or almost white ; legs and feet dark brown.

Length 57 ; wing 22 ; tail 8 ; tarsus 3·5 ; bill from gape 14 ; females slightly smaller.

Distribution.—Found wherever there are suitable sheets of water throughout the north and east of the Island as far south as Hambantota. Occurs in similar places all over India, Burma, and the East.

Habits.—This species is found often in large flocks on brackish lagoons and large tanks, but is commoner near the sea than far inland. It breeds from about December to March, building a large stick nest in high trees. It generally lays three chalky-white eggs measuring about 3 by 2·15.

Family FREGATIDÆ.

Genus **Fregata.**

Frigate Birds.

These are oceanic birds of dark plumage, whose enormously long pointed wings and slender build give them a power and speed of flight unsurpassed even by the Albatross. The bill

is long and sharply hooked at the tip ; the upper mandible is flattened; the nostrils are situated near the base of the bill; the nasal grooves are well marked, and run to the nail at the tip. The chin is naked and pouched, the tarsus very short and feathered, the web between the toes deeply scalloped and the tail deeply forked. The birds obtain their food while on the wing, largely, like the Skuas, by chasing Gulls and other sea birds and foreing them to drop their catch, but also by capturing flying fish or by swooping down on such fish, crustaceans, and young turtles as show themselves on the surface of the water. The various species range over the tropical seas and breed on oceanic islands, constructing a stick nest resting on rocks or in bushes. They lay one or two pure white eggs. Two species have occurred as stragglers on the shores of Ceylon.

Key to Ceylon Fregatidæ.

A.—Bill from gape 4·5 or over ; wing 22 or over.
Fregata aquila (Man-of-war Bird).

B.—Bill from gape under 4 ; wing about 20.
Fregata ariel (Smaller Frigate Bird).

FREGATA AQUILA (Blanford, Vol. IV., p. 338 ; Legge, p. 1204).

Frigate Bird ; Man-of-war Bird.

Description.—Male : black all over ; the head, neck, scapulars, and back glossed with green and purple.

Female : back brownish-black ; feathers of lesser and medium wing coverts lighter brown with a dark shaft stripe and pale edges ; breast and sides of abdomen white.

Immature birds resemble the female, but have the head, neck, breast, and middle of the abdomen white ; the flanks are darkish brown.

Bill bluish-gray ; iris dark brown ; naked skin of throat red ; legs and feet red.

Length about 40 ; wing 22 to 25 ; tail 15 to 19 ; depth of fork 10 to 11·5 ; tarsus ·08 ; bill from gape 4·5 to 5·5. Females are rather smaller than males.

Distribution.—The British Museum series includes one skin, that of a moulting bird, from Ceylon. The species ranges all round the seas of the tropics.

FREGATA ARIEL (Blanford, Vol. IV., p. 338).
FREGATA MINOR (Legge, p. 1203).

The Smaller Frigate Bird.

Description.—Similar to that of the last species, but the bird is smaller, while the male has an irregular white patch on the flanks, and the female a whitish collar all round the neck.

In young birds the breast is sooty-brown; the abdomen, head, and neck white.

Bill gray; iris red, black in young birds; naked skin of throat red; feet black.

Length about 30; wing 20; tail 13; depth of fork 6 to 7·5; tarsus ·75; bill from gape 3·75.

Distribution.—A not uncommon straggler to our shores; generally observed on the west coast. The species ranges over the tropical parts of the Indian Ocean, and in the Pacific from the China Seas to New Caledonia.

Family PHALACROCORACIDÆ.

Cormorants and Darters.

The present family are birds either of medium or fairly large size and of rather heavy build; their plumage is wholly or mainly black, especially on the upper parts. The neck is long; the bill long and slender; the tail feathers are stiff and harsh. The wings are of moderate length; the birds rise heavily, but have a powerful flight. They are all voracious fishers, diving and often swimming for some distance under water after their prey. After coming out of the water they have a curious habit of alighting on a low rock or tree stump, and as it were hanging themselves out to dry with their wings half extended. The nest is a platform of twigs, more or less lined with grass or water weed, and placed on low trees or ledges of rock. The eggs are narrow ovals, with an inner texture of green and a rough outer layer of chalky-white.

The family is divided into two sub-families, distinguishable by the shape of the bill, as follows:—

A.—Bill hooked at the tip, edges of the mandibles smooth.
Phalacrocoracinæ (Cormorants).

B.—Bill straight and pointed, edges of the mandibles serrated.
Plotinæ (Darters).

Sub-family *Phalacrocoracinæ*.

Genus **Phalacrocorax.**

Cormorants.

A large genus, containing nearly forty species, distributed almost all over the world. Three species occur in Ceylon. As mentioned above, the bill is hooked at the tip. The nostrils are concealed by the skin at the base of the bill; the nasal grooves are long and narrow. There is a naked gular pouch extending almost to the end of the lower mandible, the sides of which are joined together only at the tip.

Rough Key to Ceylon Species.

A.—Fourteen feathers in tail; wing 12 inches or over; plumage across the throat from eye to eye white.

P. carbo (Large Cormorant).

B.—Twelve feathers in tail.

(*a*) Wing about 10·5.*

P. fuscicollis (Indian Shag).

(*b*) Wing about 7·5.

P. javanicus (the Little Cormorant).

Phalacrocorax carbo (Blanford, Vol. IV., p. 340; Legge, p. 1182).

The Large Cormorant.

Description.—Adults: black glossed with green or purple; a white band across the throat from eye to eye adjoining the naked skin of the face; a small pointed crest on the head and nape; feathers of the upper back and wing coverts dark brown edged with black; wing quills bronzed black.

In the breeding season adults assume a patch of white low down on each flank; the head and neck are streaked with long narrow white plumes, which often almost hide the black plumage underneath.

* Abnormal specimens sometimes occur with fourteen tail feathers, but they have no white facial band.

Immature birds have the top of the head and neck finely streaked with rather lighter brown; the middle of the throat, the breast, and the middle of the abdomen are white, which becomes increasingly streaked with black until the full adult plumage is attained. Bill dark on the upper mandible and on the tip of the lower, remainder pale; iris green; naked skin round the eye dusky yellow, on the throat bright yellow spotted with black; legs and feet black.

Length 32; wing 12 inches or more; tail 7; tarsus 2·3; bill from gape 3·75.

Distribution.—There appears to be some confusion in the records concerning the occurrence in Ceylon of this species and the next. Legge does not appear to have obtained specimens of either, and thought that some large Cormorants seen by him on Minneri tank were *P. carbo*, whereas they were probably *P. fuscicollis*. The present species certainly occurs during the north-east monsoon in the north of the Island, where it may be met with on lagoons near the coast. It has not yet been ascertained if it remains all the year round. It is found on the coast, large rivers, and suitable sheets of water throughout India and Burma, and breeds in a good many localities. Its range extends over almost the whole of the Old World, also Australia and the east coast of North America.

Habits.—The birds often scatter during the day, but roost and breed in large companies. The nest is placed on trees growing in the water or on rocks. The eggs may be four to seven in number, and measure about 2·50 by 1·60.

PHALACROCORAX FUSCICOLLIS (Blanford, Vol. IV., p. 341; Legge, p. 1182).

The Indian Shag.

Description.—Adults: black glossed with green or purple; the black of the face plumage extends right up to the naked facial skin, there being no white border. There is no crest. On the side of the head are a few minute white specks. Out of the breeding season the throat is more or less speckled with white; in breeding plumage the birds assume a minute tuft of two or three white feathers on each side of the neck behind the ear.

Young birds are brown above; the throat, breast, and abdomen are mostly white, becoming more and more streaked with brown as age increases.

Bill dark horny-brown, often lighter underneath; iris greeny-blue; naked skin round the eye black, on the throat yellow; legs and feet black.

Length 25; wing about 10·5; tail 6·5; tarsus 1·8; bill from gape 3·25.

Distribution.—Occurs on Minneri and other large tanks in the north of the Island.

Four specimens shot by me out of different flocks on Minneri tank all belonged to this species.

It is also sparingly distributed in the Hambantota District and probably in the Eastern Province. I have shot the bird in August, so it would appear to be resident. Elsewhere it occurs in Sind, Central India, and the Carnatic, and more abundantly in Burma.

Habits.—This species occurs in fairly large flocks on some of the larger inland sheets of water. It is a wary bird, and seldom comes within range of the shore. As yet no nesting place appears to have been discovered in Ceylon. In India the birds breed in colonies on low trees standing in the water. The eggs are rather smaller than those of *P. carbo*, and measure about 2·1 by 1·4.

PHALACROCORAX JAVANICUS (Blanford, Vol. IV., p. 342).

PHALACROCORAX PYGMÆUS (Legge, p. 1191).

The Little Cormorant.

Description.—Black slightly glossed with green; wing coverts and scapulars dark silver-gray, each feather bordered with black. Out of the breeding season the throat adjoining the naked skin is white; in the breeding season some scattered white feathers appear on the crown and sides of the head, with a few white filaments on the sides of the neck.

Bill brown, livid purple in the breeding season; iris greenish-brown to greenish-white; the naked skin of face and throat and the legs blackish out of the breeding season, livid at breeding time.

Length 20; wing 7·5; tail 5·50; tarsus 1·3; bill from gape 2·2.

Distribution.—Common all over the low-country wherever there are tanks or marshes. Found throughout India and Burma, the range extending eastward through Malaya to the Dutch East Indies.

Habits.—The birds scatter during the day, but sometimes on large tanks unite in huge parties which form across the water and drive the fish before them. They roost and breed in big colonies on low trees. They breed chiefly during the rains of the north-east monsoon, but in favourable localities several broods are reared. The eggs are three to five in number, and measure about 1·75 by 1·15.

Sub-family *Plotinæ*.

Genus **Plotus.**

Darters.

The Darters are a tropical genus, differing from the Cormorants in having a long straight pointed bill with no nasal grooves. The head and neck are very slender, the latter being long and with a bend in the vertebræ, like the neck of a Heron. There is no naked pouch under the chin. Only one species occurs in Ceylon.

Plotus melanogaster (Blanford, Vol. IV., p. 344; Legge, p. 1194).

The Indian Darter, or Snake Bird.

Description.—General colour glossy black; head and hind-neck blackish-brown with paler edges to the feathers; a fine white streak above the eye; the feathers of the upper back with brown edges; conspicuous silvery white shaft-streaks on the scapulars, wing coverts, and tertiaries; the innermost tertiary and the four central tail feathers have the outer web corrugated. The face, throat, and upper part of the fore-neck white, a white stripe extending from the bill above the gape for some way down the side of the neck.

Immature birds are sooty-brown on the under parts and lower back; the white shaft-stripes on the upper plumage are tinged with yellow; the neck is pale brown, whitish underneath.

Bill brownish on the upper, yellowish on the lower mandible; iris yellow; legs black.

Length 36; wing 13·5; tail 10; tarsus 1·5; bill from gape 3·8.

Distribution.—Common on tanks all through the dry zone of the low-country. Found throughout India, Burma, and the whole of the Oriental region.

Habits.—Like the Cormorants, this bird feeds entirely on fish. It swims with only the head and neck out of water, and can travel for a long way under the surface. It is very wary, and generally keeps well out of range. It breeds in colonies in the early part of the year. The nest and eggs resemble those of Cormorants. The eggs are three or four in number, and measure about 2·10 by 1·35.

Family Sulidæ.

Genus **Sula.**

Gannets and Boobies.

The genus contains about six species, comprising the more active Gannets which are found in the temperate zone and the more sluggish Boobies which range round the tropics.

The bill is powerful and pointed, curving slightly at the end. The skin of the face and of the throat adjoining the bill is naked; the nostrils are placed at the base of the bill, being minute even in young birds and completely closed in adult specimens. The wings are long and pointed, the tail long and wedge-shaped.

The Boobies feed mainly on flying fish and wander throughout the tropical seas, but are chiefly found about reefs and islands. They breed on isolated rocky islands, laying one chalky-white egg with an inner texture of green.

Two species have occurred in Ceylon as occasional stragglers.

Rough Key to Ceylon Species.

A.—Fourteen tail feathers ; wing about 15 ; feet pale yellow.
Sula leucogaster (the Booby).

B.—Sixteen tail feathers ; wing about 16·5 ; feet slaty.
S. cyanops (the Masked Booby).

SULA LEUCOGASTER (Blanford, Vol. IV., p. 346).

SULA LEUCOGASTRA (Legge, p. 1177).

The Booby, or Brown Gannet.

Description.—Head, neck, all upper parts, and upper breast chocolate-brown, with a deeper bluish tinge on the wing quills and tail feathers ; the lower breast and abdomen with the lower tail coverts white ; wing lining brown with some white.

Immature birds are rather lighter than adults on the upper plumage, and the lower parts are pale brown with whitish tips to the feathers.

Bill creamy white ; iris white or very pale ; the pouch and naked skin of the face is pale, with a blue, green, or yellow tinge.

Length 28 to 32 ; wing 15 ; tail 8 ; tarsus 1·8 ; bill from gape 4·5.

Distribution.—A straggler to Ceylon during the north-east monsoon. It has been recorded on several occasions from Arippu, Colombo, Kalutara, and Galle. Occasionally met with on the coasts of India and Burma, its range extending throughout tropical seas all round the world.

SULA CYANOPS (Blanford, Vol. IV., p. 347 ; Legge, p. 1180).

The Masked Booby.

Description.—Plumage white, except the wing quills, greater coverts, and tail feathers, which are blackish-brown.

Immature birds are brown throughout, with a few paler feathers on the breast and abdomen ; the wing lining is mostly white with some brown.

Bill yellow or greenish-yellow ; iris yellow, reddish, or greenish-yellow ; pouch and naked skin of face dark slate-colour ; legs and feet slate-gray, the webs darker.

Length 32 ; wing 16·5 ; tail 7·25 ; tarsus 2·2 ; bill from gape 5.

Distribution.—There is one specimen in the Colombo Museum, which came from the coast of the North-Western Province. The bird has occasionally been obtained off the west coast of India, and, like the former species, ranges throughout tropical seas.

Family PHAËTHONTIDÆ.

Genus **Phaethon.**

Tropic Birds.

The Tropic Birds are the most graceful members of the order. In size and appearance they are not unlike the larger species of Terns.

The plumage is satiny and mainly white; the young are barred on the back with black, and in one Indian species the barring persists in the adult plumage.

The bill is stout, gently curved, and pointed; the nostrils are linear, and placed near the base of the bill. The wings are very long, and the first primary is the longest. The two middle tail feathers are produced into long narrow streamers, greatly exceeding the other tail feathers, which are short. The birds spend a great part of their time far out at sea, and breed on oceanic islands, where they nest in holes in the rocks, laying a single egg of reddish-white with brownish-purple markings. Four or five species are known, ranging over the tropical ocean. Two are said to have occurred in Ceylon.

Rough Key to Ceylon Species.

A.—Fourteen tail feathers; bill 3·25; back barred in adults, as well as in young birds.

Phaëthon indicus (Short-tailed Tropic Bird).

B.—Twelve tail feathers; bill 2·80; back white in adults.

P. flavirostris (White Tropic Bird).

PHAËTHON INDICUS (Blanford, Vol. IV., p. 349; Legge, p. 1173).

The Short-tailed Tropic Bird.

Description.—Plumage satiny white, barred on the upper parts from the neck to the tail coverts with black; the wing coverts and tertiaries are almost wholly black. There is a

crescent-shaped black patch in front of the eye, and a broken curved black streak running from behind the eye to the nape. The first five primary quills are black on the outer and on half of the inner web; the remainder of the inner web and the tip of the quill are white. The flanks are barred with black. The middle tail feathers or streamers are under 12 inches long, their shafts are black at the base and white at the tip.

Bill pale orange-red, dusky on the margins; iris blackish-brown; legs and feet yellowish-white, with some black on the inner toes and their webs.

Length, including streamers, up to 21; wing 11·5; tail 7·5 to 12; tarsus 1; bill 3·25.

Distribution.—Rather a doubtful inclusion in our list, but birds seen by Holdsworth in the Gulf of Mannar probably belonged to this species. It occurs on the Indian seas, from the straits of Malacca to the Red Sea.

PHAËTHON FLAVIROSTRIS (Blanford, Vol. IV., p. 350; Legge, p. 1172).

The White Tropic Bird.

Description.—Plumage in adults satin white; a black crescent-shaped patch in front of the eye and a black stripe behind the eye to the back of the head. There are two broad black bands on the wings: the inner one on the median coverts and tertiaries, the outer on the first five or six primaries. The streamers are long and white, with black shafts which whiten towards the tip. There is a wash of gray-black on the flanks.

Immature birds are barred with black on the upper plumage.

Bill pale yellow; iris brown; legs and base of the toes dull yellow; rest of foot black.

Length, including streamers, up to 30; tail up to 18; wing 10·75; tarsus ·9; bill 2·8.

Distribution.—Specimens have been obtained at Chilaw and Colombo, others have been seen off the west coast. Occasionally reported from the Indian coast, and once a bird was caught 170 miles inland in Cachar, north-east India. The species ranges all round the tropical seas.

Order **TUBINARES.**

Family Procellariidæ.

Petrels.

The Petrels are oceanic birds, which generally live far from land, resting on the water, and resorting to the shore merely for breeding purposes. In outward form they are not unlike Gulls, but differ from them in many characteristics of their structure. They may be told apart from all other orders by their nostrils, which terminate externally in tubes. These tubes may be united or separate, the nostrils in some species having but a single orifice, in others a double orifice separated by a septum. The upper mandible of the bill is deeply grooved, and generally sharply hooked at the tip. The front toes are well webbed; the hind toe or hallux is small, often represented by a mere claw, or sometimes absent. The wings are long in most forms, and the flight swift and powerful, the birds generally skimming near the surface of the waves. They feed on small floating forms of marine life and on small fish. Many of them follow in the wake of ships and feed on the refuse thrown overboard.

Several different methods of classification have been adopted within the order. Blanford, largely for the sake of convenience, seeing that the birds found in Indian seas are limited to rare stragglers of a few species, has left all the Indian genera in one family—*Procellariidæ*.

Three species, each representing a genus, have occurred within Ceylon limits.

Rough Key to Ceylon Procellariidæ.

A.—Size small; wing under 7 inches; nostrils with a single external orifice.

Oceanites oceanicus (Wilson's Stormy Petrel).

B.—Size medium; wing 11 inches; nostril tube with a double external orifice separated by a broad septum; plumage dark brown.

Puffinus chlororhynchus (Green-billed Shearwater).

C.—Size medium ; wing 10·25 ; nostril tube terminating in a single orifice, but divided within ; plumage black and white.

Daption capensis (the Cape Petrel).

OCEANITES OCEANICUS (Blanford, Vol. IV., p. 354 ; Legge, p. 1056).

Wilson's Stormy Petrel.

Description.—Upper parts sooty black ; the forehead and under parts slightly browner and paler ; the greater wing coverts gray-brown ; the upper tail coverts and hindmost part of the flanks white.

Bill black ; iris almost black ; legs and feet black, the centre of the webs between the toes pale yellow.

Length 7·5 ; wing 6·25 ; tail 3 ; tarsus 1·3 ; bill from gape ·65.

Distribution.—Legge records the fact that a small black Petrel with white tail coverts had occasionally been seen round the coast of Ceylon, and that it was probably this species, which occurs in the Indian and Atlantic Oceans and is not rare in the seas round India. Recently, in October, 1916, Mr. W. A. Cave came across some small petrels of a similar description skimming close to the water in rough weather at the mouth of Colombo harbour. On several occasions he came within a few yards of the birds, and identified them with practical certainty as belonging to the present species.

PUFFINUS CHLORORHYNCHUS (Blanford, Vol. IV., p. 356 ; Legge, p. 1054).

Green-billed Shearwater.

Description.—Dark smoky brown above, paler beneath, with a grayish tinge, which is most pronounced on the chin and throat.

Bill dusky greenish ; iris almost black ; legs and feet fleshy-white.

Length 16 ; wing 10·75 ; tail 5 ; tarsus 1·8 ; bill from gape 1·8.

Distribution.—Has been obtained on several occasions between Panadure and Colombo, and has been seen by Capt. Legge at Trincomalee. It is found in the Indian Ocean, the South Pacific, and the seas round Australia and New Zealand.

DAPTION CAPENSIS (Blanford, Vol. IV., p. 357 ; Legge, p. 1056).

The Cape Petrel.

Description.—The whole head with the back and sides of the neck brownish-black ; the remainder of the upper parts white with a broad black tip to each feather, except on the primary coverts and lesser wing coverts, which are wholly black. Most of the outer web of the primary quills and the tip of the inner web are black, the rest white ; tail white with a broad black tip. The under plumage is white, mottled on the throat and lower tail coverts with dusky brown.

Bill black ; iris brown ; legs and feet blackish-brown, with light patches on the side of the toes.

Length 16 ; wing 10·25 ; tail 4 ; tarsus 1·7 ; bill from gape 1·6.

Distribution.—A single specimen was obtained many years ago in the Gulf of Mannar. The species is abundant in the southern hemisphere, but rare north of the equator.

Order **HERODIONES.**

Ibises, Spoonbills, Storks, and Herons.

These are all wading birds found about marshes and swamps. They resemble the Limicolæ, or non-perching waders, in having the neck, bill, and legs long, and the hock or tibia usually bare for some distance above the joint with the tarsus. They differ from them widely, however, in many points of their structure, the most noticeable outward point of distinction being the hind toe, which in the present order is well developed and set on the foot in the same plane as the other toes, thus enabling the birds to perch firmly and to roost in trees. Again, in the manner of nidification and in the character of the nestlings they show more relationship with the

birds of prey and the Steganopodes. The nest is usually a platform of twigs placed in a tree, the eggs are, with few exceptions, unspotted, while the young are helpless when hatched, and require to be fed for some time by the parents.

The Indian members of the order fall into three sub-orders, characterized outwardly as follows :—

I.—Bill long, either curved downwards or spoon-shaped.

Plataleæ (Ibises and Spoonbills).

II.—Bill long, stout, with no distinct nasal groove, and generally straight.

Ciconiæ (Storks).

III.—Bill generally straight, slender, and pointed ; a distinct groove running from the nostrils down each side of the upper mandible ; claw of middle toe furnished with a comb.

Ardeæ (Herons).

Sub-order PLATALEÆ.

Ibises and Spoonbills.

The Ibises and Spoonbills are closely related, but have been placed in separate families owing to the great difference in the beak, the bill curving downwards in the *Ibididæ* or Ibises, and being straight and spoon-shaped in the *Plataleidæ* or Spoonbills.

Family IBIDIDÆ.

Ibises.

Ibises are medium-sized birds, with long curving bills and legs of comparatively moderate length, the bill being considerably longer than the tarsus. The nostrils are placed near the base of the bill in a groove which extends down the side of the upper mandible. Their flight is characteristic : the neck is outstretched, as with the stork, but the wing beats are quicker, and there are frequent intervals of gliding with the wings held steady. They are frequently confused with the Curlews, but may be distinguished at once by their having long hind toes and perching in trees.

Two species, placed in separate genera, are found in Ceylon.

Rough Key to Ceylon Ibididæ.

A.—Plumage white ; head and neck naked in adults.

Ibis melanocephala (White Ibis).

B.—Plumage coloured ; head and neck feathered, except in front of the eye.

Plegadis falcinellus (Glossy Ibis).

IBIS MELANOCEPHALA (Blanford, Vol. IV., p. 361 ; Legge, p. 1106).

The White Ibis.

Description.—Plumage white ; the tertiaries slate-gray at the ends ; the primaries generally mottled with brown at the tips ; the skin of the head and neck black and naked in adults. In breeding plumage the tertiaries grow long and soft, and there are a few plumes on the upper breast.

Young birds have blackish-gray feathers on the head and neck as far forward as the eyes.

Bill black ; iris red-brown ; legs and feet black ; wing skin scarlet.

Length 30 ; wing 14 ; tail 5 ; tarsus 4 ; bill from gape 6·5.

Distribution.—Scattered throughout the northern half of the Island and down the east side as far south as Tangalla. Occurs throughout India and Burma, and ranges eastward to China and South Japan.

Habits.—This species may be found in flocks here and there round the large tanks or in marshes, feeding on molluscs, worms, &c.

The birds breed in colonies, mainly during the north-east monsoon rains, but occasionally later, as I have found young unable to fly in July. The nests are fairly large platforms of twigs placed on trees growing in the water. Three eggs are generally laid ; they are white elongated ovals, sometimes delicately spotted with brown, and measuring on an average 2·57 by 1·65.

PLEGADIS FALCINELLUS (Blanford, Vol. IV., p. 364 ; Legge, p. 1109).

The Glossy Ibis.

Description.—Head, wings, and tail deep brown glossed with bronze-green and purple ; remainder of upper plumage dark chestnut ; a patch of bright maroon-red on the scapulars and smaller wing coverts ; the breast and abdomen lighter chestnut.

Out of the breeding season the red patch disappears from the wing coverts and scapulars, and the head and neck become blackish-brown streaked with white.

Young birds have sooty-black heads and necks, and brownish-black under parts.

Distribution.—Found about tanks in the low-country, and by the lagoons of the north and east coasts. Mainly resident and commonest in the north, where the numbers are probably augmented during the north-east monsoon by migrants. It occurs throughout the better-watered plains of India and Burma mostly as a winter visitor. Its range extends all round the warmer parts of the world.

Habits.—Generally met with in flocks, but not very common, and usually very shy. The birds breed in small colonies in trees near water, making smallish stick nests. The eggs are oval, pointed at each end ; the colour is a beautiful blue-green, and the surface is slightly pitted. Three are usually laid ; average size 2 by 1·40.

Family PLATALEIDÆ.

Genus **Platalea.**

Spoonbill.

Only one species occurs within our limits ; in form it resembles the Ibises, but is larger, more slender, and with longer legs. The bill is long and very flat, broadening and curving downwards at the extreme tip, like the wide handle of a huge spoon. The nostrils are placed near the base of the bill, and the nasal grooves run close to the edge of the mandible right up to the tip ; half of the tibia is naked ; the toes are long, bordered by membrane, and slightly webbed at the base.

PLATALEA LEUCORODIA (Blanford, Vol. IV., p. 366 ; Legge, p. 1096).

The Spoonbill.

Description.—Plumage white ; adults have a patch of cinnamon on the lower neck. In the breeding season a crest of pointed plumes is assumed. The skin of the face in front of the eye is naked and yellow ; the skin of the throat is also naked and yellowish-red.

In young birds the primary quills have black shafts, and the outermost quills are tipped with black.

Bill in adults black, yellow at the tip ; in young birds mainly yellow ; iris red ; legs and feet black.

Length 33 ; wing 15 ; tail 5 ; tarsus 6 ; bill from gape 8.

Distribution.—Met with in small flocks on large tanks and marshes in the wilder parts of the dry zone. Occurs here and there on the well-watered plains of the Indian peninsula, but unknown in Burma ; ranges from Central Europe to East Africa and through Central Asia to China.

Habits.—An extremely shy bird. The species is resident, and breeds about March in small colonies by the water-side. The nest is a large massive structure of sticks placed in a tree. The eggs are two to five in number, chalky-white ovals with a few brown blotches ; average size about 2·5 by 1·8.

Sub-order CICONIÆ.

Family CICONIIDÆ.

Storks.

The Storks are a familiar and widely-distributed family of large birds. Many of them are migratory, breeding in temperate regions and wintering southwards ; others are resident in the warmer regions of the world. The neck is long ; the bill long, stout, pointed, and generally straight. The nostrils are placed at the base of the bill, but there is no distinct nasal groove. The structure of the windpipe is peculiar, the voice muscles being absent, so that the birds are dumb. The legs are long, the measurements of the tarsus and of the bill from gape to tip being equal or almost equal ; the lower half of the tibia is naked. The toes are fairly short but broad, and

furnished with broad short claws. The tail is short; the wings are long and broad; the flight is ponderous, but powerful, with slow, steady wing beats, the neck and legs being held outstretched. Storks frequently soar high in the air, wheeling in slow circles with expanded wings. Their food consists of small fish, frogs, reptiles, molluscs, large insects, or even mice and such small animals. Six species, distributed among as many genera, are found in Ceylon. Three of them are decidedly rare.

Rough Key to Ceylon Ciconiidæ.

A.—Length about 46 inches; bill straight; naked skin on face confined to a ring round the eye.
Ciconia alba (White Stork).

B.—Length about 32 inches; bill straight; forehead and cheeks naked.
Dissura episcopus (White-necked Stork).

C.—Length about 52 inches; bill slightly curved up at the end; head and neck completely feathered.
Xenorhynchus asiaticus (Black-necked Stork).

D.—Length about 54 inches; bill straight; head and neck almost naked.
Leptoptilus javanicus (Hair-crested Stork).

E.—Length about 40 inches; bill curved downwards at the tip; head and throat naked.
Pseudotantalus leucocephalus (Painted Stork).

F.—Length about 32 inches; forehead feathered; face and throat naked; bill in adults with a gap between the mandibles.
Anastomus oscitans (the Openbill).

CICONIA ALBA (Blanford, Vol. IV., p. 369; Legge, pp. 1119, 1226*a*).

The White Stork.

Description.—Plumage white; the wing quills with the primary and larger secondary coverts black with a slight green or purple gloss; the secondary quills more or less frosted with white.

Bill blood-red; iris brown; naked skin round the eye black; legs red.

Length about 46; wing 24; tail 9·5; tarsus about 8; bill from gape 8.

Distribution.—An extremely rare migrant; has been seen in the south-east of the Island and, contrary to its usual habits, once found breeding in 1880 in the North-Western Province. Fairly common during the winter in northern India, rare in the south, and unknown in Burma. Breeds in temperate climates from Holland to Central Asia, wintering all over Africa and in South-western Asia.

Habits.—In its winter quarters this species is generally met with in flocks in open fields usually away from water. It feeds on locusts, reptiles, and small animals. The nest is a large structure of sticks placed in a tree or on a building. The eggs are three to five in number, pure white, and measuring about 3 by 2·15.

DISSURA EPISCOPUS (Blanford, Vol. IV., p. 370; Legge, p. 1119).

The White-necked Stork: Parson Stork.

Description.—The crown black; neck, lower abdomen, and tail white; remainder of plumage black, glossed with purple on the upper back and breast, and with bronze-green on the lower back and upper abdomen.

Bill black, tinged with red on the ridge and along the edges; iris crimson; bare skin of the face lead-coloured; legs and feet red.

Length 32; wing 18·5; tail 7·5; tarsus 6·5; bill from gape 6. Ceylon birds appear to be rather smaller than Indian.

Distribution.—Fairly common in the dry zone of the low-country. It is found almost throughout India and Burma in the plains, and extends eastwards to Cochin-China and the Dutch East Indies.

Habits.—In Ceylon this Stork appears to prefer the neighbourhood of abandoned or secluded tanks in the heart of the jungle.

The birds generally nest apart, not in colonies, making a large structure of twigs in a tall tree. The nest is lined with down or with straw, leaves, and feathers. There are generally four bluish-white eggs, averaging about 2·5 by 1·83.

Xenorhynchus asiaticus (Blanford, Vol. IV., p. 372 ; Legge, p. 1116).

The Black-necked Stork.

Description.—Head and neck black, the crown glossed with copper and purple, the remainder with bluish-green ; scapulars, tertiaries, some of the wing coverts, and tail dark glossy green ; rest of plumage white.

In young birds the upper plumage is brown with a green gloss on the scapulars and wing quills ; the lower back and rump are whitish.

Bill black ; naked patch under the bill dusky purple ; iris dark brown in males and young birds, bright yellow in females ; legs coral-red.

Length about 52 ; wing 24 ; tail 9 ; tarsus about 12·75 ; bill from gape about 12.

Distribution.—Occurs in the wildest parts of the low-country, but very rare, though probably resident. It is found in suitable localities throughout India and Burma, and extends south-eastwards to the Malay Archipelago and Australia.

Habits.—Found round wild forest tanks or secluded lagoons. Probably breeds about Christmas time. The nest is a big platform of sticks lined with rushes, grass, or water weed, and placed in a large tree. The four white eggs measure about 2·91 by 2·12.

Leptoptilus javanicus (Blanford. Vol. IV., p. 374 ; Legge, p. 1113).

The Smaller Adjutant, or Hair-crested Stork.

Description.—Skin of head and neck sallow and almost naked, being sprinkled with grayish down and long hairs of dark brown ; upper plumage, wings, and tail glossy green-black ; the longer scapulars and tertiaries edged with white ; lower parts white ; wing lining black.

Young birds have more feathers about the head, and the tertiaries have no white edging.

Bill dirty yellow; iris whitish; legs dirty ashy-brown.

Length 54; wing 26; tail 11; tarsus 10·5; bill from gape 12.

Females are a good deal smaller.

Distribution.—Sparingly scattered through the wilder parts of the dry zone. May be met with here and there over most of India; commoner in Burma, and ranges eastwards to China and the Malay Archipelago.

Habits.—Frequents remote tanks and water-holes in the heart of the forest. The species probably breeds in the Island, but no eggs appear to have been taken as yet. The nest is the usual huge pile of sticks in a tree; the three white eggs measure about 2·84 by 2·09.

PSEUDOTANTALUS LEUCOCEPHALUS (Blanford, Vol. IV., p. 376).

TANTALUS LEUCOCEPHALUS (Legge, p. 1100).

The Painted Stork, or Pelican Ibis.

Description.—Plumage mainly white; primaries, secondaries, and tail black with a green gloss; tertiaries rose-pink edged with white; lesser wing coverts glossy green-black with white edges; scapulars and greater wing coverts tinged with rose. The wing lining and a broad band across the breast black with a green gloss, each feather being edged with white; under tail coverts with a faint rosy tinge.

Young birds have the wing quills and tail coloured as in adults, but the rest of the upper parts are brown, with the exception of the rump, which, with the breast and abdomen, is dirty white.

Bill and naked skin of head, face, and throat orange-yellow; iris pale yellow; legs brown.

Length 40; wing 20; tail 6·5; tarsus about 8·5; bill from gape 10.

Distribution.—Fairly common round tanks and lagoons in the dry zone. Occurs in suitable localities all over India (except in the Punjab) and Burma, ranging eastwards to Southern China.

Habits.—This species, commonly but erroneously called the Pelican Ibis, is a Stork, with the usual habits of the rest of the family. It is sometimes met with in large flocks, but is usually found alone or in small parties about secluded tanks and brackish lagoons. The birds breed in small colonies during the early months of the year. The nest is the usual platform of sticks placed in a tree. The eggs are generally three or four in number, but sometimes more, dull white in colour, and measuring about 2·77 by 1·88.

ANASTOMUS OSCITANS (Blanford, Vol. IV., p. 377 ; Legge, p. 1103).

The Openbill, or Shell Ibis.

Description.—In breeding plumage mainly white ; the longer scapulars, the greater wing coverts, the wing quills, and tail being glossy green-black. After the breeding season the white is replaced by smoky gray, which changes without a moult into white again as the breeding season approaches.

Young birds resemble adults in the off season, but are browner on the back, the face and throat are more completely feathered, while the edges of the mandibles meet throughout instead of gaping in the middle.

Bill greenish or grayish, tinged underneath with red ; naked skin of face and throat almost black ; iris gray or light brown ; legs flesh-coloured.

Length 32; wing 16·5; tail 7 ; tarsus about 6 ; bill from gape 6.

Distribution.—Occurs in flocks round tanks and lagoons in the dry low-country. It is found all over the plains of India by large rivers and marshes, but in Burma its range is very restricted. Further eastwards it reappears in Cochin-China.

Habits.—This is our smallest and commonest Stork, though, like the last species, it is popularly mistermed an Ibis. It lives chiefly on freshwater molluscs, crushing the shells with its powerful beak. The constant attrition of the shells is said to cause the gap between the mandibles. It breeds in colonies during the rains of the north-east monsoon. The nest is of the usual type. The eggs vary from two to five, are white in colour, and measure about 2·25 by 1·6.

Sub-order ARDEÆ.

Family Ardeidæ.

The Herons, which are well represented in Ceylon, form the largest family of the order. The bill is straight, pointed, and usually slender; the nostrils are placed in a distinct groove, which runs nearly to the tip of the bill. The lores, or space in front of the eye, are naked. The neck is long, with a bend in the vertebræ, and is generally held in an S curve, whether the bird is flying or standing. This bend of the neck will almost always serve to distinguish a Heron, when on the wing, from a Stork. The wings are broad and rounded; the tail short. The body is slender and small for the size of the bird. The legs are long, the toes long and slender; the hind toe is well-developed, and there is a slight web between the middle and outer toes. The nest is made of sticks or reeds; the eggs in most cases are a pale shade of blue or green, but in some species are white or almost so.

Herons live largely on fish, and while fishing stand motionless, or stalk slowly in shallow water until a fish swims by, when it is secured by a quick dart of the head. They will also eat frogs, small crabs, and insects.

Fifteen species, representing ten genera, are found in the Island; from their size, colouration, and habits they may be divided into three main groups.

Firstly, three typical Herons, large birds over 36 inches in length, all belonging to the genus Ardea. The upper plumage is gray, the head is crested, the scapulars and the feathers at the base of the neck are lengthened into ornamental plumes, but there is no dorsal train nor change of plumage during the breeding season.

Next come the Egrets, which are in general more slenderly built and smaller, ranging from 18 inches to 3 feet in length. In the breeding season these all develop a more or less lengthy dorsal train (the egret or "osprey" plumes of commerce), except one curious species, the Reef-Heron, which carries its dorsal train of elongated, but not "decomposed" feathers all the year round. The Reef-Heron is also peculiar, in that some

specimens are wholly white, while others are almost entirely slate-gray. The remaining members of this group are either entirely white, or white on the wings, tail, and greater part of the body.

Lastly, we have the Bitterns and Night Herons, six species, which are mainly nocturnal in their habits. These are stouter in build and not so long in the leg as other Herons, the measurement of the tarsus being less than that of the bill from gape to tip, except in one conspicuously short-billed species. All the Ceylon species are under 2 feet in length, in no case are the wings, back, and tail white, nor is there a change of plumage in the breeding season.

Rough Key to Ceylon Ardeidæ.

I.—Size large; length 36 inches or over; upper plumage gray. Genus *Ardea*.

(*a*) Length about 38; middle of breast and abdomen black in adults, buff and gray in young.

Ardea manillensis (Purple Heron).

(*b*) Length about 39; middle of breast and abdomen white.

A. cinerea (Gray Heron).

(*c*) Length about 56; under surface of body chestnut in adults, streaked white and brown in young.

A. goliath (Giant Heron).

II.—Size medium; 18 to 36 inches in length; plumage all white, all gray, or with wings, tail, and greater part of body white.

A.—Plumage wholly white, naked portion of tibia or hock much longer than inner toe and claw, tarsus longer than bill. Genus *Herodias*.

(*a*) Length about 36; dorsal plumes in breeding season, but no crest or breast plumes; tarsus about 6, but variable.

Herodias alba (Large Egret).

(*b*) Length about 26 ; dorsal and breast plumes in breeding season, but no crest ; tarsus about 4·5.
H. intermedia (Smaller Egret).

(*c*) Length about 25 ; dorsal and breast plumes and crest in breeding season ; tarsus about 4 ; bill 4.
H. garzetta (Little Egret).

B.—Plumage white ; head and neck buff in breeding season ; naked part of tibia shorter than inner toe and claw ; bill 3 inches.
Bubulcus coromandus (Cattle Egret).

C.—Plumage white or slate-coloured ; naked part of tibia about same length as inner toe and claw; tarsus shorter than bill ; length about 25.
Leptorodius asha (Reef Heron).

D.—Wings, tail, and greater part of body white ; back ashy-brown, maroon in breeding season ; length about 18.
Ardeola grayi (Pond Heron).

III.—Size small or medium, 14 to 24 inches ; wings and tail not white.

A.—Plumage dark throughout ; 12 tail feathers ; bill slender, longer than tarsus ; length 18.
Butorides javanica (Green Bittern).

B.—Bill stout, longer than tarsus ; length 23 ; eyes red.
Nycticorax griseus (Night Heron).

C.—Bill stout, 2·5 inches long, shorter than tarsus ; length 20.
Gorsachius melanolophus (Malay Bittern).

D.—Size small, about 15 inches ; bill slender, longer than tarsus ; plumage mainly yellow or chestnut. Genus *Ardetta*.

(*a*) Wing quills black.
A. sinensis (Chinese Bittern).

(*b*) Wing quills chestnut.
A. cinnamomea (Chestnut Bittern).

E.—Size medium, about 23; plumage dark; chin and throat richly variegated; bill slender, much longer than tarsus; 10 tail feathers.

Dupetor flavicollis (Black Bittern).

ARDEA MANILLENSIS (Blanford, Vol. IV., p. 381).

ARDEA PURPUREA (Legge, p. 1132).

The Eastern Purple Heron.

Description.—Forehead, crown, and crest black; chin and throat white; remainder of head and neck cinnamon-rufous, with long black streaks down the back and sides; upper parts from lower hind-neck, including wings and tail, slaty-gray, darker on the back, and almost black on the wing quills and tail feathers; scapulars long, pointed, and rufous at the ends. The long feathers of the lower neck are pale buff streaked with chestnut and black; sides of the breast reddish-chestnut; the centre of the breast, the abdomen, and under tail coverts slaty-black; the thighs cinnamon; wing lining pale ferruginous.

Young birds are drab and fawn, with sometimes an almost golden tinge, and lack the crest and elongated feathers on the back and breast.

Bill yellowish-brown above, yellowish underneath; iris clear yellow; naked skin on face yellowish-green; legs and feet reddish-brown and yellow.

Length about 38; wing 14·5; tail 5·25; tarsus 5·5; bill from gape 6.

Distribution.—Common throughout the low-country. Occurs throughout India, Burma, and the whole Oriental region.

Habits.—May be seen about most tanks, brackish lagoons, and marshes, often skulking in long grass and reeds. The main breeding season is during the rains of the north-east monsoon, but where there is a favourable water supply the birds breed again in June. The nest may be placed in trees, on the flat tops of screw pines, or in thick clumps of bulrushes. In the former case it is a large platform of twigs; in the two last dried reeds and flags may enter into its composition. The eggs, three or four in number, are pale bluish-green, almost regular oval in shape, and measure about 2·19 by 1·58.

ARDEA CINEREA (Blanford, Vol. IV., p. 382 ; Legge, p. 112).

The Common Heron ; Gray Heron.

Description.—The crown, the crest, and a band from the eye to the crown black ; rest of head white ; the neck white with a few black streaks on the lower fore-neck. The upper parts from the neck to the tail ashy-gray ; the primary coverts and wing quills black. The under parts are white with a broad black band running from the sides of the breast under the thigh to the vent ; the sides of the body and wing lining ashy-gray.

Females have a shorter crest and less prominent black feathers on the side of the breast.

Young birds are of a darker and dirtier gray, with gray heads, and no black on the sides of the breast.

Bill dusky yellow, brownish along the ridge ; iris golden yellow ; naked skin on face greenish ; legs and feet greenish-brown and yellow.

Length 39 ; wing 17·5 ; tail 7 ; tarsus 6 ; bill from gape 6.

Distribution.—Not so common as the last species, but may be met with in the north, east, and south-east of the Island. Abundant in most parts of India ; rarer in Burma. Occurs nearly all over the Old World.

Habits.—Frequents the more secluded tanks and brackish lagoons. It breeds during the rains of the north-east monsoon, generally in the company of Egrets, Night Herons, &c. Such Heronries are usually on clumps of trees growing in the water. The nest is a large platform of twigs. The three eggs are fairly deep sea-green, and usually slightly pointed at each end. Average measurement 2·28 by 1·70.

ARDEA GOLIATH (Blanford, Vol. IV., p. 384 ; Legge, p. 1124).

The Giant Heron.

Description.—African adults : crown and crest deep venous chestnut ; the hind neck and sides of the neck rather paler. Upper parts with wings and tail slate-gray. The chin, cheeks, and throat white ; the lower fore-neck purple-black streaked with white ; breast plumes streaked with slate-black and white ; remainder of lower parts, including wing lining and lower tail coverts, dark chestnut.

Immature birds are duller; the head and neck is paler; the feathers of the upper parts are edged with rufous; the under parts are brown streaked with white.

Bill dark slate-colour; iris yellow with reddish margins; naked skin on face pale slate; legs and feet dark slaty-black.

Distribution.—The usual habitat of this species is in Africa. Two or three immature specimens have been obtained in Ceylon, and a few more have been shot or seen in various parts of India. All the known Indian and Ceylonese specimens are immature birds, so that it is not certain that they are identical with the African species.

Habits.—This enormous Heron may be looked for near lagoons or by the mouths and lower reaches of the larger rivers in the very wildest parts of the Island.

HERODIAS ALBA (Blanford, Vol. IV., p. 385; Legge, p. 1138).

The Large Egret.

Description.—Plumage entirely white. In the breeding season the bird assumes a train of long plumes, with very open drooping barbs. These feathers spring from the back and reach several inches beyond the tail.

Bill in breeding season black; naked skin of face bright green; iris yellow; legs and feet black. At other seasons the bill is yellow, the facial skin greenish-yellow, and the legs and feet dull greenish.

The dimensions are very variable. Length about 36; wing 13 to 15·5; tail 5·5; tarsus 6 to 7·5; bill from gape 5 to 6.

Distribution.—Common throughout the low-country, wherever there are tanks and large stretches of paddy field; also found about brackish lagoons. Occurs all over India and Burma, ranging westwards to Africa and Southern Europe.

Habits.—These birds are usually met with singly or in very small groups. They feed in shallow water well out in the open, and are very wary. They are fond of perching on tall trees. They breed in colonies, often in the company of other allied species, making a large stick nest on trees growing in the water. The eggs generally number three or four, are nearly oval in shape, bluish-green in colour, and measure about 2·18 by 1·57.

HERODIAS INTERMEDIA (Blanford, Vol. IV., p. 386; Legge, p. 1141).

The Smaller Egret.

Description.—Plumage white. In the breeding season, in addition to the long dorsal train, egret plumes are also developed on the breast; all the plumes are dropped when the breeding season is passed.

Bill in breeding season black; naked skin of face green; iris yellow; legs and feet black. At other times the bill is yellow with a dusky tip, and the facial skin greenish-yellow.

Length about 26; wing 12; tail 5; tarsus 4·5; bill from gape 3·75.

Distribution.—Common all through the low-country, but in the north not so numerous as the next species. Occurs throughout India and North Burma, the range extending to Java, the Philippines, China, and Japan.

Habits.—Similar to those of the last species, but usually the birds are met with in larger troops. They breed in Heronries from November to March, making the usual stick nest. The eggs are pale blue-green, three or four in number, and measure about 1·86 by 1·37.

HERODIAS GARZETTA (Blanford, Vol. IV., p. 388; Legge, p. 1144).

The Little Egret.

Description.—Plumage white. In the breeding season, like the other members of the genus, it carries a dorsal train of "decomposed" plumes; it also assumes breast plumes of long but not filamentous feathers, and a head crest of two feathers about 5 inches long.

Bill always black; naked skin on face greenish-yellow; iris yellow; legs and feet black with some yellow on the toes.

Length about 25; wing 11; tail 4; tarsus 4; bill from gape 4.

Distribution.—Not so widely spread in Ceylon as the other Egrets, but fairly common in the north and in the Hambantota District, and occasionally found up-country. It is common all over India and Burma, and ranges throughout Africa, Southern Europe, and Southern Asia.

Habits.—Generally met with singly or in pairs, but roosts and breeds in colonies in the same manner and at the same time as other members of the genus. In Ceylon it generally lays three or four eggs, pale bluish-green in colour, and measuring about 1·66 by 1·30.

BUBULCUS COROMANDUS (Blanford, Vol. IV., p. 389: Legge, p. 1147).

The Cattle Egret.

Description.—Out of the breeding season the plumage is white with sometimes a wash of yellow on the forehead and fore-neck. In breeding plumage the head and greater part of the neck become golden-buff, sometimes with a brown or pink tinge, while long dorsal plumes of the same colour are developed; the plumes do not extend beyond the tail.

Bill yellow; facial skin greenish-yellow; iris pale yellow; legs black, the naked portion of the tibia yellow, and the soles greenish-yellow.

Length 20; wing 9·50; tail 3·5; tarsus 3·5; bill from gape 3.

Distribution.—Abundant all over the low-country, ascending the river valleys for some little way into the hills. Common in India and Burma, ranging eastwards throughout China to the Philippines and south-east to Celebes.

Habits.—This species wanders away from water far more than other Herons and constantly follows buffaloes and cattle in the fields, feeding on ticks and grasshoppers. It breeds in colonies on trees growing in the water, making the usual stick nest and laying three to five eggs of very pale green averaging 1·71 by 1·32.

LEPTORODIUS ASHA (Blanford, Vol. IV., p. 390).

ARDEA GULARIS (Legge, p. 1136).

The Indian Reef Heron.

Description.—Most birds are slaty-blue, with a white patch on the chin, throat, and lower cheeks; the plumes on the back and breast are long, but not filamentous, and are worn all the year round; there is a crest of two long narrow ash-gray feathers. A good many specimens, however, are pure white all over.

Young birds lack the ornamental plumes, and those of the dark variety are ashy-gray. Some young birds are pied slaty-blue and white, occasionally unsymmetrically.

Bill brownish-yellow, paler at the tip and greenish at the gape; iris golden yellow; naked part of tibia and just below the knee brownish; the tarsus green.

Length 25; wing 10·5; tail 4; tarsus 4; bill from gape 4·5.

Distribution.—Found only in a few localities on the north and west coast of the Island. Extends along the west coast of India to the Persian Gulf.

Habits.—A rare bird, frequenting the open coast, especially where there are coral reefs, or the mud flats of estuaries. It has been found breeding near Chilaw about the end of May.

The nest is a large platform of sticks placed in mangroves or on rocks. The eggs are said to be three in number, slightly pointed at each end, pale sea-green in colour, and measuring about 1·70 by 1·30.

ARDEOLA GRAYI (Blanford, Vol. IV., p. 393; Legge, p. 1150).

The Pond Heron; Paddy Bird.

Description.—In breeding plumage the head and neck are grayish-yellow, with an ashy tinge on the crown; chin and throat whitish; a crest of two to four white streamers; the feathers of the back and scapulars, which are long and filamentous, are deep maroon tinged with black, the outer scapulars being brownish to creamy-buff. The remainder of the plumage, including the wings, is white, the tips of the primary quills tinged with brown.

In the off season adults have the head and neck blackish-brown streaked with yellowish-buff, the crown darker, and the buff streaks becoming wider on the lower neck; the crest wanting; chin and throat white; upper breast white streaked with brown. The back, scapulars, and tertiaries are glossy ash-brown, the scapulars with paler shaft-streaks; remainder of plumage white.

Bill bluish at the base and on top, the sides of the upper mandible and the lower mandible yellowish, the tip black; iris bright yellow; legs greenish.

Length 18 ; wing 8 ; tail 3 ; tarsus 2·15 ; bill from gape 3.

Distribution.—Ubiquitous in the low-country wherever there are paddy fields or water, ascending to a fair height in the hills, common throughout India and Burma, ranging from the Persian Gulf to the Malay Peninsula.

Habits.—May be found fishing in any little pond, stream, tank, or paddy field, and occasionally on the seashore. When standing still with its head drawn in, the white portions of the plumage are concealed and the bird is an inconspicuous object. As soon as it flies off it appears to transform itself into a white bird with startling suddenness.

It breeds pretty nearly all the year round. I have taken eggs as late as August, and the breeding season begins again in the November rains. It builds in colonies on trees, making a small platform of twigs, and generally laying four greenish-blue eggs measuring about 1·53 by 1·15.

Butorides javanica (Blanford, Vol. IV., p. 395 ; Legge, p. 1153).

The Little Green Bittern.

Description.—Adults : head, down to the eyes, and the occipital crest black glossed with green ; a narrow black band under the eye ; the area between this and the black cap buff or whitish. The chin and throat are white ; a whitish band washed with brown down the middle of the foreneck ; remainder of the head and neck ashy-gray tinged with blue. The back is ash-coloured, the rump dark gray, the upper tail coverts and tail blackish, all washed more or less with green. The scapulars and wing coverts are glossy green, the long scapulars with ashy-gray ends and white shafts ; wing coverts and tertiaries edged with pale buff ; wing quills blackish-slate ; secondaries and inner primaries tipped with white. The lower parts are slaty-gray with a brown wash on the belly and thigh coverts.

Immature birds have the crown blackish-brown with pale shaft-stripes. The upper parts, including the wings and tail, are brownish, with pale terminal spots on the scapulars and wing coverts, and white spots on the tips of the quills : lower parts streaky white and brown.

Bill black, yellowish underneath; naked skin of face yellowish-green, dull livid in the breeding season; iris yellow or reddish-yellow; legs and feet greenish-yellow, pale rufous in the breeding season.

Length 17·5; wing 6·8; tail 2·3; tarsus 1·8; bill from gape 3.

Distribution.—Fairly common all over the low-country, but often escapes notice owing to its skulking habits. Occurs throughout India and Burma, except in dry regions; extends over almost the whole of the Oriental region.

Habits.—This is more of a river bird than most of our species, and may be found along the shady borders of streams, backwaters, and mangrove-fringed lagoons, or in dark corners of tanks. It is generally solitary, and during the day time keeps mainly in the shade, feeding mostly at night. The breeding season is probably from April to July; the nest is a small structure of sticks placed low down in trees near the water or among reeds; the three eggs are greenish-white, and measure about 1·62 by 1·21.

NYCTICORAX GRISEUS (Blanford, Vol. IV., p. 397; Legge, p. 1165).

The Night Heron.

Description.—The crown and nape, back, and scapulars are black with a metallic green gloss; from the nape, the feathers of which are lengthened, spring two or three long narrow white streamers, which are dropped after the breeding season. The forehead, together with a stripe over the eye, the cheeks, and all the lower parts from chin to tail coverts are white. The sides and back of the neck and the sides of the body are delicate pale ash-gray; the wings, rump, and tail are darker ashy-gray, with a bluish or pinkish tinge.

The immature plumage is strikingly different. The upper parts are brown, the crown almost black, with pale brown shaft-stripes; there are triangular buff tips to the feathers of the back and wing coverts, and buff or whitish spots on the tips of most of the wing quills. The lower plumage is whitish with broad brown streaks.

Bill black, paler at the base; iris blood-red or scarlet; naked facial skin yellowish-green, dull livid in the breeding season; feet yellowish-green, pale rufous in the breeding season.

Length 23; wing 11·5; tail 4; tarsus 3; bill from gape 3·8.

Distribution.—Found in scattered colonies throughout the low-country; locally distributed throughout India and Burma; occurs all over Africa and the temperate and warmer regions of Europe, Asia, and North America.

Habits.—The birds roost in company on large trees during the day, departing at nightfall for their fishing grounds with a slow heavy flight, during which they frequently utter a harsh cry of "kwark."

Like many other Herons, they breed gregariously in thickets surrounded by swamp. The nest is the usual structure of sticks, and there are generally four eggs of pale sea-green measuring about 1·97 by 1·38. The breeding season appears to vary, depending on suitable conditions of weather and water supply. I have taken eggs in March, July, September, and December.

Gorsachius melanolophus (Blanford, Vol. IV., p. 398; Legge, p. 1169).

The Malay Bittern.

Description.—Adults: the crown and crested nape are black, tinged with ashy-white; sides of head, including a band above the eye, the sides of neck, and hind-neck vinous chestnut; the main portion of the upper parts are cinnamon, with wavy freckled lines of black; the outer primary coverts black with white tips; wing quills black, the outer primaries with white tips, the rest with the ends chestnut freckled with white; upper tail coverts dull rufous brown; the tail darker, almost black. The chin and throat are white; the fore-neck and upper breast brownish-buff streaked with black; the abdomen is mottled and streaked with white, black, and rufous; the lower tail coverts mainly white.

Young birds are blackish on the crown and nape, with angular white or buff spots. The upper parts are dull dark brown with wavy buff crossbars; wing quills blackish, tipped

or freckled at the tips with white; lower parts rufous buff, streaked, speckled, and blotched with white and brownish-black; chin and throat white with a few dark spots.

Bill black along the ridge, the remainder fleshy; iris golden yellow; facial skin slaty-green; legs and feet greenish tinged with brown on the front of the tarsus.

Length 20; wing 10·5; tail 3·8; tarsus 2·75; bill from gape 2·5.

Distribution.—In Ceylon an occasional north-east monsoon migrant, coming probably from Southern India.

In India the species occurs and breeds on the Malabar Coast, in Assam and Burma, and extends eastwards through the Malay Peninsula to Borneo and the Philippines.

Habits.—Chiefly a forest bird, but most of the specimens procured in Ceylon appear to have been obtained round Colombo, in November, on their first arrival in the Island.

Ardetta sinensis (Blanford, Vol. IV., p. 400; Legge, p. 1156).

The Yellow Bittern.

Description.—Male: crown and nape black, the feathers with paler gray edges; sides of head and neck vinous, darkening to chestnut on the longer plumes of the hind-neck; back, scapulars, and tertiaries pale yellowish-brown with a tinge of gray; wing coverts yellowish-buff; primary coverts, wing quills, and tail slaty-black; rump and upper tail coverts ashy or bluish-gray. The chin, throat, and fore-neck are light fulvous yellow; upper breast and abdomen buff, the long pectoral plumes concealing the lower breast feathers, which are brownish-black with fulvous edges.

Female: the upper plumage is more rufous; the crown is streaked with rufous instead of gray; the back and scapulars are rufous-brown, each feather edged with buff; the buff of the throat and fore-neck is streaked with tawny brown.

In young birds the upper and lower plumage is more streaked; the crown is brown with buff streaks, while the streaks on the fore-neck and breast are darker brown.

Bill brown on the ridge, pinkish-brown beneath; naked skin on face green; iris golden yellow; tarsus dull flesh-colour; toes pale yellow.

Length 15; wing 5·25: tail 1·8; tarsus 2; bill from gape 2·75.

Distribution.—It is scattered throughout the low-country marshes, rare in the north and east, but fairly common in certain localities in the west and south. It occurs locally over India and Burma, but is generally rare, and is found through south-eastern Asia to Japan in the north-east and Australia in the south.

Habits.—This bird skulks about reeds and thick grass in marshes and swampy banks. It is much more in evidence during the north-east than in the south-west monsoon. The majority of the birds either betake themselves to very secluded spots to breed or are migrants. The breeding season is probably from May to August; the nest is a pad of grass hidden in a clump of rushes or long grass; the eggs, three to five in number, are pale greenish-white, measuring about 1·3 by ·95.

ARDETTA CINNAMOMEA (Blanford, Vol. IV., p. 402).

ARDEIRALLA CINNAMOMEA (Legge, p. 1162).

The Chestnut Bittern.

Description.—Male: the crown and sides of the head and the whole upper plumage, including the wings and tail, chestnut; the wing coverts are a little paler; the shafts of the wing quills black. The crown is sometimes tinged with gray. The chin, throat, and lower parts are mainly tawny-brown, with a white stripe down each side of the throat and a dark brown streak down the centre of the fore-neck; the lower breast feathers, which are concealed by the pectoral plumes, are blackish-brown edged with buff.

Female: crown blackish; upper parts dull dark brown, lighter on the wing coverts and scapulars, both of which have buff edges notched with pale brown spots; wing quills chestnut, browner at the base; the tail is dull chestnut. The

sides of the head are dull chestnut; the under parts tawny-yellow, with dark brown streaks. There is a conspicuous dark chain-patterned streak down the centre of the chin, throat, and fore-neck.

Young birds resemble females, but the back and mantle feathers are more spotted on the edges with yellowish-buff.

Bill yellow, the ridge dark brown; iris pale red or yellow; legs and feet yellowish-green; naked skin of face yellow in females, reddish-purple in males.

Length 15; wing 5·5; tail 1·7; tarsus 1·90; bill from gape 2·6.

Distribution.—Found in marshy spots all over the low-country, and in the hills up to about 4,000 feet. It is generally distributed, but local in India, commoner in Burma. The range extends from Sind to China, the Dutch East Indies, and the Philippines.

Habits.—A solitary bird, and nowhere very numerous. It keeps more to standing paddy, long grass, or rushes near the water than to reed beds or tangled swamps. It breeds in June and July; the nest is a pad of grass in a bush, or a thick clump of grass; the five or six eggs are dull white ovals, measuring about 1·28 by 1.

DUPETOR FLAVICOLLIS (Blanford, p. 403).

ARDEIRALLA FLAVICOLLIS (Legge, p. 1159).

The Black Bittern.

Description.—Male: the upper parts, including the wings, black with a tinge of slate-gray; the sides of the head duller black; the lower cheeks slightly mottled with rufous; a golden-yellow stripe down each side of the throat. The chin, throat, and fore-neck are motley white, chestnut, and black, the feathers of the fore-neck being buffy-white on one web, black in the centre, and chestnut on the other margin. The plumes on the side of the chest are slaty-gray, with white margins; the centre of the breast and the abdomen slaty-black, the abdomen more or less streaked with white.

Females are brown.

Young birds are deep brown, the feathers of the upper surface fringed with buff, while the breast and sides of the body are dusky brown.

Bill dusky red-brown, lighter underneath; iris golden-brown, sometimes with an outer ring of red; facial skin livid or red-brown; legs dark brown.

Length 23; wing 8; tail 2·7; tarsus 2·7; bill from gape 4.

Distribution.—Probably a partial migrant, but some birds remain to breed. It is nowhere common, but is widely scattered over the low-country. It is extremely local in most parts of India, but commoner in Eastern Bengal and Burma, ranging eastward to China and the Dutch East Indies.

Habits.—This species often passes unnoticed owing to its skulking nocturnal habits. It breeds about April, in which month I have twice found the nest in the North-Central Province. In each case it was a small structure of twigs placed on a low thorny tree within three feet of the surface of a tank. The full clutch numbers four eggs, of very pale sea-green, measuring about 1·65 by 1·25.

Order **PHŒNICOPTERI.**

Family Phœnicopteridæ.

Genus **Phœnicopterus.**

Flamingoes.

These birds stand in an order by themselves. In their length of neck and limb, and in their general structure, they approach the Storks; in the formation of the foot with its fully-webbed front toes and rudimentary hind toe, and also in the fact that the young when hatched are covered with down and able to run, they resemble Ducks and Geese.

Flamingoes feed in shallow water with their inverted heads between their legs, and the bill is adapted accordingly. It is bent in the middle, the lower mandible is large and practically fixed, while the upper mandible is small and movable. As with the Ducks, the whole bill, except the tip, is covered with soft

skin, and the margins of the mandibles are furnished with lamellæ or ridges, with which the food is sifted from the water and soft mud in which the birds find their living.

Only one species is found in Ceylon.

Phœnicopterus roseus (Blanford, Vol. IV., p. 408; Legge, p. 1092).

The Common Flamingo.

Description.—The whole plumage, except the wings, white, tinged more or less with rose-pink; the greater portion of the wing coverts and tertiaries almost scarlet; primary and secondary quills black; the axillaries and edge of the wing lining scarlet; the rest of the wing lining largely black.

Young birds are grayish-white on the head, neck, and body, the axillaries being the only feathers tinged with pink; the wing coverts mainly brown with dark shaft-stripes; wing quills brown. Bill flesh-coloured, black at the tip; naked facial skin whitish-pink; iris yellow; legs and feet pinkish-red; claws black.

Size variable. Males: length about 50; wing 17; tail 6; tarsus 14; bill from gape 4·5. Females: length about 40; wing 15; tail 5; tarsus 10·5; bill from gape 4.

Distribution.—Found in large flocks on lagoons and the open coast round the dry zone from Puttalam, by Jaffna, to Hambantota; common about salt lakes in north-west India, and met with round the Indian coast as far as Bengal, but not in Burma. The species ranges throughout Africa, Southern Europe, Central Asia, and Southern Asia as far east as India.

Habits.—Most of our birds are migrants arriving in October and leaving in April, but some immature birds may remain all the year round, and there are traditions, which, however, have never been verified, that a breeding place lies in the extreme south of the Eastern Province. The nest is a mound of mud, raised a few inches above the surface of a shallow lagoon, and hollowed at the top.

The birds breed in colonies. Two chalky-white eggs are laid, measuring about 3·50 by 2·50.

Order **ANSERES.**

Family Anatidæ.

Geese and Ducks.

The Anatidæ, which comprise the Swans, Geese, and Ducks. form the only family of this familiar and world-wide order.

The three front toes are fully webbed ; the hind toe is small, and set on the leg higher up than the others. The bill is straight and covered with a membrane of soft skin, except on the nail, or "dertrum," at the tip of the upper mandible. The edges of both mandibles are laminated, the ridged processes varying in development among the different genera. The tongue is large and toothed at the sides to correspond with the ridges of the mandibles. Many of the family are migrants ; those that breed in northern climates generally build a nest on the ground and line it with their own down ; the species resident in warmer countries, as a rule, build in trees, and the warm nest-lining is more scanty or altogether wanting. The eggs are numerous, white or pale in colour, and unspotted. The nestlings when hatched are downy, and can run about and feed themselves. At the moulting season all the wing quills are shed at once, so that for some time the birds are unable to fly.

According to the classification adopted by Blanford, the family is divided into four sub-families.

To one of those—*Anatinæ*, the Ducks—belong all the authenticated Ceylon members of the order. There are traditions of the occurrence of Geese in the Island, but the other two sub-families—Swans and Mergansers—are with us unknown.

Sub-family *Anserinæ*.

Geese.

Geese, though they swim well, spend more of their time upon land and less upon water than do the Ducks, having the legs set further forward on the body and adapted for walking. The nostrils are placed nearly half-way down the bill, which is comparatively short and high at the base. The wings are long and broad, and the tail rounded.

In colour they are mostly gray or brownish, with lighter edges to the feathers, the plumage having a barred appearance.

They are vegetarians, feeding mainly on grass or other green food. All species are migratory, and the sexes are alike in colour. As mentioned above, there are persistent rumours, some resting on competent authority,* that Geese have been seen in Ceylon. If eventually any specimens are procured, they will probably prove to be *Anser ferus*—the Gray Lag Goose—which breeds in the north, and visits Northern India during the winter in considerable numbers, occasionally wandering further southwards. It is a large bird, the males running to 32 inches in length, with a wing measurement of 18 inches. The general colour is brownish-gray with lighter transverse barrings. It is just possible, however, that another common North Indian species, *Anser indicus*—the Barred-headed Goose—may some day turn up as a straggler. This species is more slender in build than the Gray Lag, and the greater part of the plumage is a clear pale gray. Old birds can be told at once by the white head with two black bars on the nape. Young birds have the crown and nape dark brown without any black bars.

Sub-family *Anatinæ*.

Ducks.

The ducks constitute a large and varied sub-family, nearly thirty species being found in the Indian area. Twelve of these have occurred in Ceylon, and it is possible that stray specimens of others may from time to time straggle to the Island.

In size they are generally smaller than Geese. The legs are rather short, set far back, and adapted more for swimming than walking. The bill is usually broad and shallow, with the lower mandible narrower than the upper, into which it shuts, so that the lamellæ are seldom apparent when the bill is closed. The nail, or "dertrum," at the tip of the upper mandible is, as a rule, bent downwards into a distinct hook. The nostrils, save in one genus not found in Ceylon, are situated less than half way from the base of the bill. In the majority of species the drakes before the breeding season

* *Vide* Legge, p. 1072, footnote.

moult into a bright nuptial dress, which they drop by a second moult as soon as breeding is over, assuming for the rest of the year a plumage similar, or almost similar, to that of the female. The drakes, with few exceptions, also differ from the ducks in possessing a bony bulb or drum at the base of the windpipe. In most forms the exposed portions of the secondary wing quills, together with their coverts, are brilliantly coloured, and, especially when the wing is closed, form a ribbon-like mark known as the wing bar, or "speculum." This is often more conspicuous in adult males than in females and young birds.

The twelve species on the Ceylon list are divided among eleven genera, and fall into three groups :—

(1) The Walking and Tree Ducks. These resemble Geese more nearly than do the other Ducks, and the tarsus is approximately equal in length to the bill. Five species, including our few common residents, occur in Ceylon. In only one case—the little Cotton Teal—does the drake assume a breeding plumage differing markedly from that of the duck.

(2) The Surface-feeding Ducks, which are mainly migratory. In these the tarsus is noticeably shorter than the bill. The drakes of all the six Ceylon species possess a brightly coloured wing bar, and, with the exception of the Spotted-billed Duck, in which both sexes are alike, assume a distinct breeding plumage. In the females of several species the wing bar is duller or wanting.

(3) The Diving Ducks ; limited in Ceylon to a single species of rather doubtful occurrence. These may be distinguished from all other members of the sub-family by the large foot, in which the outer toe is as long or longer than the middle toe, while the hind toe has a deep lobe.

Rough Key to Ceylon Species.

I.—Perching Ducks.—Outer toe shorter than middle toe; bill approximately same length as tarsus.

A.—Size large ; wing 11 inches or more.

(*a*) Lower parts white.

Sarcidiornis melanonotus (Comb Duck).

(*b*) Lower parts reddish-brown.

Casarca rutila (Brahminy Duck).

B.—Size medium; wing under 10 inches, broad and rounded. Genus *Dendrocygna*.

(*a*) Wing about 7·5; upper tail coverts maroon.
D. javanica (Whistling Teal).

(*b*) Wing about 9; upper tail coverts creamy white.
D. fulva (Large Whistling Teal).

C.—Size small; wing 6·5; bill 1·15 inch.
Nettopus coromandelianus (Cotton Teal).

II.—Surface-feeding Ducks.—Outer toe shorter than the middle; tarsus noticeably shorter than bill.

(*a*) Wing 10 to 11; wing bar metallic green or purple, bordered with black; sexes alike; bill black with a broad orange band.
Anas pœcilorhyncha (Spotted-billed Duck).

(*b*) Wing 9·5 to 10·5; wing bar black and white; sexes unlike.
Chaulelasmus streperus (Gadwall).

(*c*) Wing 7·5; wing bar velvet-black and green; sexes unlike.
Nettium crecca (Common Teal).

(*d*) Wing 10 to 11; tail long and pointed; wing bar in males bronze-green and velvet-black, with an inner border of cinnamon; in females replaced by two white bars; sexes unlike.
Dafila acuta (Pintail).

(*e*) Wing 8; wing coverts lavender-gray; wing bar in males glossy green between two white bands, in females absent or nearly so.
Querquedula circia (Garganey Teal).

(*f*) Wing 8·75 to 9·5; bill long, much broader at tip than at base, speculum glossy green, bordered in front with white; sexes unlike.
Spatula clypeata (Shoveller).

III.—Diving Ducks.—Outer toe as long as the middle toe; hind toe deeply lobed.
Netta rufina (Red-crested Pochard).

SARCIDIORNIS MELANONOTUS (Blanford, Vol. IV., p. 423 ; Legge, p. 1063).

The Comb Duck.

Description.—Male : head and neck white, interspersed with feathers of metallic black, which are thickest on the crown and down the back of the neck. The lower parts and the lower neck all round are white ; the upper back, wings, rump, upper tail coverts, and tail are black glossed with green and blue, except the scapulars, which are glossed with rich purple ; the lower back is dusky gray ; the flanks vary from brownish-gray to white with a gray tinge ; a black bar runs from the upper back a short way down the side of the breast and another black bar from the rump to the lower flanks.

Males carry at the base of the bill a high fleshy comb, which is largest during the breeding season.

Females are similar in plumage, but smaller ; they lack the comb on the bill ; the head and neck are blacker, there is less gloss on the upper plumage, while the lower back and rump are paler.

Young birds are brown where adults are black, and the white of the lower plumage is tinged with rust-colour.

Bill and comb black ; iris brown ; legs and feet dull lead-colour.

Length of male 30 ; wing 15 ; tail 6 ; tarsus 2·75 ; bill from gape 2·7. Females : length 26 ; wing 11·25 ; tail 4·5 ; tarsus 2 ; bill 2.

Distribution.—Found here and there on larger tanks in the north and east of the Island. It occurs in suitable localities over the greater part of India and Burma, also in tropical and Southern Africa.

Habits.—This large Duck is nowhere common, but may be met with in small flocks on large weedy tanks in the heart of the jungle. During the breeding season, about February and March, the birds pair off. The nest is a slight collection of sticks, leaves, grass, and feathers placed in a hole low down in a large tree, or in the hollow angle where a large branch meets the stem. The eggs number seven to twelve, are polished ivory-white, and measure about 2·40 by 1·70.

CASARCA RUTILA (Blanford, Vol. IV., p. 428).

TADORNA CASARCA (Legge, pp. 1070 and 1222).

The Brahminy Duck.

Description.—Male : head and neck creamy-buff, darkenings to orange on the lower neck, which is encircled by a narrow blackish ring. This ring disappears in the winter months. The upper and lower body plumage is mainly fox-red or orange-brown ; the lower back and rump are vermiculated with black ; the upper tail coverts, tail, and wing quills black, the secondary quills being metallic green, glossed with bronze on the outer webs ; the inner tertiaries fox-red on the outer web and gray on the inner ; wing coverts whitish-buff ; wing lining white.

Females are smaller and duller, have whitish heads, and never assume the black collar.

Bill, legs, and feet blackish ; iris dark brown.

Length 26 ; wing 14·6 ; tail 5·5 ; tarsus 2·5 ; bill from gape 2·2. Females : length 23 ; wing 13.

Distribution.—A rare winter visitor to the lagoons on the north coast from Mannar to Mullaittivu. This is a migratory species, breeding from Southern Europe and Northern Africa to Thibet, and wintering southward. It is a winter visitor to India and parts of Burma.

Habits.—This species is partly vegetarian, eating grass and green crops. The birds generally associate in pairs, but occasionally gather into flocks. During the day time they usually sit on the sand by the edge of the water, and are not often seen swimming. They are good walkers. In India they mainly frequent the banks of rivers.

DENDROCYGNA JAVANICA (Blanford, Vol. IV., p. 430 ; Legge, p. 1069).

The Whistling Teal.

Description.—Forehead, crown, and nape brown, darkest on the nape ; sides of head and neck fulvous gray, becoming almost white on the throat and chin ; back and scapulars dark brown, each feather with a rufous tip ; the upper tail coverts and most of the wing coverts deep maroon ; the greater wing

coverts, the wing quills, tail, lower back, and rump brownish-black. The lower parts are ferruginous, shading on the upper breast to yellowish-brown, and on the vent to whitish.

Females are similar, but slightly paler on the under parts.

Young birds have the under parts uniformly dull pale brown. Bill, legs, and feet brownish-blue; iris brown; eyelids yellow.

Length 17; wing 7·5; tail 2·2; tarsus 1·75; bill from gape 2.

Distribution.—Abundant in most parts of the low-country. Occurs almost throughout India and Burma, extending eastwards to China and the Dutch East Indies.

Habits.—Found on almost every tank in the dry zone of the low-country, and on marshes, weedy backwaters, and flooded paddy fields in parts of the wet zone where there are no tanks. The birds move about a good deal, and appear to be commonest during the rains of the north-east monsoon. It is probable that many of the birds seen then are migrants from Southern India. At that time of year I have heard whistling from flocks passing over Colombo during the night. This species is very fond of roosting and perching on the dead branches of trees near water. Its cry is a peculiar whistling uttered while on the wing. It breeds mostly in the early part of the year, but if the weather conditions and water supply are favourable, it will breed right on to June, or even August. The nest may either be formed by beating down a small circle of reeds, rushes, or grass in swampy ground, or consist of a scanty lining of grass and feathers placed in the angle made by the junction of a large bough with the stem of a tree standing in the water. The eggs are broad, almost regular ovals, white and smooth, but not glossy. They measure about 1·89 by 1·49, and the full clutch varies from seven to twelve, or even more.

Dendrocygna fulva (Branford, Vol. IV., p. 432; Legge, p. 1226*a*).

The Large Whistling Teal.

Description.—This bird is, in general, similar to the last species, but considerably larger, rather darker on the upper parts, and has the following differences: there is a black

stripe down the back of the nape ; the chestnut on the wing coverts is not nearly so pronounced ; the upper tail coverts are creamy-white, while the sides and front of the lower neck are whitish, with small and often inconspicuous dusky streaks.

Bill blue-black ; iris brown ; eyelids pale livid ; legs and feet dark lead-colour.

Length 20 ; wing 9 ; tail 2 ; tarsus 2·25 ; bill from gape 2·4.

Distribution.—A few specimens were once obtained near Mannar. It is occasionally found in various parts of India and Burma, but its main habitat is in Central and South America, tropical and South Africa, and Madagascar.

Habits.—Similar to those of the common Whistling Teal; the birds associate in small flocks, and should be looked for on the north coast of the Island.

NETTOPUS COROMANDELIANUS (Blanford, Vol. IV., p. 433).

NETTAPUS COROMANDELIANUS (Legge, p. 1066).

The Cotton Teal ; Quacky Duck.

Description.—Males in the breeding season have the forehead, crown, and nape brown ; the rest of the head, the neck, and lower parts are white, with a broad black collar, glossed with green behind, round the neck. The remainder of the upper parts down to the rump are dark brown glossed with green and purple ; the outer half of the primaries white tipped with black ; white tips to the secondaries ; wing lining brown ; flanks white vermiculated with brown, which increases in density on the upper tail coverts ; tail dark brown ; under tail coverts mottled brown and white.

In winter the male loses the black collar, and resembles the female, but retains the white on the primaries and some of the gloss on the wings and back.

Female : crown and nape brown ; a brown stripe from the base of the bill through the eyes ; the rest of the head, the neck, and upper breast grayish-white with stipplings and wavy bars of brown ; remainder of under plumage dirty white mixed with brown, darkest on the flanks and under wing coverts. The upper surface, wings, and tail are brown ; inner primaries and secondaries with white tips ; upper tail coverts freckled white and brown.

Young birds resemble the females.

In breeding males bill black ; iris red ; legs and feet black, dusky yellow down the sides.

In females bill brown above, yellowish underneath ; iris brown ; legs and toes greenish-yellow, webs black.

Length 13 ; wing 6·5 ; tail 2·75 ; tarsus 1 ; bill from gape 1·15.

Females are slightly smaller.

Distribution.—Commonest in the north and east of the Island, but spreads during the north-east monsoon to the west and south-west. Occurs through most parts of India and Burma, and extends through south-eastern Asia to China, the Philippines, and Dutch East Indies.

Habits.—Very fond of weedy tanks, which it frequents in small flocks ; occasionally larger flocks may be seen, especially on large tanks during the hot weather, when smaller tanks are dry. These little ducks fly low and fast, uttering their curious cackle, which sounds like "quacky-duck, quacky-duck." They breed in the early part of the year and again about August. The nest is a scanty lining of down placed in holes in trees or in old buildings. About eight to twelve eggs are laid, smooth ivory-white, measuring about 1·65 by 1·28.

ANAS PŒCILORHYNCHA (Blanford, Vol. IV., p. 436 ; Legge, p. 1073).

The Spotted-billed Duck.

Description.—Forehead, crown, and nape dark brown, with paler streaks ; a stripe above the eye ; the sides of the head and the neck whitish with brown streaks ; chin and throat unstreaked. The rest of the upper parts are brown, darkening almost to black on the tail, with pale edges to the feathers on the upper back and scapulars, and a slight green gloss on the tail coverts ; breast and abdomen buff-white with large brown spots ; on the lower abdomen the ground-colour gradually deepens to the hue of the spots ; the under tail coverts are deep sooty-brown.

The primaries are dark brown ; the outer webs of the secondaries are glossy purple, shading to peacock-green, with an outer border of black narrowly edged with white ; outer

webs of tertiaries white; the greater wing coverts are brown, with a sub-terminal white band and velvet-black tip; wing lining white. The sexes are alike.

Bill black with a broad orange-yellow tip and a blackish nail; a naked orange or red patch on each side at the base of the upper mandible; iris reddish-brown; legs and feet orange-yellow, claws black.

Length 24; wing 11; tail 4·5; tarsus 1·75; bill from gape 2·5.

Females are rather smaller.

Distribution.—In Ceylon probably a winter migrant from India. It is occasionally found during the north-east monsoon on some of the larger tanks in the north and east of the Island. A resident species in India, Upper Burma, and the Shan States.

Habits.—A fresh-water species, which generally goes about in pairs or small troops. It is rather heavy on the wing.

Chaulelasmus streperus (Blanford, Vol. IV., p. 440; not in Legge).

The Gadwall.

Description.—Male in breeding plumage: head and neck grayish-white, speckled with brown most thickly on the crown and nape; lower neck, upper back, scapulars, flanks, and upper breast whitish with brown wavy bars, which become crescent-shaped on the breast; lower back dark brown, turning to black on the rump and upper tail coverts; tail and wing quills grayish-brown; the outer webs of the middle secondaries black, of the inner secondaries white; the smaller wing coverts brown, the median chestnut, the greater velvet-black; lower breast and abdomen dirty white, with indistinct brown bars towards the vent; the under tail coverts black. In the off season drakes assume female plumage.

Female: head and neck streaky brown and white, darkest above; the upper parts dark brown mottled with buff on the upper back and scapulars; breast and flanks rufous-buff spotted with brown; abdomen dirty white; wings as in the male, save that the chestnut of the median wing coverts is wanting or greatly diminished.

Young birds resemble females, but have no chestnut or black on the wings, while the lower parts are spotted throughout.

Bill in males lead-colour or blackish-brown, and in females orange ; iris brown ; legs yellowy-brown to dull orange.

Length 20 ; wing 10·5 ; tail 3·4 ; tarsus 1·5 ; bill from gape 2·1.

Females are smaller ; their wings about 9·5.

Distribution.—A recent addition to the birds of Ceylon. A single specimen, now in the Museum, was secured a few years ago at Palatupana, in the Hambantota District. A winter visitant to Northern India and Upper Burma ; rare in the south. Found nearly all over the Northern Hemisphere, breeding in the temperate zone and wintering further southwards.

Nettium crecca (Blanford, Vol. IV., p. 443).

Anas crecca (Legge, p. 1083).

The Common Teal.

Description.—Male : the head and upper neck chestnut ; a broad band of metallic green surrounds the eye and runs backwards to the nape ; a narrow buff line runs from the chin to the front of this green band, and then borders it above and below. The chin and feathers edging the upper mandible are almost black. The lower neck all round, upper back, inner scapulars, and flanks are minutely barred black and white ; outer scapulars buff with a broad black edge on the outer web ; lower back and rump brown, turning to black on the tail coverts, which are edged with dark buff. The tail and wing quills are brown ; the outer secondaries velvet-black edged with white ; outer webs of inner secondaries metallic green ; a velvet-black band on the outer web of the first tertiary ; the outer wing coverts whitish-buff, the remainder dark brown. The breast is white with black drops ; abdomen white, tinged at times with brown ; under tail coverts black in the centre and buff at the sides. Males, from about June to October, assume a plumage like that of females.

Female: upper parts dark brown, with buff or reddish edges to each feather; lower parts dirty white, sometimes with a reddish tinge; the sides and under part of the head and neck whitish speckled with brown, the upper part of the head and neck being darker. Wings and wing bar as in males, but duller, while the larger secondary coverts are white or buff.

Young birds resemble females, but have pale edges to the wing coverts.

Bill almost black; iris hazel; legs and feet brownish-gray.

Length 14·5; wing 7·25; tail 3; tarsus 1·2; bill from gape 1·7. Females are rather smaller.

Distribution.—An irregular visitant during the cold weather, chiefly to the north of the Island. At this season it is found nearly all over India and Burma. It occurs throughout Europe, Asia, and Northern Africa, breeding in the north temperate zone and wintering in the south.

Habits.—In some years this species is fairly plentiful among the lagoons in the north of the Island; at such times it spreads inland over the tank country as far south as Anuradhapura and down the east coast to the confines of the Hambantota District. It flies in considerable flocks, resting during most of the day and flighting to its feeding grounds at sunset.

Dafila acuta (Blanford, Vol. IV., p. 447).

Anas acuta (Legge, p. 1076).

The Pintail.

Description.—Male: the head and under-side of the neck dark brown; hind-neck black; on each side of the neck is a white stripe, which meets the white of the under parts; the lower hind-neck, the back, sides, and flanks dark brown, with fine wavy markings of light gray. The larger scapulars are velvet-black edged with whitish or light brown; upper tail coverts black and gray; tail black; wing coverts gray-brown, the last row bordering the wing bar being tipped with cinnamon. Primary quills brown-gray; the secondaries have the outer webs bronzed-green and purple and the ends black, tipped with white; the innermost secondary has the outer

web black with a whitish bar inside; the tertiaries are gray with a velvet-black stripe; breast and abdomen white, speckled towards the vent with gray; lower tail coverts black, the outside feathers with a whitish border. From June to October the male resembles the female, but retains the wing bar.

Female: dusky gray above, with irregular buff or white bars on the back and scapulars; the greater wing coverts and the secondaries are tipped with white, thus forming two white bands across the wing; there is no bright wing bar; primaries brown-gray. The chin and throat are whitish; the sides of the head and fore-neck white speckled with dark brown markings, which are more distinct on the lower neck. The lower parts, flanks, and under tail coverts are whitish tinged and streaked with dusky brown.

Young males resemble females, but show traces of the wing bar.

Bill black, dull lead-blue on the sides; iris dark brown; legs and feet gray-black.

Length 22 to 29; wing 11; tail 5 to 8·5; tarsus 1·6; bill from gape 2·25. Females are smaller; wing 10.

Distribution.—Appears to visit the lagoons in the north of the Island fairly regularly from November to about March. A winter visitor to scattered districts throughout India and Burma. It occurs almost throughout the Northern Hemisphere, breeding near the Arctic Circle.

Habits.—This is mostly a fresh-water bird, but with us it seems to be confined to coastal lagoons, which, however, at the season of its visit are flooded with rain water and become brackish, in some places nearly fresh.

Querquedula circia (Blanford, Vol. IV., p. 449).

Anas circia (Legge, p. 1080).

The Garganey Teal.

Description.—Male in breeding plumage: the top of the head, from crown to nape, brownish-black; a white stripe from the front of the eye to the side of the nape; the chin

black ; the remainder of the head and neck rufous-brown finely streaked with white ; back, rump, and upper tail coverts brown with pale edges to the feathers ; the scapulars, which are elongated, black with white shaft-stripes ; the outer webs of the outer scapulars and the wing coverts lavender-gray ; the tips of the secondary coverts white ; tail feathers and primary quills dark brown ; the secondaries with glossy green outer webs and white tips, tertiaries dark brown with narrow white borders. The breast is buff or brownish with concentric bars of dark brown ; abdomen white, speckled with brown towards the vent and on the tail coverts ; the flanks marked with narrow wavy dark lines.

In the off season males resemble females, but retain the bright wing bar and lavender-gray wing coverts.

Female : upper parts brown, with pale borders to each feather ; the top of the head dark brown ; a buff spot on the lores, and a white stripe running back from above the eye ; chin and throat whitish ; the sides of the head and neck and the fore-neck white, streaked with brownish-black ; the wing coverts grayish-brown or ash-coloured ; the wing bar is absent, or is merely a faint tinge of bronze-green between the white bars formed by the tips of the secondary coverts and of the secondary quills ; the breast and abdomen white, spotted towards the vent and on the flanks and lower tail coverts with brown.

Young males resemble the females.

Bill black-brown ; iris hazel ; legs and feet lead-colour to greenish.

Length 16 ; wing 7·75 ; tail 2·75 ; tarsus 1·1 ; bill from gape 1·75.

Females are rather smaller.

Distribution.—A winter visitor, chiefly to the northern lagoons, but sometimes extending down the east coast as far as Hambantota. Found at this season throughout India and Burma. It is a migratory species, breeding in Central Europe and Asia and wintering southwards.

Habits.—Very similar to those of the Common Teal. Like that species, it keeps, in Ceylon, to lagoons near the coast, though mainly a fresh-water bird.

SPATULA CLYPEATA (Blanford, Vol. IV., p. 452 ; Legge, p. 1086).

The Shoveller.

Description.—Male in breeding plumage : head and upper neck glossy green ; lower neck, breast, and shorter scapulars pure white ; the feathers of the back dark brown with paler edges ; the rump with the upper and under tail coverts black glossed with green ; tail dark brown, the outer feathers edged with white ; the wing coverts and outer webs of the two longest scapulars pale blue-gray ; the rest of the long scapulars are black with broad white shaft-stripes. The wing quills are brown ; the wing bar on the secondaries is bright green bordered by a white bar formed by the outer wing coverts ; tertiaries glossy green-black with a whitish stripe along the shafts. The lower breast and abdomen are chestnut ; the feathers round the vent and the upper flanks finely barred with buff ; a patch of white on the lower flanks. Males in undress resemble females, but are more richly coloured.

Female : feathers of the upper parts brown with broad rufous margins ; the scapulars and upper tail coverts with concentric bands of buff or rufous ; the wing coverts are duller, and the wing bar less glossy than in the male ; under parts reddish or brownish-buff speckled with brown.

Bill of male in full plumage black, in females dark brown above, lighter underneath ; iris hazel-brown in females, yellow or orange in males ; legs orange or red.

Length 20 ; wing 9·5 ; tail 3·75 ; tarsus 1·4 ; bill from gape 3.

Females are rather smaller.

Distribution.—An occasional winter visitor to the lagoons on the north coast ; rare in the south of India and Burma, much commoner in the north. It is found over most of the Northern Hemisphere, breeding in temperate climates. Layard once found a female with nestlings near Jaffna in March.

Habits.—This is usually a fresh-water species, found in small flocks round tanks and marshes. It nests in dry secluded spots in the middle of a swamp. The nest is made of flags and rushes and lined with down, the feathers of which are

small and dark brown with whitish centres. The eggs, 8 to 12 in number, are smooth gray-green or stone-green, and measure about 2·17 by 1·48.

NETTA RUFINA (Blanford, Vol. IV., p. 456).

FULIGULA RUFINA (Legge, p. 1087, note).

The Red-crested Pochard.

Description.—Male: head, throat, and upper neck reddish-chestnut, paler on the crown and rufous-buff on the longish crest; lower neck all round and upper breast glossy brown-black, which changes on the lower breast and abdomen to glossy brown; the middle of the back lighter brown darkening to brownish-black on the rump and upper tail coverts, which are slightly glossed with green; tail brown. The primaries are white at the base and whitish-brown outside, the tips of all and the outer webs of the first five quills being dark brown; secondaries creamy-white, with an outer brown border narrowly edged with white; the tertiaries and most of the wing coverts are grayish-brown; the coverts near the edge of the wing and the wing lining are white, as is a large area on the flanks and sides of the body. Males in the off season resemble females, but are more richly coloured, and have a longer crest.

Female: the upper plumage grayish-brown darkening to blackish-brown on the rump; there is no white on the wing coverts, and the secondaries are grayish-white; otherwise the wings and tail resemble those of males. The under parts are grayish-white.

Bill in males vermilion-red, the nail whitish-pink; in females the bill is black, becoming reddish towards the tip; iris in males red-brown, in females brown; legs and feet in males orange-red, in females brownish-orange.

Length 21; wing 10·5; tail 3·5; tarsus 1·75; bill from gape 2·25. Females are slightly smaller.

Distribution.—A doubtful visitor to Ceylon; said to have been seen near Jaffna by Layard. This species is a winter migrant to Northern and Central India. It breeds in Northern Africa, Southern Europe, and in Asia from the Caspian to Turkestan.

Order **PYGOPODES.**

Family Podicipedidæ.

Genus **Podiceps.**

The Grebes.

The Grebes belong to an order represented in the Indian area by a single genus, of which only one species is found in Ceylon.

The bill is fairly short, straight, and pointed. The legs are placed very far back; the small hind toe is placed above the level of the others and is lobed; the front toes are furnished each with a separate broad fringe of web, the fringes uniting only at the base of the toes. Grebes are expert swimmers and divers, but bad walkers, and seldom leave the water. Their wings are short and pointed, and their flight is usually an agitated scurry along the top of the water; but once they have mounted, they have powers of flying which enable them to travel long distances. The tail is practically wanting. The nest is composed of floating water weed or other herbage; the eggs are white; the young when hatched are covered with down, and are able to swim at once.

Podiceps albipennis (Blanford, Vol. IV., p. 476).

Podiceps fluviatilis (Legge, p. 1059).

The Indian Little Grebe, or Dabchick.

Description.—In breeding plumage the chin, the lores, the front of the cheeks, the forehead, crown, and hind neck are blackish-brown; the side of the head up to the eye, the throat, and fore-neck are chestnut; upper parts dull dark brown; the wings paler, the primaries being white at the base and the secondaries almost wholly white. The abdomen is silky white, which colour mingles gradually on the breast, flanks, and vent with the brown of the upper parts.

In the off season the crown and hind-neck are brown ; the chin turns white, and the chestnut of the head and neck is replaced by pale rufous-buff.

Young birds are paler brown above, white underneath, and pale rufous on the side of the head and neck.

Bill black with a white tip, greenish or yellowish at the base and round the gape ; iris red-brown ; legs and feet blackish-green, the inside of the tarsus pale olive-brown.

Length 9 ; wing 3·9 ; tarsus 1·3 ; bill from gape ·9.

Distribution.—Found all over the low-country wherever there are suitable sheets of water ; it has been seen on the Nuwara Eliya Lake ; occurs throughout India and Burma.

Habits.—This species may be found in little flocks on most tanks and still weedy stretches of water. The breeding season is from May to about July. The nest is usually a large round blob of floating water weed, and the eggs are always covered over with wet weed when the bird leaves them. They are long narrow ovals, dull white when first laid, but soon discoloured as incubation proceeds. The usual number is four or five, and the average size 1·36 by ·97.

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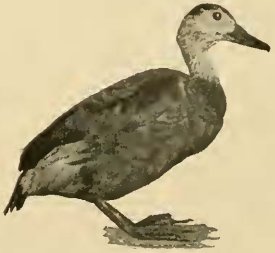

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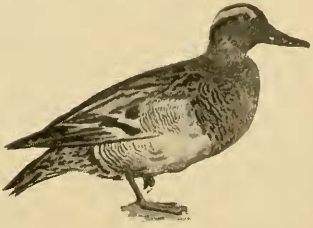

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FIG. 1. PHALACROCORAX JAVANICUS.
FIG. 2.—PUFFINUS CHLORORHYNCHUS.
FIG. 3. PLEGADIS FALCINELLUS.
FIG. 4 DISSURA EPISCOPUS

FIG. 5.—ARDEA MANILLENSIS
FIG. 6.—NYCTICORAX GRISEUS.
FIG. 7. DENDROCYCNA JAVANICA
FIG 8 QUERQUEDULA CIRCIA

ROUGH DRAFT OF CEYLON PIGEONS AND GAME BIRDS.

By W. E. Wait, M.A., M.B.O.U.

(*With a Plate.*)

THIS instalment of the rough draft comprises the Pigeons and Game Birds. In my notes on the Pigeons, while following Blanford's classification in accordance with the scheme adopted for the handbook, I have given short references to the trinomial arrangement adopted by Stuart Baker in his recently published monograph "Indian Pigeons and Doves,"* the latest work on the Indian families of this order. Unfortunately, the same author's "Game Birds of India, Burma, and Ceylon," which is now appearing serially in the Journal of the Bombay Natural History Society, has not yet treated of more than two or three species of our Ceylon game birds.

Order **COLUMBÆ.**

Pigeons and Doves.

The Pigeons and Doves form a distinct order, their nearest allies being the Sand Grouse and the Gallinaceous birds; but they differ from these two orders, in that the young when hatched are helpless and naked. In this respect they resemble the Passerine birds. Again, in certain details of their anatomy they show affinities with the Owls and Vultures.

In the bill of a Pigeon the basal portion of the upper mandible is covered with a soft skin or cere; the tip is swollen, hard, and convex, forming a sort of knob. The nostrils are narrow slits placed near the base of the bill. The wings are generally long and pointed, with eleven primary and four secondary

* Published in London, 1913, by Witherby & Co.

quills. The hind toe is placed on the same level as the front toes, and is well developed; in those forms which are wholly arboreal the soles of the foot are flat and expanded, in the species which feed on the ground they are more slender.

The birds are vegetarian, living mainly on fruit or seeds. In most cases the nest is the scantiest platform of twigs placed in a tree or bush, but some species nest on rocks.

The eggs are white or cream-coloured, oval, and usually glossy; they are generally two in number, but some Pigeons lay only one.

Classification within the order is a subject of some difficulty and divergence of opinion. The British Museum Catalogue recognizes five families, three of which contain genera found in India. Blanford, however—followed by Stuart Baker in his recent work on the Indian Pigeons and Doves—includes all the Indian representatives in one family *Columbidæ*, which he divides again into six sub-families, stating at the same time that the differences between several of these sub-families are hardly more than generic, and that he has adopted these divisions more from deference to the usual practice than from conviction.

In Ceylon thirteen species of Pigeon have been recorded, belonging to four of the six Indian sub-families. Of these thirteen, however, five are the merest stragglers, three more are local, and only five are common and widely distributed throughout the Island.

The following are the external characteristics by which our four sub-families may be distinguished :—

(1) *Treroninæ* (Green Pigeons).

Fourteen feathers in the tail; plumage mainly green, with conspicuous yellow bands on the wings; wing measurement not exceeding 8 inches; in all Ceylon species the inner web of the third wing quill is notched.

(2) *Carpophaginæ* (Imperial Pigeons).

Fourteen feathers in tail; size large; wing 8 inches or over; soles of feet flat and expanded; in Ceylon species the head, neck, and lower parts are gray.

(3) *Phabinæ* (Bronze-wing Pigeon).

Twelve feathers in tail; size small; wing under 6 inches; back and wing coverts metallic green; bill red.

(4) *Columbinæ* (Rock Pigeons, Wood Pigeons, and Doves).

Twelve feathers in tail; size variable; large forms, in which the wing is 8 inches or over, have a glossy upper plumage or a metallic lustre on the neck feathers; in smaller forms the plumage is dull-coloured and lustreless.

Sub-family *Treroninæ*.

Green Pigeons.

The Green Pigeons may be distinguished at once by their plumage, which is mainly a soft yellowish-green, and by their call, which is a low melodious whistle, not a coo.

They associate in flocks, and live almost entirely in trees, seldom descending to the ground. The soles of their feet are well adapted for perching, being flat, and considerably broader than the upper sides of the toes; the tarsus is short, and has the upper portion feathered. They feed entirely on the fruit of various trees and shrubs, and are themselves very good for the pot.

Three species are found in Ceylon: one, a very rare straggler, belongs to the genus *Crocopus*, in which the sexes are almost alike; the other two, our common Green Pigeons, are both members of the genus *Osmotreron*, in which the males differ distinctly from the females in their colouration.

Rough Key to Ceylon Species.

A.—Legs and feet yellow; wing 7·25.

Crocopus chlorogaster (Southern Green Pigeon).

B.—Legs and feet red; wing 5·6: genus *Osmotreron*.

(*a*) Middle tail feathers green; males with a maroon mantle.

O. pompadora (Pompadour Green Pigeon).

(*b*) Middle tail feathers slate-gray; males with a breast of lilac and orange.

O. bicincta (Orange-breasted Green Pigeon).

CROCOPUS CHLOROGASTER (Blanford, Vol. IV., p. 6).

CROCOPUS CHLORIGASTER (Legge, p. 722).

The Southern Green Pigeon.

Description.—Male: the forehead, top, and sides of head bluish-gray, often encroaching on the yellowish-green of the chin and throat; under parts yellowish-green, brightest on the upper breast; vent and thighs yellow; flanks grayer; under tail coverts dull purple-chestnut with broad white edges and tips of grayish-white. Round the hind-neck is a broad collar of olive-yellow, and behind this a narrower collar of bluish-gray; the rest of the upper parts, together with the wing and tail coverts, are olive-green with a yellow tinge; greater wing coverts and secondary quills edged with yellow; primaries dark brown, also more or less edged with yellow. The small coverts at the bend of the wing are lilac. The tail is gray above, the feathers being tinged with green at the base; underneath the tail feathers are gray with a broad black base.

Females, as a rule, are slightly duller, while the lilac patch on the wing is smaller and not so pronounced.

Bill greenish or bluish-white; iris with an inner circle of blue and an outer ring of carmine; legs and feet chrome-yellow.

Length up to 12·50; wing 7·25; tail about 4·5; tarsus ·9; bill from gape ·9.

Females are a little smaller. Ceylon and South Indian birds are smaller than those from Northern India.

Distribution.—In Ceylon a very rare visitor from Southern India. A few specimens have been obtained near Jaffna and at Arippu.

Blanford gives specific distinction to the southern form of this Pigeon, which ranges through Southern, Central, and North-western India.

Stuart Baker counts it as a sub-species of the Bengal Green Pigeon, *C. phœnicopterus*, and describes it as *C. phœnicopterus chlorogaster*.

Habits.—According to Layard, this species appears in Ceylon only when the fruit is ripe in the jungles. He says it is especially fond of the figs of the banyan. Like most Green Pigeons, it always perches in trees, but occasionally descends to the water to drink.

OSMOTRERON POMPADORA (Blanford, Vol. VI., p. 9; Legge, p. 728).

Pompadour Green Pigeon.

Description.—Male: forehead, lores, and cheeks greenish-yellow, becoming purer yellow on the chin and throat. Crown and nape ashy-blue, changing into ashy-green on the hind-neck and sides of neck. The mantle (*i.e.*, back, scapulars, and lesser wing coverts) chestnut-maroon. Lower back, rump, and upper tail coverts green. Central tail feathers green, the outer feathers passing into black with bluish-gray tips. Outer wing coverts and quills black, the secondaries and greater coverts boldly edged with bright yellow. Under parts yellowish-green; the flanks more ash-coloured; lower flanks and thighs dark greenish with yellowish-white tips; under tail coverts pale buff or whitish.

Female: the maroon mantle is wanting, being replaced by dark green. As a rule, the yellow edges of the wing feathers are paler, and the lower tail coverts are more marked, especially at their bases, with green and ash-colour.

Bill glaucous-green, the tip bluish; iris carmine, with an inner ring of cobalt-blue; legs and feet red with a purple tinge.

Length 10·5; wing 5·6; tail 3·6; tarsus ·8; bill from gape ·9.

Distribution.—Peculiar to Ceylon. It is abundant all over the low-country, and ranges up to about 4,000 feet. Near the sea, except in the north-east, it is largely replaced by the next species.

Stuart Baker regards it as a sub-species, which he names *O. pompadora pompadora*, uniting with it as three allied sub-species the three forms from Eastern India and Burma, the Malabar Coast, and from the Andamans, which are described by Blanford as *O. phayrei*, *O. affinis*, and *O. chloroptera*, respectively.

Habits.—The present species is common in forest country, largely in the vicinity of jungle-girt villages. In the more cultivated districts it may be found in plantations of jak or other fruit trees, but such birds are generally not such fine specimens as those from the thick jungles of Sabaragamuwa or the North-Central Province. They live entirely upon fruit, and at the season when the banyan and other wild figs are ripe their flesh is delicious. The breeding season is from about February to May, or, if the weather is favourable, right on to August. The nest is a scanty mesh of twigs placed in the small branches of a tree, usually about 10 to 20 feet from the ground. Sometimes two, often only one egg is laid. They are broad blunt ovals, white and smooth in texture. The average size is about 1·12 by ·90.

OSMOTREREON BICINCTA (Blanford, Vol. IV., p. 11 ; Legge, p. 725).

The Orange-breasted Green Pigeon.

Description.—Male : the forehead, crown, face, and throat yellowish-green, passing into delicate blue-gray on the nape and hind-neck. Back, wing coverts, and tertiaries are green, shading into bronze-green on the rump and upper tail coverts. Tail ashy-gray, with a dark broad cross-band, which is most marked on the outer, and indistinct on the central, feathers. Wing quills black ; the primaries and secondaries are narrowly edged with bright yellow, the outer coverts and tertiaries with deep borders of the same colour.

The upper portion and sides of the breast are lilac, the lower breast orange ; abdomen yellowish-green, shading into pure yellow round the vent ; thigh plumes yellow with broad centres of ashy-green ; under tail coverts cinnamon.

Females have no lilac and orange on the breast, which is yellowish-green ; the under tail coverts are paler, the outer webs being almost white.

Bill glaucous-green, pale blue on the tip ; iris cobalt-blue, with an outer ring of carmine ; legs pinkish-red.

Length 10·5 ; wing 5·6 ; tail 3·7 ; tarsus ·75 ; bill from gape ·8.

Females are slightly smaller.

Distribution.—Common all round the coast, except in the palm belts, where it keeps a little further inland; it is also found over a good part of the low-country in the interior.

Blanford unites in one species the larger northern form of this Pigeon, which is found in Bengal, Assam, and Burma, ranging eastward to South China and south-eastwards to Malaya, with the decidedly smaller form from Southern India and Ceylon. Stuart Baker distinguishes the latter as a subspecies, *O. bicincta bicincta*.

Habits.—The present species, though often found in the same locality as the Pompadour Green Pigeon, is rather fonder of lower jungle or even scrub. In the chena districts in the Southern Province it has taken kindly to the fruit of the *lantana;* it also feeds on wild dates and the berries of various shrubs, as well as on wild figs and other forest fruits. Like all Green Pigeons, these birds will swarm on the boughs of a favourite fruit tree, and their plumage so harmonizes with the foliage that unless they move it is almost impossible to see them. The call is a low soft whistle, like that of the last species, but generally preceded by a funny little chuckle.

The breeding season is from February till May, and sometimes again from July till September. I have found a fair number of nests, always by the side of a path or clearing and placed from 6 to 10 feet up in a low tree or tall shrub. Two white eggs of the usual type are laid on a very scanty structure of twigs. During the day incubation is carried on by the male, which sits so close that one can almost touch it.

The average size of the eggs is about 1·10 by ·88.

Sub-family *Carpophaginæ.*

Imperial Pigeons.

The Imperial Pigeons are large fruit-eating species with arboreal habits resembling those of Green Pigeons. In their structure they are more akin to the Common Pigeon. The toes are stout, the sole broad and flat. Two species have occurred in Ceylon: one is fairly common; the other owes its place in the list to a single and recent record.

Rough Key to Ceylon Species.

A.—Mantle green with a metallic gloss.

Carpophaga ænea (Green Imperial Pigeon).

B.—Mantle olive-brown with little or no gloss.

Ducula cuprea (Jerdon's Imperial Pigeon).

CARPOPHAGA ÆNEA (Blanford, Vol. IV., p. 19 ; Legge p. 718.)

The Green Imperial Pigeon.

Description.—The head, neck, and the lower parts to the vent pale dove-gray, sometimes tinged wholly or in part with vinous. The short feathers adjoining the bill are generally white. Back, rump, upper tail coverts, and wings bronze-green with a metallic lustre ; tail deep slaty-green above with less lustre than the back, underneath yellowish-gray. Wing quills blackish, tinged on the outer webs with gray, and changing gradually on the secondaries into the same colour as the back feathers. Lower tail coverts liver-coloured.

Bill grayish-green, bluish at the tip, and dull red by the nostrils ; iris deep red ; legs and feet dull lake-red.

Length 16 ; wing 8·25 ; tail 5·5 ; tarsus 1 ; bill from gape 1·3. Ceylon birds are considerably smaller than those from Northern India.

Distribution.—Fairly common throughout the low-country wherever there is high forest. In India it occurs in heavy forest on the Malabar Coast, and in similar country up the east coast through Bengal and Assam to Burma and the south-eastern portion of the Oriental region.

Habits.—A forest-loving species, commonest in the wilder districts. In the jungles of the northern and south-eastern parts of the Island, where the rainfall is not very heavy, it may be found in the strips of tall timber which fringe the streams and tanks.

The birds are generally very shy, but like the Green Pigeons they are greedy fruit eaters, and when the berries are ripe on a favourite tree they will flock to it in the morning and early

evening. At such times they can be approached with more chance of success. Old birds are apt to be tough, but young ones are tender and good to eat. The call is a fine deep dissyllabic coo.

The nest is the usual scanty saucer of twigs placed at a height of about 20 feet or more on a tree in the heart of the jungle. The nesting season appears to be in April and May. A single smooth white egg is laid, measuring about 1·65 by 1·30.

DUCULA CUPREA (Blanford, Vol. IV., p. 22 ; not in Legge).

Jerdon's Imperial Pigeon.

Description.—Upper part of head, neck, and shoulders pale lilac-gray, remainder of upper plumage, including wings, dark olive-brown, with little or no gloss ; rump and upper tail coverts almost the same colour as the back ; basal portion of tail dark chocolate-brown, outer third lighter brown. Chin and throat white ; remainder of lower parts grayish-lilac ; abdomen and hinder flanks tinged with ochreous ; under tail coverts buff with dusky freckles.

Bill dull lake-red at the base, slaty at the tip ; iris reddish-brown ; legs dull lake-red.

Length 17 ; wing 8·75 ; tail 7 ; tarsus 1·1 ; bill from gape 1·4.

Distribution.—In recent years a breeding bird and an egg have been obtained in the Ratnapura District.* In India this Pigeon, which is considered by Stuart Baker to be a sub-species of the Himalayan form *D. insignis*, occurs on the Nilgiris and other hill ranges near the Malabar Coast.

Habits.—This species has only recently been discovered in Ceylon, but as the nest and egg were taken, it would appear to be a very rare resident in the jungles of the Adam's Peak range. In the South Indian hills it keeps to heavy forest, but at certain seasons it migrates in large numbers to the coast to feed on the buds of various plants which grow in salt-water swamps.

The breeding season in Southern India is from January to April and again in November.

* *Vide* Stuart Baker, "Indian Pigeons and Doves," p. 107.

The egg obtained in Ceylon was taken in October. The nidification resembles that of the last species. The average size of the egg is 1·75 by 1·29.

Sub-family *Phabinæ*.

Genus **Chalcophaps.**

Bronze-wing Pigeons.

This sub-family contains a considerable number of genera and species from Africa, Asia, the Malay Archipelago, and Australia, but only one species is found within Indian limits. The feathers of the mantle have a metallic lustre; the wing is moderately long, the tail short and slightly rounded; the tarsus is slender and not feathered, the toes are slender and adapted to the terrestrial habits of the bird.

Chalcophaps indica (Blanford, Vol. IV., p. 26; Legge, p. 714).

The Bronze-wing Pigeon.

Description.—Male: forehead and eyebrow white, changing to slate-gray on the crown and nape. The sides of the head, the neck all round, and the upper breast are deep vinous-red, which pales gradually on the lower breast and abdomen; the gray of the nape may be continued more or less indistinctly down the hind-neck. The back and wing coverts are golden green with a varying amount of bronze sheen. The primaries, secondaries, and greater primary coverts are dark brown, the outer webs of the secondaries glossed with green, the small wing coverts at the shoulder of the wing vinous-red fringed with white. The lower back is coppery-brown with two blue-gray cross-bands; rump and upper tail coverts blackish-brown; tail blackish-brown, the outer feathers gray, with a black cross-bar towards the tip.

In females the white patch on the forehead and eyebrow is smaller, and at times almost absent; there is no slate-gray on the crown and nape, and the white patch on the shoulder of the wing is lacking. The upper tail coverts are chocolate-brown with dark tips; the middle four tail feathers are reddish-brown, the next pair redder with darker tips, and the outermost pair, as in the male, gray with a black cross-bar.

Bill red ; iris dark brown ; legs coral-red.

Length 10·5 ; wing 5·6 ; tail 3·75 ; tarsus 1 ; bill from gape ·9.

Distribution.—Found almost all over the Island wherever there are forests. In India it occurs in most forest districts with sufficient rainfall. Common throughout Burma, and extends through South-eastern Asia to New Guinea and the Philippines.

Habits.—Essentially a bird of the forest ; it feeds largely on the ground, and may often be seen on roads and paths through the jungle, picking up any grain which has been spilled at wayside halts. In the low-country it is also very fond of the little open spaces made in the jungle by the outcrops of bare slab rock, coming to drink from the water-holes in the crevices. The call is a soft deep " hoo." The flight is low and swift. There are probably several broods during the year, and the nest may be looked for at any time from February to June : it is a more compact structure than that of most Pigeons, placed in a tall bush or low tree from 5 to 10 feet above the ground.

The two eggs are not white, but buff or cream-coloured, and their average size is about 1·05 by ·83.

Sub-family *Columbinæ.*

Rock Pigeons, Wood Pigeons, and Doves.

This sub-family includes the typical Pigeons and Doves, of which seven species are found in Ceylon. These seven species are distributed amongst four genera, which vary considerably in size and colour of plumage—superficial distinctions without any correspondingly important structural differences. In the Rock Pigeons—genus *Columba*—the plumage is mainly gray with some metallic lustre about the neck ; the wings are fairly long and pointed, the tail is short, the tarsus is not feathered, and the feet are formed for walking, with slender toes and narrow soles. The Indian Wood Pigeons—genus *Alsocomus*—have a dark plumage, the greater part of it lustred with a changeable metallic sheen. In habits they approach the Imperial Pigeons, being arboreal and fruit eaters. The Turtle

Doves—genus *Turtur*—are smallish birds, clad in rather sober brown or gray, with small heads, slender necks, and weak bills. The wing is long and pointed, the legs short, and the foot formed for walking. The sexes are similar. The genus *Œnopopelia* contains one small Dove, which has been placed apart owing to the difference in plumage between the sexes and the comparatively longer wing.

Rough Key to Ceylon Columbinæ.

A.—Size large ; wing 7·5 inches or over.

(*a*) Secondaries barred with black, a metallic lustre on neck.

Columba intermedia (Indian Rock Pigeon).

(*b*) No bars on wing quills, plumage iridescent.

(1) A patch of black feathers with white tips on either side of the hind-neck.

Alsocomus torringtoniæ (Ceylon Wood Pigeon).

(2) Mantle chestnut, the hind-neck without a mottled patch.

A. puniceus (Purple Wood Pigeon).

B.—Size smaller ; wing under 7·5 inches, plumage dull.

(*a*) Sexes alike ; second and third wing quills longest.

(1) A patch of black feathers tipped with gray on each side of the neck ; wing 7·25.

Turtur ferrago (Indian Turtle Dove).

(2) A collar, round the back of the neck, of black feathers, each tipped with a white spot ; wing 5.

T. suratensis (Spotted Dove).

(3) A collar of plain black round the back of the neck ; wing 6·5.

T. risorius (Indian Ring Dove).

(*b*) Sexes unlike ; first and second quills longest ; wing 5·5.

Œnopopelia tranquebarica (Red Turtle Dove).

COLUMBA INTERMEDIA (Blanford, Vol. IV., p. 29; Legge, p. 698).

The Indian Rock Pigeon.

Description,—Head slate-gray; neck glossed all round with metallic green changing into purple, especially on the lower hind-neck and upper breast; back and wings ashy-gray; rump, upper tail coverts, and tail darker, the tail being broadly tipped with black. There is a black bar across the greater wing coverts, also a second black bar formed by the tips of the secondaries, together with a broad band on the tertiaries; primaries grayish-brown; under plumage dark slate-gray; wing lining whitish.

Bill black, the cere grayish-white; iris brownish-orange; legs and feet pinkish-red.

Length 13·25; wing 8·75; tail 4·75; tarsus 1·1; bill from gape 1.

Distribution.—In Ceylon very local; confined to a few colonies on rocky islets off the coasts of the Trincomalee District and of the Southern Province, and on one or two of the isolated hills in the northern forest tract. This Pigeon, which is merely the eastern form of the European Rock Pigeon *C. livia*, and which is classified by Stuart Baker as a sub-species *C. livia intermedia*, is found practically all over India, especially in the west and north-west, and in the drier parts of Burma.

Habits.—This species roosts and breeds in colonies in the crevices of cliffs and rocks. It feeds on grain, especially paddy. In India it is commonest in cultivated country, and it is strange that it is not more abundant in this Island. According to Legge, in the Trincomalee District it breeds in May and June, but off the Hambantota coast I have taken the eggs in February. The nests were placed in the jagged rifts of a low rocky islet, and consisted of a few twigs mixed with some dry grass and feathers. The eggs are a smooth glossy white, their average measurement being about 1·45 by 1·12.

ALSOCOMUS TORRINGTONIÆ (Blanford, Vol. IV., p. 36).

PALUMBUS TORRINGTONIÆ (Legge, p. 694).

The Ceylon Wood Pigeon.

Description.—Male: head and nape lilac-gray, with a lilac and green gloss; a patch on the back and sides of the neck black, with broad white tips to the feathers; the sides of the neck and the upper back are glossed with reddish-lilac; rest of the upper parts, including wings and tail, blackish-brown; rump blackish-gray; chin and middle of throat whitish; lower neck and breast lilac, glossed as on the upper back, but not so intensely; lower breast and abdomen paler; under tail coverts ashy-brown with a reddish tinge.

Females are similar, but the head, chest, and under surface are more ruddy, and there is a deeper coppery hue on the lower hind-neck.

Bill lead-coloured at the base, bluish at the tip; iris pale red; legs red in front, paler behind.

Length about 14; wing 7·6; tail 5·25; tarsus ·9; bill from gape 1.

Distribution.—Peculiar to Ceylon; found only in the hill forests, mostly above 4,000 feet, but occasionally as low as 2,500.

Habits.—A shy forest bird feeding entirely on fruit, especially wild cinnamon.

Like many fruit-eating pigeons, it roams about a good deal in search of its food, moving from locality to locality as the various jungle fruit trees ripen. The flight is powerful. The call is a deep "hoo," rather like the hoot of an owl. Little is known of its nidification. It would appear to breed during the north-east monsoon, making a slight stick nest placed in forest trees at a height of about 20 feet. Probably only one egg is laid, of a pure glossy white, and measuring about 1·50 by 1·12.

ALSOCOMUS PUNICEUS (Blanford, Vol. IV., p. 38; Legge, p. 696).

The Purple Wood Pigeon.

Description.—The top of the head from the forehead to the nape and a line under the eye grayish-white; neck, cheeks, and throat pale chestnut-brown; back, scapulars, wing coverts,

and tertiaries rich chestnut, the feathers edged with glossy green and amethyst, the green predominating on the shoulders and the amethyst on the inter-scapulars and back ; rump and upper tail coverts dark slaty-gray, almost black, and edged with amethyst ; wing quills and tail blackish-brown ; lower plumage, including wing lining, pale vinous-chestnut ; under tail coverts rather paler than the tail.

Bill, the horny tip bluish-white, basal portion lake-pink ; iris orange ; legs and feet purple-red.

Length 16 ; wing 8·75 ; tail 6 ; tarsus ·9 ; bill from gape 1·1.

Distribution.—A specimen, probably a chance straggler, was once obtained by Layard in Ceylon. The species is unknown in Southern India, its range extending from the forests of Eastern Bengal through Burma to Cochin-China and Malaya.

Habits.—In India this Pigeon is found in forests near cultivation. It feeds both on fruit and on grain. Natives informed Layard that it visited Ceylon when the cinnamon fruit was ripe, and Legge thought he once saw a flock in the cinnamon near Borella. No specimens are likely to be found breeding.

TURTUR FERRAGO (Blanford, Vol. IV., p. 412).

TURTUR PULCHRATUS (Legge, p. 711).

The Indian Turtle Dove.

Description.—Head, neck, and back brown with a vinous tinge, the margins of the feathers shading into a dull rusty colour, and the forehead and crown often with a blue-gray bloom. On each side of the neck is a patch of black feathers tipped with blue-gray ; the scapulars, the greater part of the wing coverts, and the tertiaries are slaty-black with broad rufous-brown borders. The outer wing coverts are bluish-gray, lightest at the tips ; wing quills brown with a pale line on the outer border ; lower back and rump bluish-gray ; upper tail coverts slaty-brown with pale margins. The tail is blackish-brown ; all the feathers, except the middle pair, have pale gray tips, the tip and outer web of the outermost feathers being almost white.

The face and throat are pale ashy-brown, the chin and centre of the throat almost white; neck and breast vinous-gray; abdomen whitish; flanks and wing lining ashy-blue, under tail coverts pure white.

Young birds have no neck patch, and are duller brown, while the feathers of the back, wing coverts, and breast have pale borders.

Bill dull slate-colour, the cere and base reddish; iris light orange; legs and feet dull or purplish-red.

Length 13; wing about 7·25; tail 5·25; tarsus ·85; bill from gape ·95.

Distribution.—Stragglers have been recorded from Ceylon twice. The species is migratory, spreading in winter over nearly the whole of India, and breeding in the Himalayas and Central Asia. Stuart Baker regards it as a sub-species of *Turtur* (*streptopelia*) *turtur*, the European Turtle Dove.

Habits.—The bird may be looked for about Christmas time in the wetter districts of the Island. Its habits are very much those of the common Ash Dove.

Turtur suratensis (Blanford, Vol. IV., p. 43; Legge, p. 705).

The Spotted Dove; Ash Dove.

Description.—The upper part of the head and nape are vinous-gray, grayer on the forehead and above the eye; a black spot between the eye and the bill; the sides and back of the neck are black, each feather bifurcate and with two white spots on each fork. On the upper back the black ground-colour shades into brown and the white spots into rufous, while the feathers become less forked; on the lower back and rump the spots are replaced by pale rufous fringes. The scapulars and wing coverts are brown at the base and grayish-rufous at the tip, with wedge-shaped black-brown shaft-stripes; primary and greater wing coverts bluish-gray with some brown; wing quills blackish-brown. The tail coverts are ash-brown, the tips marked with a dark central wedge and paler fringes on each side. The four central tail feathers are brown, the remainder almost black, with slate-gray ends becoming paler and broader on the outer feathers.

The chin and centre of the throat are whitish, the rest of the throat and the breast vinous ; the centre of the abdomen and lower tail coverts whitish, the tail coverts often spotted at the tips with black.

Young birds have no black and white collar, are duller in colour, and less spotted on the back and wing coverts.

Bill dark lead-colour ; iris hazel with a reddish outer ring ; legs and feet lake-red.

Length 11·25 ; wing 5 ; tail 5·25 ; tarsus ·85 ; bill from gape ·7. Ceylon birds are smaller than Indian.

Distribution.—Abundant all over the Island up to about 3,000 feet ; found all over India ; replaced in Burma by *Turtur* (*streptopelia*) *tigrinus*, which is considered by Stuart Baker to be only a sub-species of the present form.

Habits.—A ground feeder, living on paddy, other grains, and grass seeds. It may be seen in swarms about native threshing-floors and newly-reaped paddy fields or in chenas searching for the grains which have been dropped. The nests may be taken at almost any time of year. They are small slight saucers of twigs, usually placed in thorny bushes or low trees about 5 to 10 feet above the ground. Generally two eggs are laid, but sometimes only one. They are broad ovals of pure white, measuring about 1·02 by ·80.

Turtur risorius (Blanford, Vol. IV., p. 46 ; Legge, p. 702).

The Indian Ring Dove.

Description.—Head and neck gray with a lilac tinge, the forehead paler and the chin almost white. On the sides and back of the lower neck runs a collar of black bordered above and below with a narrow edge of white. The upper plumage from this collar to the tail, including the wing coverts, is brownish-gray. The outer wing coverts and secondary quills are largely tinged with bluish-gray ; primary coverts and quills dark brown. The middle tail feathers are brownish-gray, the outer feathers grayer with whitish tips, the white increasing towards the sides. Breast lilac-gray passing through dove-gray on the abdomen and flanks into slate-gray on the lower tail coverts. Wing lining very light gray.

Bill black ; iris crimson ; legs and feet purple-red.

Length 12·25 ; wing 6·5 ; tail 5 ; tarsus ·9 ; bill from gape ·9.

Ceylon birds are slightly smaller than Indian.

Distribution.—Confined to the dry north-west coast district from Jaffna to Puttalam. Within these limits it is fairly common. It occurs in open country nearly all over India, except on the Malabar coast. The Burmese form is separated by Stuart Baker as a sub-species—*Turtur* (*streptopelia*) *risoria xanthocycla*.

Habits.—Found in open country dotted with scrub jungle ; it is especially fond of places in which *Euphorbia* trees are abundant. The note is much deeper than that of the Ash Dove, and consists of three syllables, " kookoo—koo," repeated two or three times. It feeds principally on grain, but sometimes on fruit. The nest is the usual small saucer of twigs placed generally in *Euphorbia* trees from 5 to 15 feet above the ground. The two white eggs measure about 1·14 by ·90.

ŒNOPOPELIA TRANQUEBARICA (Blanford, Vol. IV., p. 47).

TURTUR TRANQUEBARICUS (Legge, p. 708).

The Red Turtle Dove.

Description.—Male : upper part of the head and neck dark ashy-gray ; a black collar round the sides and back of the neck ; back, scapulars, wing coverts and innermost secondaries, together with the greater part of the lower plumage, vinous-red, paler on the breast and fore-neck ; primary coverts and quills blackish-brown ; lower back, rump, and upper tail coverts dark slate-gray ; the middle tail feathers brown tinged with gray, the next feathers dark gray at the base and with pale ends, the outermost pair being black at the base with the whole outer web and the end half of the inner web white. Chin and vent whitish, flanks and wing lining very pale gray ; under tail coverts white.

Female : the upper plumage is brown ; the black collar and colouring of the tail as in the male ; the forehead and crown, the rump, flanks, and edge of the wing are grayish, and the breast brownish-gray, often with a vinous tinge.

Young birds resemble females, but have no collar, while the feathers of the back and wings have pale edges.

Bill blackish ; iris dark brown ; legs dull red or brownish.

Length 9 ; wing 5·5 ; tail 4 ; tarsus ·7 ; bill from gape ·75.

Distribution.—Layard once found a small colony breeding in the Jaffna peninsula. The species occurs throughout the greater part of India. Stuart Baker gives a sub-specific title—*Oe. tranquebarica humilis*—to the Burmese race, which ranges eastward to China and the Philippines.

Habits.—This tiny Dove should be looked for in the dry north-west district, where it may possibly be re-discovered. The birds found by Layard, probably in April, were nesting on the dry leaf-stems of a palmyra palm. The nest and two eggs are of the usual Dove type. The average measurement of the eggs is 1·02 by ·8.

Order **GALLINÆ.**

Sub-order ALECTOROPODES.

Family Phasianidæ.

The game birds, which in one form or another are found nearly all over the world, constitute a well-marked order. The body is plump, the wings are rounded with ten primary and five secondary quills, while the legs and feet are well developed for running and walking, and the bill is stout. In many genera the tarsus is furnished with a spur, sometimes with more than one. The hind toe is present, and in the family to which all our Ceylon species belong it is short and raised above the level of the three front toes. In this family, too, the tarsus and toes are naked.

As a general rule the nest is placed upon the ground ; the nestlings are covered with down when hatched, and can run about almost as soon as they come out of the eggs.

Compared with many parts of India, Ceylon is poorly stocked with game birds. Only eight species, distributed amongst seven genera, have been authentically included in our list ; most of them are rare or local, while two are peculiar to the Island.

Turning to the characteristics of the various genera, the Peacocks—*Pavo*—and the Jungle Fowl—*Gallus*—are too well known to require much description. The Spur Fowl—*Galloperdix*—belongs to an Indian genus, which in structure shows affinity with the Pheasant and Jungle Fowl, but which in appearance approximates to the Partridge. Of the Quail group, the Chinese Quail is placed in a separate genus—*Excalfactoria*—owing to slight differences in the wing and tail feathers, and to the greater dissimilarity between the sexes in the colouration of the under parts.

The true Quails—*Coturnix*—are almost unknown in Ceylon; one species has recently been authenticated, while another may possibly occur. In parenthesis, it should be noted that the Bustard Quail, the "Quail" of Ceylon sportsmen, is not a true game bird, but belongs to the next order. The Bush Quails—*Perdicula*—form another Indian genus. They are little larger than Quails, but rather resemble Partridges in their habits, structure, and unspotted eggs. The list is closed by the Francolins—*Francolinus*—a Partridge-like genus with many African and five Indian species, two of which are found within our limits.

Rough Key to Ceylon Species.

A.—Size large; wing 6 inches or over.

(*a*) Wing about 20 inches in males, 16 in females; an erect crest on the crown.

Pavo cristatus (Peafowl).

(*b*) Males with a large fleshy comb; wing about 9·5. Females with a rudimentary comb; the wing about 7·5.

Gallus lafeyetti (Ceylon Jungle Fowl).

(*c*) No comb; a naked patch round the eye; wing 6 to 6·5.

Galloperdix bicalcarata (Ceylon Spur Fowl).

B.—Size small ; wing under 4 inches.

(*a*) Tail of 8 feathers ; * wing 2·75.
Excalfactoria chinensis (Chinese Quail).

(*b*) Tail of 10 or 12 feathers ; * first and second wing quills longest ; no spur ; wing 3·5.
Coturnix coromandelica (Black-breasted Quail).

(*c*) Tail of 12 feathers ; fourth wing quill longest, males with a blunt spur ; wing 3·25.
Perdicula asiatica (Bush Quail).

C.—Size medium ; wing about 5·5 ; face completely feathered.

(*a*) Back black and white.
Francolinus pictus (Painted Partridge).

(*b*) Back brown and buff.
Francolinus pondicerianus (Gray Partridge).

Pavo cristatus (Blanford, Vol. IV., p. 68 ; Legge, p. 731).

The Common Peafowl.

Description.—Male : the head, face, and throat are covered with short feathers of metallic green and blue, the blue predominating on the crown and the green elsewhere ; from the crown springs an erect crest of feathers with almost naked shafts and fan-shaped tips of black fringed with blue-green ; the neck all round and upper breast are a rich metallic blue. The back feathers are metallic green with black circular margins at the tip and dark wedge-shaped stripes adjoining the shafts, which are green. These feathers shade into the bronze-green plumes of the long train with their ocelli of purple and black ringed by blue-green, copper, green, and bronze. The scapulars, wing coverts, and tertiaries are buff-barred and mottled with black. The primary coverts and quills are chestnut, the secondary quills blue-black ; some of the secondary coverts are black glossed with purple and green. The tail is brown ; the breast and flanks glossy dark green ; the abdomen and fluffy lower tail coverts dark brown ; the thighs buff.

* The tail feathers in these species are concealed by the tail coverts.

Female : head and nape chocolate-brown ; the tips of the crest feathers chestnut fringed with green ; the upper plumage brown ; the coverts of the wings and tail finely mottled with buff, the quills darkish brown ; a patch on the throat and sides of the neck whitish ; below this the neck is chestnut, changing on the lower neck to metallic green ; breast feathers dark brown glossed with green and with broad buff fringes ; abdomen whitish-buff ; vent and fluffy under tail coverts dark brown.

Young males resemble females, save that the primary quills are chestnut or partly so.

Bill horny brown ; naked skin of face grayish ; iris dark brown ; legs and feet fleshy-brown.

Male : length without train about 47 ; tail 22 ; wing 20 ; tarsus 5·75 ; bill from gape 2 ; the train in old birds may be up to 5 or 6 feet.

Females are smaller ; length about 38 ; wing 13 to 16 ; tarsus 5 ; bill 1·75.

Distribution.—Found in the scrubby tracts of the dry coast zone from Puttalam to Jaffna, and down most of the east coast as far south as Ranna, a little east of Tangalla. It also occurs inland in the park country as far north as Polonnaruwa, and there are a few isolated colonies at the heads of some of the largest tanks in the North-Central and Northern Provinces.

It is common in suitable districts throughout the low-country in India. In Burma it is replaced by an allied species.

Habits.—Peafowl are most common in scrub jungle or forest adjoining wild open spaces, in which the birds can come out to feed on grass seeds, insects, and small reptiles. In the forenoon and towards nightfall they perch on the branches of tall trees, from which they can keep a good look out. The cocks are polygamous, and may often be seen attended by four or five hens ; in the mating season they spread their trains and execute fantastic step dances to show off before their partners. The cry is a loud harsh " pee-auw." During the rains of the north-east monsoon or a little later the hen lays four or five eggs in a small hollow of the ground, which it

lines with dry grass or leaves. The eggs are broad ovals measuring about 2·70 by 2·15; in colour they are brownish-buff. The shell is extremely thick, much pitted, and fairly glossy.

Gallus lafeyetti (Blanford, Vol. IV., p. 77; Legge, p. 736).

The Ceylon Jungle Fowl.

Description.—Male: the hackles of the neck and the smaller wing coverts are golden or straw-yellow with dark shaft-stripes; on the crown the feathers shade into chestnut, on the back, scapulars, medium wing coverts, and elongated feathers at the side of the rump into shining yellowish-red with almost black shaft-stripes. The feathers of the lower back and centre of the rump are amethyst with reddish-chestnut margins; the greater wing coverts are black splashed with dull chestnut; primary quills dark brown, secondaries black with a metallic purple gloss; tail coverts glossy violet; tail feathers black with a purple and steel-blue gloss. The fore-neck is glossy purple, the breast bright chestnut with dark shaft-stripes, shading through reddish-brown on the upper abdomen into dull blackish-brown with rufous edges on the thighs and towards the vent. The under tail coverts are green-black.

Female: the crown is dark brown, the sides and back of the neck blackish-brown with rufous edges to the feathers. These colours gradually shade into the fine vermiculated blackish-brown and buff of the back, scapulars, and wing coverts. The rump and tail are similarly coloured, but the shafts of the feathers are darker. The primary quills are dark brown with lighter mottlings on the outer web; the secondaries and greater wing coverts are black, boldly marked with mottled buff cross-bars and tinged at the ends with rufous. The chin and throat are almost naked; the fore-neck and breast are mottled black and brown with broad buff centres; the lower breast and abdomen are white with broad black markings, which disappear towards the vent. The under tail coverts are of the same colour as the tail.

Young males resemble females, but the upper plumage is more rufous, and there is no white on the under parts.

In the male the bill is brownish-red, paler at the tip and on the lower mandible ; comb orange-yellow, shading into bright red on the edge ; the naked face, throat, and wattles are purplish-red ; iris light yellow ; legs and feet pale yellow, darker down the front ; tarsus armed with a sharp spur.

In females the bill is dark brown, paler beneath ; iris olive-yellow ; feet and legs as in the male.

Male : length about 27 ; wing 9·5 ; tail 13 to 15 ; tarsus 3·25 ; bill from gape 1·2.

Female : length about 14 ; wing 7 ; tail 4 ; tarsus 2·5 ; bill 1·1.

Distribution.—Peculiar to Ceylon. Found in most parts of the Island, except in the more cultivated districts. Its chief haunts are the forests of the north and the scrub jungle of the dry maritime districts. It ascends in great numbers to the Horton Plains and other elevated plateaux when the *nellu* (a species of *Strobilanthus*) is ripe to feed on the seeds.

Habits.—A jungle bird living largely in the cover of the undergrowth. In the morning and evening, especially after rain, it comes out on the roads, jungle paths, and open spaces in the forest to feed ; during the heat of the day it keeps well inside the jungle, and at night time roosts in trees. The cry of the cock, "cluck—joy-joyce," may be heard constantly from sunrise till about 9 A.M. ; the hen has a curious little metallic clucking cry. The cocks are polygamous, and leave all family cares entirely to the hens. I have taken the eggs in February, April, June, and August, so the breeding season extends over a considerable period. The nest is sometimes a small hollow in the ground under a bush or behind a fallen log, the eggs resting on a few dry leaves. I have, however, often found it in such situations as on the stump of a felled tree, in the tangle of dry leaves caught up by a bush overhanging a water-course, or in an oven-shaped hollow in a tree trunk. The eggs vary in number from two to four. In shape they resemble those of a domestic hen. The ground colour is creamy-white with light brown or purple-brown markings, which vary from an excessively fine stippling all over the egg to comparatively large and scattered freckles. Their average size is 1·82 by 1·39.

GALLOPERDIX BICALCARATA (Blanford, Vol. IV., p. 109 ; Legge, p. 742).

The Ceylon Spur Fowl.

Description.—Male : the top of the head, the back and the sides of the neck, the upper back, the sides of the breast, and the flanks are black with white shaft-stripes, which are narrowest on the head and broadest on the flanks. The inter-scapulars, scapulars, and wing coverts have conspicuous white wedge-shaped shaft-stripes surrounded by a broad black border, the rest of the feather being chestnut vermiculated with black. The lower back, rump, and tail coverts are rufous chestnut finely mottled with black. The primary quills are dark brown ; the secondaries mottled with chestnut ; the tail black, with minute indistinct chestnut mottlings. The feathers of the face and throat are white edged with black, the chin white ; the centre of the breast and the upper abdomen are white with black borders, giving a scaly effect ; the lower abdomen is dirty brown mixed with whitish-gray ; the under tail coverts brownish-black with paler tips.

Female : head and hind-neck blackish-brown ; the chin is whitish ; most of the remainder of the plumage dull chestnut finely mottled with black, except on the breast ; wing quills and tail as in the male.

Bill, legs, and feet red ; naked skin round the eye red ; iris yellowish-brown. In males the tarsus is armed with spurs, generally two on each leg ; sometimes the number is uneven. Females are generally without spurs ; if they are present, they are small and often uneven in number.

Length 13·5 ; wing 6·5 ; tail 4 ; tarsus 2 ; bill from gape 1 ; females are smaller, length 11·75 ; wing 6.

Distribution.—Peculiar to Ceylon. It is found up to about 4,500 feet in the central hill zone and in the forests of the damp zone. In the north it does not extend much beyond the foothills of the main ranges ; in the south-east it spreads further into the dry flat country between the hills and the sea.

Habits.—The " Haban-kukula " is a very shy bird. Like the English Corn-crake, it is constantly heard but seldom seen, and possesses undoubted powers of ventriloquism. In

the foothills of the Southern Province, where it is very common, its piping note may be heard nearly all the morning among the undergrowth and *lantana* scrub.

The breeding season appears to be from about November to March or April, and occasionally again in July and August. Usually two eggs, sometimes more, are laid in a slight hollow of the ground under a bush in the jungle. In colour they are cream or *cafe-au-lait*, at times with a few white chalky specks. In shape they are long ovals, slightly pointed at the narrow end. The average size is 1·60 by 1·16.

EXCALFACTORIA CHINENSIS (Blanford, Vol. IV., p. 112).

COTURNIX CHINENSIS (Legge, p. 755).

The Blue-breasted Quail.

Description.—Male: upper plumage in general is brown vermiculated and blotched with black; in younger birds the feathers of the back and rump have conspicuous white shaft-stripes; in very old birds these fade away, and the upper parts are largely tinged with bluish-gray. In some birds the larger wing coverts are washed with chestnut. The wing quills are dull brown, the tail slaty-blue edged with chestnut, in old birds entirely chestnut. The sides of the head are slaty-gray or brownish; the chin and throat black, bordered on each side by a white cheek stripe edged above with black; lower fore-neck white, bordered by a band of black; the upper breast, the sides of the breast, and the flanks bluish-gray; the rest of the under surface chestnut.

Female: on the upper parts the plumage resembles that of young males, but there is more black on the scapulars and wing coverts. The forehead, eyebrow, face, chin, and throat are pale rufous-brown, lightest on the chin and throat; lower parts buff, with black cross-bars on the breast, flanks, and thighs.

Bill black, lead-coloured at the base; iris in adult males crimson, in young males and in females yellowish-red; legs and feet yellow.

Length 5·5; wing 2·75; tail ·9; tarsus ·85; bill from gape ·45.

Distribution.—Found here and there in the low-country and in the hills up to about 3,500 feet. Rare in Southern India, commoner in Bengal and the plains of Northern India; ranges eastwards through Burma to South-eastern Asia and Southern China.

Habits.—Nowhere in the Island is this species very common; it is occasionally met with in damp grass, especially round the edges of tanks and in rough grassy paddy fields. The breeding season is generally about May. Four to six eggs are laid on a little pad of grass in a hollow of the ground amongst damp herbage. I once, however, got a clutch of seven eggs in January in the North-Central Province, from a nest which was a pad of grass lined with soft rootlets and moored to the floating stems of a water grass in about a foot of water at the head of a tank.

The eggs are dumpy ovals of brownish-olive, thinly speckled with very dark brown dots. Their average measurement is ·98 by ·76

COTURNIX COROMANDELICA (Blanford, Vol. IV., pp. 116 and 486; not in Legge).

The Black-breasted or Rain Quail.

Description.—Male: the crown and nape black with brown edges and a buff streak down the centre; a white stripe from the forehead over each eye to the hind-neck; back, rump, and upper tail coverts mottled black and light brown with broad whitish-buff shaft-stripes; scapulars and wing coverts sandy-brown with buff shaft-stripes and markings; primary quills drab-brown. The throat and fore-neck are white; down the chin and centre of the throat is a black stripe which crosses a curved black band running across the throat to the ear coverts; another black stripe runs also to the ear coverts from the gape of the bill, passing below the eye. The breast and sides of the body are rufous-buff with broad black median stripes; in old birds almost the whole breast is black. The centre of the abdomen and the lower tail coverts are buff.

In females the chin and throat are buff, while the breast is rufous-brown with buff shaft-stripes and dark brown spots.

Bill in males blackish, in females brownish horn; iris brown; legs pale fleshy.

Length 7 ; wing 3·5 ; tail 1 ; tarsus 1 ; bill from gape ·5.

Distribution.—The species has been recorded from Colombo, and there are three specimens in the Museum taken near that town ; it is probably not a resident. It occurs throughout the greater portion of India, where it is partially migratory. In Burma it appears to be confined to the Irrawaddy valley.

Habits.—This Quail is found in grass land and growing crops of dry grain, moving from district to district with the seasons. It is just possible that stray birds may be found breeding in the Island. The nest is a mere hollow in the ground ; the eggs, four to nine in number, are whitish to brownish-buff, speckled thickly with brown, and measuring about 1·09 by ·83.

Note.—Coturnix communis, the Gray Quail, may possibly occur in Ceylon. Legge (p. 757) states that Mr. Bligh, a well-known Ceylon Ornithologist, met with a pair of quails larger than *Turnix taigoor* in the Yala district one January. He was, however, unable to obtain a specimen, but concluded that they were Gray Quail. The species differs from *C. coromandelica* in being larger, with a wing measurement of 4 inches, and by having pale cross-bars on the primary quills.

Perdicula asiatica (Blanford, Vol. IV., p. 118 ; Legge, p. 752).

The Jungle Bush Quail.

Description.—Male : the crown is rufous-brown with some blackish markings ; it is bounded below by a white streak running over the eye to the nape ; forehead, eyebrow, chin, and throat rufous-chestnut ; hind-neck and upper back brown, with light shaft-stripes and narrow black wavy cross-bars ; rump and upper tail coverts similarly coloured, but the pale shaft-stripes are wanting, and there are some dark buff black-bordered markings. The scapulars, wing coverts, and tertiaries are more boldly marked with blackish-brown and dark buff ; wing quills brown with buff markings on the outer webs ; tail brown with wavy cross-bars of black and dark buff. The cheek feathers are whitish with black edges ; under parts from the lower neck barred black and white ; lower abdomen, thighs, and under tail coverts rufous.

In females the upper plumage is similar, but less conspicuously marked than in the male; the under parts from the fore-neck are plain dull rufous with a grayish or lilac tinge on the breast.

Young birds lack the chestnut on the head, while the shaft-stripes on the upper plumage are broader; under parts dull rufous with pale shaft-stripes on the throat, fore-neck, and sides of the breast.

Bill dark horn-colour, the lower mandible paler; iris brown; legs yellowish-red.

Length 6·5; wing 3·2; tail 1·4; tarsus 1; bill from gape ·5.

Distribution.—In Ceylon confined to the grassy glades in the forest from the foothills of the Uva ranges eastwards through the park country. It does not appear to extend much south of the Kumbukkan river, nor as far north as the Mahaweli-ganga. In India it occurs in well-wooded tracts from the lower Himalayas to the extreme south of the peninsula.

Habits.—Like the Partridge, this species goes about in covies, and may be found in the grassy "talawas" of the park country. After rain the birds come out on to roads and paths in search of food. Like other quails when flushed, they fly straight and swiftly for a short distance, then suddenly drop into the grass and run. They breed about April, making a small nest of grass on the ground under a bush or tuft of grass. The full clutch is from five to seven eggs of creamy white, rather pointed at one end, and measuring about 1·02 by ·84.

Francolinus pictus (Blanford, Vol. IV., p. 137; Legge, p. 744).

The Painted Partridge.

Description.—Male: the forehead, face, and a broad stripe over the eye to the sides of the nape dull rusty red; the feathers of the crown and nape black with buff edges; on the

back and sides of the neck the buff edges are broader and more rufous; the upper back black with white spots; the scapulars browner with transverse and arrow-shaped bars of rufous-buff; the wing coverts similarly coloured, but with more blotchy buff markings; wing quills brown with broad blotchy rufous bars; the lower back, rump, upper tail coverts, and central tail feathers black with narrow white cross-bars, the outer tail feathers with black ends, broadest on the outermost pair. The chin and throat pale rust-colour, the fore-neck with black streaks; breast and flanks black with large scaly white spots, which increase in size on the flanks; abdomen pale rufous shading into chestnut on the under tail coverts; lower flanks rufous barred with black.

Female: the upper parts are less conspicuously marked; the rump and tail are browner, with the white cross-bars set further apart; throat whitish; the under parts buff with broad irregular bars of black, at times approaching in character the markings of the male.

Bill blackish; iris yellowish-brown; legs and feet yellowish-red.

Length 12; wing 5·5; tail 3; tarsus 1·6; bill from gape 1·05.

Distribution.—In Ceylon confined to the patanas of the Uva basin and the south-eastern and eastern slopes of the hills towards Wellawaya and Nilgala. It occurs in various parts of Central India, becoming rarer southwards, and wanting south of Coimbatore.

Habits.—This Partridge frequents the patanas, ferny slopes, and scrub jungles within its limits. It is of rather skulking habits, coming out into the open only early in the morning, late in the evening, or after rain. When flushed it rises with a whirr, rather like an English Partridge. It breeds apparently about Christmas time, making a grass nest in a hollow under a bush or tuft of grass. There are seven or eight eggs, which in colour are creamy white or drab, and in shape broad at one end and pointed at the other. They measure about 1·40 by 1·18.

FRANCOLINUS PONDICERIANUS (Blanford, Vol. IV., p. 139).

ORTYGORNIS PONDICERIANUS (Legge, p. 748).

The Gray Partridge.

Description.—The sexes are alike. The crown and nape olive-brown; forehead rufous; a broad eyebrow, with the cheeks and throat paler rufous, the lores speckled with black; hind-neck, back, scapulars, and wing coverts grayish-brown, splashed with chestnut and chequered by cross-bars of buffy-white, with narrow black edges and white shafts; wing quills brown, at times with whitish spots on the outer webs; secondaries barred with pale buff; the upper tail coverts and the two central tail feathers marked like the back, but without any chestnut; the remaining tail feathers chestnut, deepening towards the end to nearly black, but with pale tips; a patch on the chin and throat is rufous-buff or whitish bordered by a broken line of deep brown; remainder of lower parts grayish-white, tinged on the breast with rufous and crossed by narrow wavy black bars, which fade away on the abdomen and tail coverts.

Bill dusky brown, paler beneath; iris light hazel; legs and feet dull red.

Length 12·25; wing 5·6; tail 3·3; tarsus 1·7; bill from gape ·9. Females are slightly smaller.

Distribution.—Restricted to the dry zone of the north-west coast from the Jaffna peninsula to Puttalam, with the adjacent islands. It occurs in suitable country throughout most of India proper, but is not found in lower Bengal or eastwards thereof, and is unknown on the Malabar Coast, south of Bombay. It extends westwards to the Persian Gulf.

Habits.—It is found in open ground dotted with scrub jungle, but never very far from cover. It is a strong runner and often rather difficult to flush. The noisy call is constantly uttered in the early morning and again in the evening. It is said to breed in August and again in December. The nest is a small hollow under a bush or grass tuft. The eggs vary in number from six to eight or nine; they are of the usual partridge type, pale buff in colour, and measuring about 1·3 by 1·03.

Order **HEMIPODII.**

Family Turnicidæ

Genus **Turnix.**

The Three-toed Quails.

The Three-toed Quails are a group of quail-like birds, which have been placed in an order apart from the game birds, owing to several important distinctions in their anatomical structure. As regards the Indian forms, the chief external difference is the lack of a hind toe, though in an Australian genus the hind toe is present. Only one genus occurs within Indian limits, and but a single species in Ceylon. In this genus the females are larger and generally more brightly coloured than the males. They take advantage of their superior position, leaving the cocks to incubate the eggs and look after the chicks.

Turnix pugnax (Blanford, Vol. IV., p. 151).

Turnix taigoor (Legge, p. 761).

The Bustard Quail.

Description.—Male: head and upper parts rufous-brown; eyebrows, lores, and sides of head speckled black and whitish; the crown is black, with rufous edges to the feathers and often with a paler stripe down the middle. The plumage of the back is very variably marked, the rufous ground being irregularly banded with black, and many of the feathers edged with white; wing coverts buff with broad black bars; wing quills dark brown, the outer webs of the primaries edged with buff; the outer webs of the secondaries with buff indentations; the throat, fore-neck, and chest whitish-buff; the breast buff with black bars; the rest of the lower parts tawny rufous.

Female: the chin, throat, and a patch of variable size on the middle of the breast are black; the stripe down the centre of the crown is speckled black and white; the lower parts are deeper rufous.

Bill slate-colour, dusky brown on the ridge; iris white or pale yellow; legs and feet leaden.

Length of female 5·3; wing 3·3; tail 1; tarsus 1; bill from gape ·65. Males are slightly smaller; wing 3.

Distribution.—This species occurs in chena, scrub jungle, or patana nearly all over the Island, except perhaps on the higher hills. It is found in similar localities throughout India and Burma, and from thence east and south-east to South China, Malaya, Java, &c. The various geographical races are divided into sub-species, the form from Ceylon—which curiously enough is identical with that from Java—being termed *T. pugnax pugnax.*

Habits.—This is the "Quail" usually met with in Ceylon. During the day the birds keep to cover, coming out into bare open spaces mainly in the morning and evening. When flushed they fly off with some speed for a few yards, then suddenly drop into cover and run, seldom taking flight a second time. Their food consists chiefly of small seeds. The hens challenge their rivals by making a low drumming call, and often have furious fights with each other. If conditions are favourable, breeding seems to go on for a great part of the year, and I have taken eggs in February, May, and August. They vary from two to four in number, and are usually laid in a small hollow under the shelter of a grass tuft or bush. The colour varies from dirty white to almost olive-brown, thickly speckled with inky-gray and black or dark brown spots; the size of the darker spots varies greatly in different clutches. In shape they are dumpy ovals, rather pointed at one end. The average size is ·91 by ·71.

RECORDS OF CEYLON SPECIES.

Insecta.

Description of Microlepidoptera from Ceylon. E. Mayrick. J. B. N. H. S., Vol. XXII., No. 1, April, 1913, pp. 160–182.

Tituacia deviella, Walk. Habitat: Maskeliya, Madulsima
Palintropa hippica, sp. n. Habitat: Maskeliya, Madulsima
Chelaria iophana, sp. n. Habitat: Central Province.
Chelaria corynetis, sp. n. Habitat: Maskeliya.
Chelaria ericta, sp. n. Habitat: Maskeliya.
Chelaria isoptila, sp. n. Habitat: Kandy.
Chelaria scriniata, sp. n. Habitat: Pundaluoya.
Chelaria tortuosa, sp. n. Habitat: Matale.
Chelaria phacelota, sp. n. Habitat: Peradeniya.
Chelaria paroctas, sp. n. Habitat: Maskeliya.
Chelaria particulata, sp. n. Habitat: Maskeliya.
Encolapta metorcha, sp. n. Habitat: Maskeliya.
Anarsia phortica, sp. n. Habitat: Maskeliya, Kegalla, Haldummulla, Undugoda.
Anarsia tricornis, sp. n. Habitat: Maskeliya, Peradeniya, Haldummulla.
Anarsia stylota, sp. n. Habitat: Maskeliya, Pattipola.
Anarsia patulella, Walk. Habitat: Maskeliya, Peradeniya.
Anarsia pensilis, sp. n. Habitat: Maskeliya.
Nothris incondita, sp. n. Habitat: Madulsima.
Hypeclictis charonæa, sp. n. Habitat: Puttalam.
Dichomeris metrodes, sp. n. Habitat: Hambantota.
Dichomeris intensa, sp. n. Habitat: Maskeliya, Puttalam.
Dichomeris clarescens, sp. n. Habitat: Maskeliya.
Dichomeris olivescens, sp. n. Habitat: Kandy, Maskeliya.
Dichomeris ampliata, sp. n. Habitat: Eppawela, Puttalam.

Holaxyra isoclera, sp. n. Habitat : Maskeliya.
Holaxyra ampycota, sp. n. Habitat : Hakgala.
Trichotaphe chartaria, sp. n. Habitat : Peradeniya, Kandy.
Trichotaphe immerita, sp. n. Habitat : Puttalam, Maskeliya.
Trichotaphe plutelliformis, Snell. Habitat : Puttalam.
Carbatina levigata, sp. n. Habitat : Puttalam.

Description of Microlepidoptera from Ceylon. E. Mayrick. J. B. N. H. S., Vol. XXII., No. 4, March, 1914, pp. 776, 778.

Trissodoris honorariella, Wals. Habitat : Ambalangoda, Weligama, and Barberyn Island.
Amorbœa galbanea, sp. n. Habitat : Maskeliya.
Metathrinca memnon, sp. n. Habitat : Hakgala.
Ptochoryctis anguillaris, sp. n. Habitat : Hambantota and Maskeliya.
Epimactis infulata, sp. n. Habitat : Kegalla.
Epimactis strombodes, sp. n. Habitat : Kandy.
Odites atmopa, sp. n. Habitat : Kandy.

Description of Indian Microlepidoptera. E. Mayrick. J. B. N. H. S., Vol. XXIII., No. 1, June, 1914, pp. 120, 122, 123, 124, 125, 126, 127, 128, 129, 130.

Acrocerops præclusa, sp. n. Habitat : Maskeliya.
Gracilaria ariana, sp. n. Habitat : Pundaluoya.
Argyresthia leuculias, sp. n. Habitat : Maskeliya.
Zelleria strophæa, sp. n. Habitat : Maskeliya, Namunukuli Puttalam.
Paradoxus deformis, sp. n. Habitat : Kegalla.
Xyrosaris campsiptila, sp. n. Habitat : Puttalam.
Prays citri, Mill. Habitat : Maskeliya, Madulsima.
Prays ducalis, sp. n. Habitat : Namunukuli.
Orthosaris strictulata, sp. n. Habitat : Matale.
Anticrates decaplaca, sp. n. Habitat : Anuradhapura.
Aetherastis constellata, sp. n. Habitat : Wellawaya.
Comocritis præcolor, sp. n. Habitat : Trincomalee.
Comocritis nephelista, sp. n. Habitat : Kandy, Maskeliya.
Ethmia duplicata, sp. n. Habitat : Maskeliya Pattipola, Puttalam.

Description of new Thysanoptera. R. S. Bagnall. Ann. Mag. Nat. Hist., Vol. XV., No. 87, eighth series, pp. 318, 319, 320, 321, 324. March, 1915.

Heliothrips brunneipennis, sp. n. Habitat : Peradeniya.
Dinurothrips rutherfordi, sp. n. Habitat : Peradeniya.
Rhipiphorothrips bicolor, Morgan. Habitat (no definite locality given).
Ecacanthothrips sanguineus, Bagnall. Habitat (no definite locality given).
Ecacanthothrips steinskyi, Schmutz. Habitat: Peradeniya.
Aleurodothrips fasciapennis, Franklin. Habitat: Peradeniya.

Description of new Dermestidæ from Ceylon. G. J. Arrow. Ann. Mag. Nat. Hist., eighth series, Vol. XV., No. 89, May, 1915, pp. 441, 451.

Orphinus funestus, sp. n. Habitat : Dikoya.
Trinodes emarginatus, sp. n. Habitat : Kandy.

Description of an undescribed Rhynchota from Ceylon. W. L. Distant. Ann. Mag. Nat. Hist., eighth series, Vol. XV., No. 89, May, 1915, p. 506.

Salda rutherfordi, sp. n. Habitat : Peradeniya.

Description of four Psyllidæ from Ceylon. D. L. Crawford. The Philippine Journal of Science, Vol. X., Sect. D., No. 4, July, 1915, pp. 259, 260, 265.

Pauropsylla floccosa, sp. n. Habitat: Peradeniya.
Pauropsylla spondiasæ, sp. n. Habitat : Peradeniya.
Paurocephala psylloptera, Crawford. Habitat: Peradeniya.
Trioza eugeniæ, sp. n. Habitat : Peradeniya.

Description of Lepidoptera from Ceylon. C. Swinhoe. Ann. Mag. Nat. Hist., No. 93, September, 1915, Vol. XVI., eighth series, p. 171.

Elymnias merula, sp. n. Habitat : Kandy.

Description of the Xylophilidæ of Ceylon. G. C. Champion. Ann. Mag. Nat. Hist., Vol. XVI., No. 93, September, 1915, eighth series, pp. 215–226.

Hylobænus fasciatus, Pic. Habitat : Galle.
Euxylophilus principalis, sp. n. Habitat : Dikoya.
Xylophilus palliditarsis, Pic. Habitat : Kandy.
Xylophilus dentatifemur, Pic. Habitat : Kandy.
Xylophilus planipennis. Habitat : Nuwara Eliya.
Xylophilus testaceipennis, Pic. Habitat : Dikoya, Nuwara Eliya.
Xylophilus crassipes, sp. n. Habitat : Kandy.
Xylophilus taprobanus, sp. n. Habitat : Bogawantalawa.
Xylophilus scoparius. Habitat : Dikoya.
Xylophilus cribricollis. Habitat : Kandy.
Xylophilus nigronotatus. Habitat : Kandy.
Xylophilus nigropictus, sp. n. Habitat : Dikoya.
Xylophilus ceylonicus. Habitat : Kandy.
Xylophilus dikoyanus, sp. n. Habitat : Dikoya.
Xylophilus orientalis, sp. n. Habitat (no definite locality given).
Xylophilus diversiceps. Habitat : Kandy.
Xylophilus bryanti. Habitat : Kandy.
Xylophilus concolor, sp. n. Habitat : Kandy.
Xylophilus subcrassicornis. Habitat : Kandy.
Xylophilus laticornis. Habitat : Kandy.

Description of some new Ceylon Coccidæ. A. Rutherford. J. B. N. H. S., Vol. XXIV., No. 1, September, 1915, pp. 111–118.

Ripersia theæ, sp. n. Habitat : Peradeniya.
Coccus litzeæ, sp. n. Habitat : Peradeniya.
Neolecanium pseudoleæ, sp. n. Habitat : Peradeniya.
Aspidiotus (*s. str.*) *panici*, sp. n. Habitat : Peradeniya.
Parlatoria zeylanica, sp. n. Habitat : Peradeniya.
Parlatoria cinnamomi, sp. n. Habitat : Peradeniya.
Parlatoria zeylanica, sp. n. Habitat : Peradeniya.
Parlatoria sp. Habitat : Peradeniya.
Lepidosaphes vandæ, sp. n. Habitat : Peradeniya.
Leucaspis limoniæ, sp. n. Habitat : Peradeniya.

Description of Ceylon Dragon Flies. F. F. Laidlaw. Rec. Ind. Mus., Vol. XI., Pt. V., September, 1915, p. 389.

Platysticta hilaris, Hagen. Habitat: Kandy.

Description of Lucanidæ from Ceylon. F. H. Gravely. Rec. Ind. Mus., Vol. XI., Pt. VI., December, 1915, pp. 416, 427, 430.

Odontolabis carinatus, Linnæus. Habitat: Central Province: Lindula, Maskeliya; Sabaragamuwa: Bulutota in the Ratnapura District.

Aegus kandiensis, Hope. Habitat: Central Province: Kandy, Peradeniya, Pundalu-oya, Talawakele; Sabaragamuwa: Kegalla, Yatiyantota; Uva: Haldummulla.

Figulus interruptus, Waterhouse. Habitat: Peradeniya.

Mammalia.

Description of the Mammal Survey of Ceylon. Kathleen V. Ryley. J. B. N. H. S., Vol. XXII., No. 4, March, 1914, pp. 700–710.

Simia pileatus, Shaw (the Toque Monkey). Habitat: Kottawa, Ranna, Wellawaya, Kumbukkan.

Presbytis cephalopterus, Zimm. (the Purple-faced Monkey). Habitat: Kottawa.

Presbytis priamus, Blyth (the Madras Langur). Habitat: Ranna, Kirinda, Weligatta.

Rousettus seminudus, Kel. Habitat: Hambantota.

Cynopterus sphinx sphinx, Vahl. (the Southern Short-nosed Fruit Bat). Habitat: Hambantota.

Lyroderma lyra, Geoffr. (the Indian Vampire Bat). Habitat: Udugama, Nagoda.

Hipposideros dukhunensis, Sykes (Sykes' Leaf-nosed Bat). Habitat: Hambantota, Weligatta.

Hipposideros fulvus, Gray (the Bicoloured Leaf-nosed Bat). Habitat: Hambantota.

Rhinolophus rouxi, Temm. (the Rufous Horseshoe Bat). Habitat: Wellawaya, Lunugala.

Pipistrellus coromandra, Gray (the Coromandel Pipistrelle). Habitat: Nakiadeniya.

Pipistrellus mimus, Wrought. (the Southern Dwarf Pipistrelle). Habitat: Ranna, Hambantota.

Miniopterus schreibersi, Kuhl. (the Long-winged Bat). Habitat: Wellawaya.

Pachyura sp., Shrews. Habitat: Udugama, Wellawaya.

Felis pardus, L. (the Panther). Habitat: Tanamawila.

Felis rubiginosa, Geoffr. (the Rusty Spotted Cat). Habitat: Weligatta.

Mungos smithi, Gray (the Ruddy Mungoose). Habitat: Ranna, Hambantota, Weligatta, Wellawaya.

Mungos flavidens, Kel. (the Ceylon Brown Mungoose). Habitat: Weligatta, Kumbukkan.

Viverricula malaccensis, Gmel. (the Small Indian Civet). Habitat; Ranna, Weligatta, Kumbukkan.

Paradoxurus niger, Desm. (the Indian Toddy Cat). Habitat: Udugama, Nakiadeniya.

Melursus ursinus, Shaw (the Sloth Bear). Habitat: Kumbukkan.

Petaurista lanka, Wrought. (the Large Gray Flying Squirrel). Habitat: Kumbukkan, Wellawaya.

Sciuropterus (*petinomys*) *fuscocapillus*, Blyth (the Small Flying Squirrel). Habitat: Wellawaya.

Ratufa macroura, Penn. (the Black Giant Squirrel). Habitat: Kottawa.

Ratufa macroura tennenti, Blyth (the Grizzled Giant Squirrel). Habitat: Ranna, Wellawaya, Kumbukkan.

Funambulus palamarum, L. (the Palm Squirrel). Habitat: Colombo, Kottawa, Udugama, Ranna, Hambantota, Weligatta, Wellawaya, Kumbukkan.

Funambulus trilineatus, Kel. (the Nuwara Eliya Ground Squirrel). Habitat: Kottawa.

Tatera indica, Hardw. (the Indian Gerbil). Habitat: Udugama, Ranna, Hambantota, Tellula, Weligatta, Wellawaya.

Millardia meltada, Gray (the Soft-furred Field Rat). Habitat: Ranna, Hambantota, Weligatta, Wellawaya.

Epimys rufescens, Gray (the Common Indian Rat). Habitat: Colombo, Hambantota, Kumbukkan.

Variety with white under parts. Habitat: Kottawa, Udugama, Nakiadeniya, Colombo, Hambantota, Weligatta, Wellawaya, Kumbukkan.

Mus manei, Kel. (the Common Indian House Mouse). Habitat: Colombo, Udugama, Nakiadeniya, Hambantota, Wellawaya.

Mus booduga, Gray (the Southern Field Mouse). Habitat: Kottawa, Hambantota, Weligatta, Kumbukkan.

Bandicota malabarica, Shaw (the Malabar Bandicoot). Habitat: Udugama.

Leggada hannyngtoni, Ryl. (the Coorg Lowland Leggad). Habitat: Kottawa.

Lepus nigricollis, Cuv. (the Black-naped Hare). Habitat: Hambantota, Kirinda, Weligatta, Kumbukkan.

Tragulus meminna, Erxl. (the Indian Chevrotian, or Mouse Deer). Habitat: Kumbukkan.

Manis crassicaudata, G. St. Hil. (the Indian Pangolin). Habitat: Kirinda.

Description of a new Murine genus and species from Ceylon. Oldfield Thomas. J. B. N. H. S., Vol. XXIII., No. 3, February, 1915, p. 44.

Cœlomys mayori, sp. n. Habitat: Pattipola.

Description of a Bat from Ceylon. Oldfield Thomas. J. B. N. H. S., Vol. XXIII., No. 4, May, 1915, p. 610.

Leuconœ hasselti, Temm. Habitat: Kokopeetchie, Eastern Province; Anuradhapura, North-Central Province.

Description of the Giant Squirrels of Ceylon. Oldfield Thomas and Robert C. Wroughton. J. B. N. H. S., Vol. XXIV., No. 1, September, 1915, pp. 35, 36.

Ratufa macroura macroura, Penn. Habitat: Pattipola, Nuwara Eliya, and central highlands.

Ratufa macroura melanochra, subsp. n. Habitat: Southern Province: Kottawa.

Ratufa macroura dandolena, subsp. n. Habitat: lowland areas all round Ceylon; Province of Uva: Wellawaya.

Description of the Sinhalese species of Funambulus. Oldfield Thomas and Robert C. Wroughton. J. B. N. H. S., Vol. XXIV., No. 1, September, 1915, pp. 37 to 41.

Funambulus layardi, Blyth. Habitat (no definite locality given).

Funambulus kathleenæ, nom. nov. Habitat: Southern Province: Kottawa; Central Province: Pattipola, Ambawela.

Funambulus palmarum favonicus, subsp. n. Habitat: submontane area of Southern Province and Udugama.

Funambulus palmarum kelaarti, Layard. Habitat: North-Central Province to Trincomalee.

Funambulus palmarum brodiei, Blyth. Habitat: North Ceylon: the palmyra district, Puttalam to Jaffna.

Funambulus palmarum olympius, subsp. n. Habitat: the highlands of central Ceylon. Type from Urugala.

Description of the Ceylon Hare. R. C. Wroughton. J. B. N. H. S., Vol. XXIV., No. 1, September, 1915, pp. 41, 42.

Lepus nigricollis singhala, subsp. n. Habitat: Kumbukkan, Uva.

Description of the genus Epimys in Ceylon. R. C. Wroughton. J. B. N. H. S., Vol. XXIV., No. 1, September, 1915, p. 48.

Epimys kelaarti, sp. n. Habitat: highlands of Ceylon (no definite locality given). Type from Pattipola.

Description of a second species of Cœlomys from Ceylon. Oldfield Thomas. J. B. N. H. S., Vol. XXIV., No. 1, September, 1915, p. 49.

Cœlomys bicolor, sp. n. Habitat: Kottawa, Southern Province.

Description of a new Mungoose. R. C. Wroughton. J. B. N. H. S., Vol. XXIV., No. 1, September, 1915, p. 53.

Mungos lanka, sp. n. Habitat: Cheddikulam.

Description of the Mammal Survey of Ceylon. R. C. Wroughton. J. B. N. H. S., Vol. XXIV., No. 1, September, 1915, pp. 83 to 96.

Pithecus pileatus, Shaw (the Toque Monkey). Habitat: Maha-oya, Mankeni, Cheddikulam, Panadure, Kesbewa, Rayigam, Tammanewa, Kala-oya, South Ceylon.

Presbytis ursinus, Blyth (the Bear Monkey). Habitat: Pattipola, Hakgala.

Presbytis cephalopterus, Temm. (the Purple-faced Monkey). Habitat: South Ceylon (no definite locality given).

Presbytis priamus, Blyth (the Madras Langur). Habitat: Arugam Bay, Mankeni, Valaichenai, Cheddikulam, Kala-oya, Tammanewa, Ambawela, Bambarabottuwa, South Ceylon.

Loris tardigradus, L. (Slender Loris). Habitat: Mannar, Anuradhapura, Willichia, Tammanewa.

Pteropus giganteus, Bruenn. (the Common Flying Fox). Habitat: Valaichenai, Cheddikulam, Peradeniya.

Rousettus seminudus, Kel. (the Ceylon Fruit Bat). Habitat: Urugala, Kandy, South Ceylon.

Cynopterus sphinx, Vahl. (the Southern Short-nosed Fruit Bat). Habitat: Urugala, Ambawela, Nochchiyagama, Tammanewa, Kala-oya, Anuradhapura, South Ceylon.

Rhinolophus rouxi, Temm. (the Rufous Horseshoe Bat). Habitat: Maha-oya, South Ceylon.

Rhinolophus beddomei, K. And. (the Great Indian Horseshoe Bat). Habitat: Kala-oya.

Hipposideros brachyotus, Dobs. (the Dekhan Leaf-nosed Bat). Habitat: Kala-oya.

Hipposideros dukhunensis, Sykes (Sykes' Leaf-nosed Bat). Habitat: Samarakella, Valaichenai, Mannar, Tammanewa, Kala-oya, Trincomalee, Anuradhapura, South Ceylon.

Hipposideros fulvus, Gray (the Bicoloured Leaf-nosed Bat). Habitat: Valaichenai, Trincomalee, Anuradhapura, South Ceylon.

Megaderma spasma trifolium, Geoffr. (the Malay Vampire Bat). Habitat: Mankeni, Panchikankeni, Samarakella, Trincomalee.

Pipistrellus coromandra, Gray (the Coromandel Pipistrel). Habitat: South Ceylon (no definite locality given).

Pipistrellus mimus, Wrought. (Southern Dwarf Pipistrel). Habitat : South Ceylon and Kandy.

Scotophilus wroughtoni, Thos. (Wroughton's Bat). Habitat : Anuradhapura.

Hesperoptenus tickelli, Blyth (Tickell's Bat). Habitat : Anuradhapura.

Miniopterus schreibersi, Kuhl. (the Long-winged Bat). Habitat : South Ceylon (no definite locality given).

Leuconœ hasselti, Temm. (Van Hasselt's Bat). Habitat : Valaichenai, Kokoputchi, Anuradhapura.

Taphozous crassus, Blyth (the Pouch-bearing Sheath-tailed Bat). Habitat : Gangodawila.

Pachyura sp. (Shrews.). Habitat : Mannar, Colombo, Kandy.

Pachyura kandiana, Kel. (the Kandy Shrew). Habitat : South Ceylon, Kandy.

Pachyura montana, Blyth (the Ceylon Highland Shrew). Habitat : Pattipola, Ambawela, South Ceylon.

Felis pardus, L. (the Panther). Habitat : Ambawela, Kala-oya, South Ceylon.

Felis viverrina, Benn. (Fishing Cat). Habitat : Maha-oya.

Felis affinis, Gray (Jungle Cat). Habitat : Cheddikulam.

Felis rubiginosa, Geoffr. (the Rusty Spotted Cat). Habitat : Ambawela, Hakgala, South Ceylon.

Felis (domestic). Habitat : Yatiyantota, Ambawela.

Viverricula malaccensis, Gmel. (the Small Indian Civet). Habitat : Maha-oya, Mankeni, Cheddikulam, Pattipola, Tammanewa, South Ceylon.

Paradoxurus niger, Desm. (the Indian Toddy Cat). Habitat : Tammanewa, South Ceylon.

Paradoxurus aureus, F. Cuv. (the Ceylonese Palm Civet). Habitat : Maha-oya.

Mungos lanka, Wrought. (the Common Ceylon Mungoose). Habitat : Mannar, Kala-oya, Tammanewa.

Mungos smithi, Gray (the Ruddy Mungoose). Habitat : Mankeni, Kirinda, Kala-oya, South Ceylon.

Mungos flavidens, Kel. (the Ceylon Brown Mungoose). Habitat : Yatiyantota, Pattipola, South Ceylon.

Canis indicus (the Common Indian Jackal). Habitat : Arugam Bay, Mankeni.

Lutra lutra, L. (the Common Otter). Habitat: Nuwara Eliya.

Melursus ursinus, Shaw (the Sloth Bear). Habitat: Delagowella, South Ceylon.

Petaurista lanka, Wrought. (the Large Gray Flying Squirrel). Habitat: South Ceylon (no definite locality given).

Pteromys (*Petinomys*) *layardi*, Kel. (the Small Ceylon Flying Squirrel). Habitat: South Ceylon (no definite locality given).

Ratufa macroura, Penn. (Pennant's Long-tailed Squirrel). Habitat: Pattipola.

Ratufa macroura dandolena, Thos. and Wr. (the Common Ceylon Giant Squirrel). Habitat: Maha-oya, Arugam Bay Mankeni, Tammanewa, Anuradhapura, South Ceylon.

Ratufa macroura melanochra, Thos. and Wr. (the Black and Yellow Giant Squirrel). Habitat: South Ceylon (no definite locality given).

Funambulus layardi (Layard's Striped Squirrel). Habitat: Ratnapura.

Funambulus kathleenæ, Thos. and Wr. (the Ceylon Dusky-striped Squirrel). Habitat: Pattipola, Ambawela, Bambarabottuwa, South Ceylon.

Funambulus palmarum brodiei, Blyth (the Northern Ceylon Palm Squirrel). Habitat: Mannar, Cheddikulam.

Funambulus palmarum olympius, Thos. and Wr. (the Highland Ceylon Palm Squirrel). Habitat: Urugala, Kandy, Peradeniya, Ambawela.

Funambulus palmarum kelaarti, Lay. (the Lowland Ceylon Palm Squirrel). Habitat: Pattipola, Mankeni, Welimada, Kala-oya, Tammanewa, Puttalam, Anuradhapura, Trincomalee, South Ceylon.

Funambulus palmarum favonicus, Thos. and Wr. (the Submontane Ceylon Palm Squirrel). Habitat: Kottawa, Udugama, Ranna.

Tatera cuvieri, Waterh. (the South Indian Gerbil). Habitat: Maha-oya, Mankeni, Colombo, Kala-oya, South Ceylon.

Mus manei, Kel. (the Ceylon House Mouse). Habitat: Maha-oya, Kandy, Cheddikulam, Colombo, Urugala, Peradeniya, Ambawela, Tammanewa, Anuradhapura, Trincomalee, Nagagala Estate, South Ceylon.

Mus booduga, Gray (the Southern Field Mouse). Habitat: Maha-oya, Mankeni, Mannar, Valaichenai, Cheddikulam, Urugala, Kala-oya, South Ceylon.

Cœlomys mayori, Thos. (Mayors' Rat). Habitat: Pattipola.

Cœlomys bicolor, Thos. (the Bicoloured Cœlomys). Habitat: South Ceylon (no definite locality given).

Epimys nemoralis, Blyth (the Ceylon Large Tree Rat). Habitat: Mannar, Kandy, South Ceylon, Trincomalee.

Epimys kandianus, Kel. (the White-bellied Tree Rat). Habitat: Maha-oya, Valaichenai, Cheddikulam, Urugala, Nagagala Estate, Kandy, Tammanewa, Mankeni, Peradeniya, South Ceylon.

Epimys kelaarti, Wr. (Kelaart's Rat). Habitat: Pattipola.

Gunomys gracilis, Nehr. (the Ceylon Mole Rat). Habitat: Urugala, Tammanewa, Kandy.

Bandicota malabarica, Shaw (the Malabar Bandicoot). Habitat: Urugala, Ambawela, South Ceylon.

Millardi meltada, Gray (the Soft-furred Field Rat). Habitat: South Ceylon (no definite locality given).

Golunda newera, Kel. (the Nuwara Eliya Bush Rat). Habitat: Pattipola, Ambawela, Nuwara Eliya.

Hystrix leucura, Sykes (the Indian Porcupine). Habitat: Mankeni, Yatiyantota, Tammanewa.

Lepus nigricollis singhala, Wrought. (the Ceylon Hare). Habitat: Tammanewa, Hakgala, Ambawela, South Ceylon.

Muntiacus malabaricus, Wr. (the South Indian Muntjac). Habitat: Tammanewa, Ambawela.

Axis axis ceylonensis, Fitz. (the Ceylon Spotted Deer). Habitat: Mankeni, Valaichenai, Cheddikulam.

Rusa unicolor, Bechst. (the Sambur). Habitat: Urugala.

Tragulus meminna, Erxl. (the Indian Chevrotain). Habitat: Tammanewa, Cheddikulam, South Ceylon.

Sus zeylonensis, Blyth (the Ceylon Wild Pig). Habitat: Mankeni.

Manis crassicaudata, G. St. Hil. (the Indian Pangolin). Habitat: Kala-oya, South Ceylon.

Reptilia.

Notes of Snakes from Ceylon. F. Wall. J. B. N. H. S., Vol. XXII., No. 3, December, 1913, p. 639 (no definite locality given).

Dryophis pulverulentus. Habitat (no definite locality given).
Dendrophis bifrenalis. Habitat (no definite locality given).

Aves.

Description of Timeliides from Ceylon. Major H. H. Harrington. J. B. N. H. S., Vol. XXIII., No. 2, November, 1914, pp. 326, 327.

Crateropus griseus striatus, Swainson (the Ceylon Babbler). Habitat (no definite locality given).
Crateropus rufescens, Blyth (the Ceylon Rufous Babbler). Habitat (no definite locality given).

Description of the Game Birds of Ceylon. E. C. S. Baker. J. B. N. H. S., Vol. XXIII., No. 3, February, 1915, p. 391.

Turnix pugnax pugnax, Temm. (the Ceylon Bustard Quail). Habitat (no definite locality given).

Description of Timeliides from Ceylon. Lieut.-Col. H. H. Harrington. J. B. N. H. S., Vol. XXIII., No. 3, February, 1915, pp. 423 to 437.

Pyctorhis sinensis nasalis, Legge (the Ceylon Yellow-eyed Babbler). Habitat (no definite locality given).
Elaphrornis palliseri, Blyth (Palliser's Warbler). Habitat: Horton Plains.
Dumetia albigularis albigularis, Blyth (the Small White-throated Babbler). Habitat (no definite locality given).
Scotocichla fuscicapilla, Blyth (the Brown-capped Babbler). Habitat (no definite locality given).
Rhopocichla atriceps nigrifrons, Blyth (the Black-fronted Babbler). Habitat (no definite locality given).

Arachnida.

Description of two new Pedipalpi from Ceylon. F. H. Gravely, M.Sc. Rec. Ind. Mus., Vol. XI., Pt. V., September, 1915, pp. 383, 385.

Schizomus (*Trithyreus*) *perplexus*, sp. n. Habitat: Polonnaruwa, North-Central Province.

Schizomus (*Trithyreus*) *buxtoni*, sp. n. Habitat: Minneriya, Polonnaruwa, North-Central Province, Sigiri, Central Province.

Description of Ant-like Spiders from Ceylon. K. Narayan. Rec. Ind. Mus., Vol. XI., Pt. 5, September, 1915, p. 396.

Myrmarachne plataleoides, Camb. Habitat: Peradeniya.

Description of Oriental Tarantulidæ. F. H. Gravely, M. Sc. Rec. Ind. Mus., Vol. XI., Pt. VI., pp. 449, 450, 452.

Phrynichus ceylonicus, Koch. Habitat: North-Central Province: Horowapotana, Maha Iluppallama; Western Province: Wennappuwa, ten miles from Negombo; Central Province: Nalanda, Galagedara, Haragama, Kandy, and Peradeniya; Southern Province: Ambalangoda, Kottawa.

Phrynichus ceylonicus var. *gracilibrachiatus*, Gravely. Habitat: Central Province: Nalanda, Galagedara, Kandy, Peradeniya.

Phrynichus ceylonicus var. *pusillus*, Pocock. Habitat: Central Province: Nalanda, Galagedara, Kandy, Peradeniya.

Porifera.

Description of Parasitic Sponges from Ceylon. N. Annandale. Rec. Ind. Mus., Vol. XI., Pt. VI., December, 1915, pp. 459, 460.

Stelletta vestigium, Dendy. Habitat (no definite locality given).

Coppatias investigatrix, sp. n. Habitat (no definite locality given).

Cliona quadrata, Hancock. Habitat: Gulf of Mannar.

Ascidians.

Description of Tunicata from Ceylon. A. Oka. Mem. Ind. Mus., Vol. VI., No. 1, December, 1915, pp. 8, 13, 15.

Hexacrobylus indicus, Oka. Habitat: south of Ceylon at station 278; 6° 52′ N., 81° 11′ E.

Cynthia lanka, Herdman. Habitat: Palk Strait.

Rhabdocynthia ceylonica, Herdman. Habitat: Station 152; 11½ miles S. 83° W. of Colombo lighthouse.

Chætopoda.

Description of Oligochæta from Ceylon. J. Stephenson. Mem. Ind. Mus., Vol. VI., No. 1, December, 1915, pp. 61, 75, 76, 77, 78, 80, 83, 84, 86, 88, 99, and 105.

Pontodrilus agnesæ, sp. n. Habitat: Nuwara Eliya.

Megascolex nureliyensis, Mich. Habitat: Horton Plains.

Megascolex singhalensis, Mich. Habitat: Horton Plains.

Megascolex escherichi, Mich., var. *papilifer*, var. nov. Habitat: Horton Plains.

Megascolex campester, sp. n. Habitat: Horton Plains.

Megascolex bifoveatus, Stephenson. Habitat: Horton Plains.

Megascolex hortonensis, sp. n. Habitat: Horton Plains.

Megascolex kempi, sp. n. Habitat: Horton Plains.

Megascolex varians, Mchlsn., var. *insolitus*, var. n. Habitat: Horton Plains.

Megascolex sextus, Stephenson. Habitat: Pattipola.

Pheretima heterochæta, Mchlsn. Habitat: Horton Plains.

Genus *pontoscolex*, probably *P. corethrurus*. Habitat: west Haputale.

Mollusca.

Description of a new Modiola from Ceylon. H. B. Preston. Ann. Mag. Nat. Hist., Vol. XVI., No. 91, July, 1915, p. 84.

Modiola taprobanensis, sp. n. Habitat (no definite locality given).

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FIG. 1.—CHALCOPHAPS INDICA.
FIG. 2.—GALLUS LAFAYETTII.

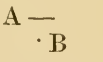
FIG. 3.—EXCALFACTORIA CHINENSIS.
FIG. 4.—TURNIX PUGNAX.

NOTES.

Note on the emergence of Winged Termites.—Though the appearance of swarms of winged termites is a common occurrence, very little is known of the circumstances attending their emergence from the nest. It may be worth while, therefore, to place on record a few observations on a flight of a species which has been kindly identified by Mr. G. M. Henry as *Termes obscuriceps*, Wasm.

The nest is situated beneath the verandah of my bungalow at Peradeniya, and the insects chose to emerge through cracks in the cement at the entrance. At midday on December 11, 1916, my attention was directed to the spot by a squirrel, which was devouring the workers, and shaking its head from time to time when a soldier bit it on the nose. The appearance of worker termites at the entrance to the nest at midday is somewhat unusual, but, as subsequent events proved, they were engaged in narrowing the crack in the cement by lining its sides with earth, preparatory to the exit of the winged insects in the evening.

The flight began at 5.57 P.M. The main exit, which may be called A, was a narrow slit, 1½ inches long. Besides this, there was a small circular hole, B, about a quarter of an inch in



diameter, about 6 inches from A, and another slightly larger circular hole, C, about a foot from A, on the other side. The majority of the winged insects emerged from A; only a few from B and C. All the holes were surrounded by workers and soldiers, which, in the case of A, formed a dense crowd about six inches in diameter.

The main flight occupied about 13 minutes, from 5.57 to 6.10 P.M. During this time winged insects poured out in a continuous stream. Between 6.10 and 6.15 P.M. only nine emerged, and from 6.15–6.20 only three, all from A. At 6.17 all the workers and soldiers round C had re-entered the hole, and this had happened at B by 6.20 P.M. By this time

several dealated males and females were wandering about, in pairs as usual. At 6.22 one more winged insect emerged from A; with the exception of a few workers, the crowd which originally surrounded A had now re-entered the nest.

At 6.24 a pair of dealated insects crossed A, and were driven off by a soldier. At the same time a winged insect emerged from A, and was followed by another a minute later. B and C were now closed by a layer of earth. The first seal is very thin, and consists of apparently a single layer of particles with numerous minute interspaces. The particles are subsequently re-arranged and more added, and during the course of re-arrangement the opening may be partly opened from time to time. C was partly open at 6.30, and was approached by a pair of dealated insects; one tried to enter, and got partly in, but came out again. On a second attempt it succeeded. The other ran round the entrance for a little while, and then followed the first into the nest.

At 6.30 a winged insect emerging from A stuck fast in the earth with which the exit was being closed; it succeeded in getting free at 6.32, but whether it was assisted by the workers I could not determine. At 6.34 a dealated insect attempted to enter B (now open), and was driven off by a soldier, which was carried away adhering to its head. Another tried to enter B at 6.35, but was attacked and dragged away by a red ant (*Plagiolepis longipes*). At 6.36 two tried to enter A, but were driven off. At 6.37 one entered B through a small opening which was guarded by a soldier, and another forced its way into C through the thin earthen covering.

At 6.40 A appeared to be closed, but the process of re-arranging the earth was not completed until 7.30, and in the interval the exit was frequently partly open. Several dealated insects were wandering round, but the red ants, now present in considerable numbers, prevented them approaching the holes. At 7 P.M. one more winged insect emerged from A. At 7.5 P.M. one dealated insect attempted to enter B, and was driven off by a soldier. B and C were finally closed at 7.10, and A at 7.30. No workers or soldiers were left outside the nest. In the latter respect this flight differed from the one recorded in Annals of Peradeniya, III., p. 269.

The majority of the dealated males and females took refuge under the matting on the verandah, but I am unable to say what ultimately became of them. Their behaviour under observation may be to some extent abnormal, as it is usually necessary to use a light, and that, of course, induces them to remain in the vicinity of the nest. In the present instance they were observed by the light of a lamp 4 feet from the exits of the nest.

The following points may be specially noted :—

1. The narrowing of the exit in preparation for the emergence of the winged insects. This has been observed on several occasions during the last ten years, and it would appear to be the usual course in the case of the Ceylon mound-building termites. The opening is narrowed, generally so that the insects emerge in a single row. This is probably done to facilitate the closing after the flight.

2. The provision of a " guard " of soldiers and workers round the exits, and its withdrawal as soon as the main flight is over. It would seem improbable that these are for the protection of the winged insects, as they re-enter the nest when they are most required, *i.e.*, when the dealated insects return ; and if for protection, the workers would be useless. It may be that they are merely stationed in a convenient position for closing the nest. The operation of closing, however, is conducted from within.

3. The return of dealated females and males to the nest, apparently before the fertilization of the female.

4. The apparent selection of the returning insects by the soldiers.

5. The closing of the exits after the flight. The chimneys of the common termite hills in Ceylon are normally open ; they are closed after the flight, perhaps in order to prevent the return of too many males and females.

6. The absence of any exiled workers and soldiers who could assist the discarded female insects in founding new nests.

T. PETCH.

Note on the Breeding Habits of the Did-he-do-it (*Sarcogrammus indicus*).—Two years ago, in the Northern Province,

while on a camping trip in jungle, I had an opportunity of watching one of these birds on its nest. The nest is a mere scrape in the ground. It was situated within a few feet of the track from the road to the village, in an open grassy spot, where the village cattle were in the habit of grazing. There were plenty of other suitable spots quite close and further from the path. Within a few yards was a shallow stretch of water, a few inches deep and grassy. It seemed wonderful that the eggs could have escaped destruction ; our carts were drawn up within a few yards of them. The eggs are, of course, protectively coloured, and it was rather hard to spot the nest, even after one had seen the place several times. We watched the bird on the nest from the shelter of our carts, and unsuccessfully attempted to get photographs of it on the nest. In the middle of the day, when the sun was very hot, the bird would frequently leave the eggs and go down to the patch of water, walk into and deliberately move its breast up and down in it, at the same time spreading out its breast feathers. When this part of the body was apparently wetted and cooled it would cautiously return to its nest and sit on the eggs. We watched this happen frequently, so that there was no question as to whether the bird was merely going into the water to get a drink or to get some food. I presume that the reason is that on the dry ground and in the hot sun the eggs would become too dry if the bird did not adopt some means of this sort to keep them in proper condition.

C. T. SYMONS.

Wilson's Stormy Petrel (*O. oceanicus*) *at Colombo.*—In September of last year I was fortunate enough to see a number of these Petrels about a quarter of a mile outside Colombo harbour. The first one I saw took no notice of the boat I was sailing, until I got to within a few yards of it, and so I had an excellent view of the bird. On two or three successive evenings later I saw flocks of three to ten in number of these birds actually *inside the harbour* flying about over the water at dusk. I was able to sail quite close to them.

W. A. CAVE.

PROCEEDINGS OF THE CEYLON NATURAL HISTORY SOCIETY.

Seventeenth General Meeting.

The Seventeenth General Meeting of the Society was held in the Colombo Museum Library on June 6, 1916, at 5.15 P.M., with Dr. A. Nell in the Chair.

A lecture on "Plant Dispersal" was delivered by G. Bryce Esq., Assistant Botanist and Mycologist, Peradeniya, and severa specimens of seeds, &c., were exhibited.

Mr. W. A. Cave read a paper entitled "Some Notes on the Flight of the Albatross," made on a recent voyage to Australia.

Eighteenth General Meeting.

The Eighteenth General Meeting of the Society was held in the Colombo Museum Library on September 20, 1916, at 5.15 P.M., with Dr. A. Nell in the Chair.

A lecture on "Root Parasitism (Flowering Plants)" was delivered by H. L. van Buuren, Esq., which was well illustrated by diagrams and specimens.

Nineteenth General Meeting.

The Nineteenth General Meeting of the Society was held on January 18, 1917, in the Colombo Museum Library, at 5.15 P.M., with Dr. A. Nell in the Chair.

A resolution to the effect that the annual subscription of *bona fide* students of recognized institutions in Ceylon shall be two rupees was unanimously passed. Twenty-seven student members were elected.

Miss Ursula van Rooyen read a paper on "Autotomy in Crustacea," illustrating her remarks by diagrams and demonstrations on live specimens.

An account of a fight between a frog and a sparrow was given by C. T. Symons, Esq., who had witnessed the incident.

The Chairman took this opportunity of bidding farewell, on behalf of the Members of the Society, to Dr. Joseph Pearson, who was about to proceed to England to offer himself for war service.

Twentieth General Meeting.

The Twentieth, or Fifth Anniversary, Meeting of the Society was held in the Colombo Museum Library on March 13, 1917, at 5.15 P.M., with Dr. A. Nell in the Chair.

The report of the Honorary Secretaries and Treasurers, together with the accounts for the past year, were adopted and passed unanimously.

A vote of thanks was passed to Mr. Sibbald for kindly auditing the accounts.

The following were elected as Office-bearers for 1917 :—

Patron.

His Excellency Sir John Anderson, G.C.M.G., K.C.B.

President.

The Hon. Mr. R. E. Stubbs, C.M.G., F.Z.S.

Vice-Presidents.

F. M. Mackwood, Esq.
Sir S. D. Bandaranaike, Kt., C.M.G.
Dr. A. Nell, M.R.C.S., L.M.S.
Dr. Joseph Pearson, D.Sc., F.R.S.E., F.L.S.

Council.

T. Petch, Esq., B.A., B.Sc.
The Ven. the Archdeacon of Colombo.
The Hon. Mr. Harry Creasy.
The Rev. Father M. J. Le Goc O.M.I., M.A., Ph.D.
C. F. S. Baker, Esq.
E. Evans, Esq., B.Sc.

Joint Honorary Secretaries and Treasurers.

C. T. Symons, Esq., B.A., F.R.G.S.
W. A. Cave, Esq.

The Rev. Father M. J. Le Goc delivered a very interesting lecture on the Madugaha plant (*Cycas Rumphii*), during the course of which he explained a fact new to Science, which he discovered whilst making investigations with the plant, and which is published in "The Annals of the Royal Botanic Gardens, Peradeniya," Vol. VI, Part III., June, 1917.

Mr. W. A. Cave read "A Note on the Occurrence of Wilson's Stormy Petrel (*Occanites oceanicus*)," which he observed near Colombo harbour.

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